Episode 89 – Oral Self-care July 28, 2023

History of oral self-care
Humans have been trying to care for their teeth for centuries. The tools for oral self-care have evolved over the years but still bear resemblance to what can be purchased today.

Toothbrushes

- Before toothbrushes were invented, many used chew sticks, thin twigs that were chewed on until one end frayed, creating a sort of brush. Chew sticks remain in use in some cultures today.
- Toothbrushes appear to have been invented in China, sometime during the Tang Dynasty, from 618 to 907 A.D. The earliest models had handles of bamboo or bone and boar hair bristles.
- Boar hair toothbrushes remain available today, often promoted as an environmentally friendly alternative to the nylon-bristled, plastic-handled variety.
- William Addis, from England, was the first entrepreneur to mass-produce toothbrushes, supposedly creating his prototype in 1780.
- In 1857, H. N. Wadsworth, a dentist, received the first U.S. patent for a toothbrush.
- Numerous other innovations followed, including nylon bristles in 1938.
- In 1937, American inventor Tomlinson I. Moseley patented a design for an electric toothbrush. The idea failed to catch on until Philippe-Guy Woog, a Swiss scientist, introduced a model in 1954. Woog's Broxodent electric brush was intended to assist people with limited mobility, but was soon promoted to the general public.

Toothpaste

- Around 3,000-5,000 B.C., ancient Egyptians developed a dental cream that contained powdered ashes from oxen hooves, myrrh, egg shells, and pumice.
- Around 1,000 B.C., Persians added burnt snail and oyster shells, gypsum, herbs, and honey.
- People continued to make their own toothpaste and powders even after the advent of commercially produced versions centuries later. For example, an 1860 book titled *The Practical Housewife* recommended a mixture of powdered orris-root, charcoal, and Peruvian bark; prepared chalk and oil of bergamot or lavender.
- In the 1880s, Washington Wentworth Sheffield, an American dentist, invented a squeezable tube for packing toothpaste. Before then, it was commonly sold in bottles, porcelain pots, or paper boxes. His invention helped to make it possible for toothpaste to be mass-produced and mass-marketed.
- In 1955, Crest launched the first toothpaste to contain fluoride.

Toothpicks

- Toothpicks may be the oldest oral hygiene tool, dating back over a million years.
- Earliest toothpicks were probably small slivers of wood, although bone, ivory, geese and crow quills came into use at various points.
- During the Victorian era, toothpicks made of silver or gold became popular among those who could afford them.
- In the 1860s, wooden toothpicks returned in popularity when American entrepreneur Charles Forster developed a method to mass-produce them. His factory produced 500 million a year. Free toothpicks became common restaurant giveaways.

Dental Floss

- In the 19th century, dental floss came into common use due to the efforts of an American dentist, Levi Spear Parmly. In an 1819 book, Parmly recommended running "waxed silken thread" between the teeth "to dislodge that irritating matter which no brush can remove, and which is the real source of disease."
- By the end of the 19th century, commercially manufactured waxed or unwaxed silk dental floss became available. It was largely replaced by nylon floss in the 1940s, driven by the scarcity of silk during World War II and by nylon's greater shredding resistance. Today, floss is made from a variety of synthetic fibres.
- In the late 1950s, oral irrigators became available. The Waterpik, introduced in 1962, was the result of a collaboration between a US dentist and a hydraulic engineer. [1]

Oral self-care statistics

The 2018 Canadian Community Health Survey found 78% of Canadians aged ≥12 brushed their teeth at least two times per day, while less than half (43%) flossed their teeth at least once per day. Together, just over one-third (37%) of Canadians met the recommended guidelines of brushing teeth twice a day and flossing daily. Significantly more females (45%) than males (29%) met the guidelines for both brushing and flossing. Males aged 50-64 and females aged ≥50 were the most likely to meet the guidelines. [2]

Su et al. 2022 examined differences in oral health and oral health behaviours of females and males in the United States. The results showed males tended to have fewer oral healthcare visits, worse perception of their periodontal and tooth health, poorer flossing habits, and more dental caries. Females were more proactive in oral healthcare visits and displayed a greater awareness of oral health. Considering males visit oral health clinicians less, clinicians should view each appointment as a teachable opportunity to improve oral health knowledge and promote positive oral health behaviours. [3]

Toothbrushing

Both manual and power toothbrushes are available options to promote oral health. In 2022, the global toothbrush market size was valued at $6.90 billion USD and is projected to grow from $7.07 billion USD in 2023 to $9.63 billion USD by 2030. Despite the introduction of power toothbrushes, manual toothbrushes are still more frequently used, generating 78% of the global toothbrush market share in 2019. The large share of the global market was attributed to their convenient availability in supermarkets and convenience stores as well as their lower cost compared to power toothbrushes. [4] [5]

Manual toothbrushing

A systematic review by Rajwani et al. (2020) analyzed the effectiveness of various manual toothbrushing techniques, such as Bass, modified Bass, Charters, Fones, scrub, rolling, Stillman, modified Stillman, and toothpick method. The study found the current evidence was inadequate to conclude one toothbrushing method was more effective than another in removing plaque and reducing gingival inflammation. Excessive variability in many aspects of the design and methodology of the included studies hindered the conclusion on an ideal manual brushing method. [6]

Weng et al. (2023) compared the effectiveness of the modified Bass technique, rolling stroke, and current brushing technique in plaque removal. The participants received training in one of the brushing techniques and were evaluated over a 4-week period. The results showed a decrease in plaque levels in all groups initially, with no significant difference in plaque removal among the groups. However, the modified Bass technique was found to be more effective in removing plaque at the cervical margin, whereas the rolling technique was easier for participants to master. Although clinicians may consider recommending the modified Bass technique, the recommended technique should consider the clients' hand coordination. [7]

Toothbrushing methods [6] [8]

Method	Description
Bass (sulcular)	Toothbrush bristles are placed into the gingival sulcus and embrasures at a 45-degree angle to the long axis of the tooth. Short back and forth vibratory strokes are used.
Modified Bass	Incorporates a rolling stroke after the horizontal movements at the gingival sulcus. Research has shown modified Bass is the most commonly recommended technique.
Charters	Brush head is angled at 45° coronally to the margin rather than apically. Vibratory and slight rotary movements are applied. Originally described for clients with orthodontic appliances.
Fone (circular)	With teeth closed, upper and lower facial surfaces are brushed simultaneously with large, circular strokes. Inner surfaces require small circles or back and forth strokes.
Horizontal scrub	Bristles activated in a horizontal back and forth motion.
Rolling stroke	Side of the brush is placed on attached gingiva with bristles directed apically. The brush is rolled slowly over the teeth in a sweeping motion towards the occlusal or incisal surfaces.
Stillman	Bristles are directed apically, placed partly on the gingiva and the cervical areas of the tooth at a 45° angle. A slight rotary motion is used.
Modified Stillman	Incorporates a rolling stroke towards the incisal or occlusal surfaces after the slight rotary motion.
Toothpick method	Toothbrush head is applied at a 30-degree angle towards the crown of the tooth. The bristles are pushed between the teeth eight to nine times.

Brushing duration

Oral health practitioners generally recommend brushing for two minutes at least twice a day with an effective technique. However, estimates of individuals' actual brushing time vary between just over 30 seconds to just over 60 seconds, the average being 45 seconds by most people. [9]

Gallagher et al. (2009) looked at how brushing time affected plaque removal in 47 people. The results suggest increasing brushing time from 45 seconds to two minutes may help remove up to 26% more plaque. The use of toothpaste did not increase plaque removal during 60 seconds of brushing, supporting the view that plaque removal effectiveness is essentially the function of the brush bristles rather than the toothpaste abrasive. [9]

However, utilizing fluoridated toothpaste is important since brushing with fluoride toothpaste twice-daily is a simple and effective way to prevent dental caries, slow progression of existing caries, and reduce caries severity among children, adults, and seniors.[1] [10]

Saghiri et al. (2023) conducted an in vitro study to evaluate various brushing times on plaque-removal efficacy of a power toothbrush to determine the optimal time length required to brush teeth. Using a robotic arm, toothbrushing a typodont was performed over eight different brushing times (0, 60, 120, 180, 240, 300, 360, 420 seconds). Plaque removal significantly increased with brushing time. Efficient plaque removal was achieved after 240 seconds of brushing. However, the authors cautioned due to the limitations of this in vitro study, clinical studies are needed to change the brushing recommendation from two minutes to four minutes. [11]

Manual versus power toothbrushes

A Cochrane review (2014) included 56 randomized controlled trials (RCTs) involving 5,068 participants. The results provided moderate quality evidence suggesting power toothbrushes may be more effective than manual brushes in reducing plaque and gingivitis in the short and long term. There was an 11% reduction in plaque at one to three months of use, and a 21% reduction in plaque when assessed after three months of use. For gingivitis, there was a 6% reduction at one to three months of use, and an 11% reduction after three months of use. The greatest body of evidence was for rotation oscillation power brushes which demonstrated a statistically significant reduction in plaque and gingivitis at both time points. However, the authors concluded the benefits of these findings for long-term oral health are unclear. [12]

Petker-Jung et al. (2022) evaluated videos of university students using their own power or manual toothbrush to identify tooth brushing behaviours that predict oral cleanliness after brushing. One hundred students participated in the study. Forty-eight used a power toothbrush with rotating-oscillating movements and 52 used a manual toothbrush with vertical bristles. Each participant's dental status, gingival bleeding, and plaque levels were assessed before brushing. In a separate oral hygiene room, the students were then asked to brush with their own toothbrush to the best of their abilities. They were recorded on a tablet computer (which also served as a mirror) during brushing. They were given no time limit and there was no time display on the tablet computer. During brushing, the participants were left alone but videos were recorded simultaneously. Immediately after completing brushing, the remaining plaque levels were determined.

[1] Refer to Episodes 86 and 87 for discussion on fluoride and dental caries.

The study showed, despite brushers' best efforts, high plaque levels remained after brushing, especially along the gingival margins, suggesting it was not the type of toothbrush but the brushing technique that affected results.

The videos showed the brushing behaviours of power and manual toothbrush users were quite similar, with both groups brushing for comparable periods of time and both brushing all outer sextants sufficiently long. However, both power and manual toothbrush users neglected the inner surfaces. This emphasizes using a power toothbrush does not automatically result in more comprehensive tooth brushing.

The videos also showed most brushing techniques were only moderately related to the type of toothbrush used. Often power toothbrush users applied manual toothbrush movements that were not necessary or productive in removing plaque. Plaque removal at gingival margins was challenging for both manual and power toothbrush users, highlighting the importance to direct brushers' attention to this area. In manual toothbrush users, circular movements seemed to be more efficient than vertical movements on outer surfaces.

Overall, the results emphasize the importance of analyzing tooth brushing behaviours to understand brushing shortfalls. Future studies should investigate how unproductive brushing behaviours can be replaced with more effective brushing techniques. [13]

A study by Essalat et al. (2022) emphasizes clients need better power brushing instruction. The observational study examined the brushing patterns of 12 healthy college students in their home settings, using the toothbrushes' built-in sensors and digital data collection platform to capture unobtrusive and accurate habitual brushing patterns. Basic instructions were given on brush use and setting up the data collection system. Participants were instructed to brush twice daily for two minutes each time and to freely brush their teeth in a manner most natural to them. Brushing data in the home setting were collected over three weeks (50 sessions each). The researchers selected 10 sessions (out of the 50 recorded sessions per participant) at random for a total of 120 brushing sessions for the 12 participants.

Over 90% of the participants brushed their teeth for less than 2 minutes, and most demonstrated inconsistencies in their brushing time. Buccal surfaces were brushed more than twice as long as occlusal and lingual surfaces. Most participants applied too much pressure on occlusal surfaces, and lingual surfaces of maxillary molars were most often forgotten. There were also individual variations in time and brushing patterns.

The authors concluded the findings underscore the limited uptake of generic oral self-care recommendations and emphasize the need for personalized brushing instructions. Simply asking clients to brush longer or more frequently may not result in a more thorough brushing behaviour. Clinicians should educate clients on the appropriate use of power toothbrushes and emphasize maintaining consistency in toothbrushing and the importance of brushing all surfaces. [14]

Pitchika et al. (2019) assessed the 11-year longitudinal effects of power toothbrush use on periodontal health, caries, and tooth loss from a prospective population-based cohort of 2,819 adults. To establish baseline data, participants received clinical examinations to determine number of teeth present; probing depths (PDs); clinical attachment loss (CAL); decayed, missing, filled surfaces scores (DMFS); and decayed, filled surfaces scores (DFS); and were asked oral health questions, including whether they used a power or manual toothbrush. Follow-up occurred 6 and 11 years later.

The findings suggested power toothbrush use over 11 years reduced mean PDs and mean CAL progressions. This protective effect translated into more retained teeth in the whole cohort over the 11-year study period. However, power toothbrush use did not influence caries progression. The authors felt the results addressed the unclear long-term oral health benefits noted by the authors of the 2014 Cochrane review (discussed above), since reduced PDs and CAL as well as more retained teeth demonstrate tangible health benefits of power toothbrush use. [15]

Brushing and cognitive impairment

In many parts of the world, life expectancy and the prevalence of mild cognitive impairment and dementia are increasing. Dementia and cognitive impairment are reported to result in a rapid deterioration of oral health, increased incidence of oral diseases, and a poorer quality of life.[2] [16]

Sarcopenia (loss of muscle tissue due to aging) and impaired fine motors skills are associated with cognitive impairment and hinder self-care. The inability to remember to brush teeth increases as dementia progresses. Accordingly, it is vital to develop good oral self-care routines for individuals with mild cognitive impairment. [16] [17]

A Cochrane review (2014) showed using a power toothbrush may be more effective in removing plaque and reducing gingival inflammation than a manual toothbrush. Additionally, power toothbrush design may make it easier to hold, and its use typically requires less motor skill. Therefore, using a power toothbrush may benefit individuals with mild cognitive impairment. [12] [16]

Flyborg et al. (2022) investigated whether power toothbrush use could maintain oral health by reducing plaque index (PI), bleeding on probing (BOP), and periodontal pocket depth (PPD) ≥4 mm in 170 participants with mild cognitive impairment, and if changes in oral health affect various aspects of quality of life.

In this study, 61% of the participants reported using a power toothbrush at least daily at baseline, 95% at 6 months, and 95% after 12 months. There was a significant decrease in the PI, BOP, and percentage of PPDs ≥4 mm from baseline to 12 months. The Oral Health Impact Profile-14 scores showed significant improvement during the study.

Even among those with declining Mini-Mental State Examination scores, power toothbrush use was associated with a reduction in PI, BOP, and percentage of deep

[2] Refer to Episode 29 and 55 for discussion on dementia and oral health.

PPDs over the 1-year follow-up period. Also, the obtained improvements in BOP, PI, and PPD were associated with improvements in oral health-related quality of life. The authors concluded using a power toothbrush over a 12-month period improved oral health parameters among individuals with mild cognitive impairment. Future research and RCTs are needed to further clarify the impact of using a power toothbrush among the older population to improve long-term oral health. [16]

Cardiovascular disease and oral self-care

Based on research conducted over several decades, oral health is increasingly recognized as an important factor in cardiovascular health. Periodontitis and cardiovascular disease (CVD) share risk factors (e.g., tobacco use, obesity, poor nutrition, physical inactivity). Although causal relationships have not yet been established, research has linked various oral health issues with an elevated risk of CVD, including hypertension, atherosclerosis, and myocardial infarction.[3] [18] [19] [20] [21]

Isomura et al. (2023) investigated whether toothbrush timing affected CVD risk. In the study of 1,583 participants, researchers found those who brushed their teeth before bed had a decreased risk of experiencing a cardiovascular event than those who brushed their teeth only in the morning or not at all. The study was composed of individuals age ≥20 who were inpatients at a university hospital in Japan. Researchers suspect the bacterial load within the oral cavity proliferates overnight due to reduced salivary flow during sleep, emphasizing the need to brush teeth before bed. The authors concluded their findings were limited to CVDs and cannot be generalized to healthy populations. However, they suggest brushing teeth at night is important for lowering CVD risk. [22]

Janket et al. (2023) investigated whether good oral self-care and mouthwash use would influence CVD mortality among 354 participants. They also investigated how mouthwash use impacts oral microbes. Results showed good oral self-care that encompassed both brushing and flossing was associated with a 51% reduction in the risk of CVD mortality compared with poor oral self-care during a median follow-up of 18.8 years. Even those who had coronary artery disease at baseline showed a marginally significant benefit with good oral self-care. The additional use of mouthwash with oral self-care did not influence the risk of cardiovascular mortality, indicating no additional benefits nor detriments. All tested microbes tended to decrease with mouthwash use in the short term, but none were statistically significant.

The authors concluded the results have public health importance because brushing and flossing are relatively inexpensive and have low risk of adverse effects. Moreover, even those who already have heart disease can lower the risk of CVD mortality by maintaining good oral hygiene. Further large-scale studies are warranted. [23]

Suspension of oral self-care

Dr. Glogauer and colleagues utilized the experimental gingivitis model to understand the bacterial dynamics during the induction and resolution of gingival inflammation. The bacterial community was profiled in 15 healthy participants who suspended all oral self-

[3] Refer to Episodes 37, 79, 80 and 81 for additional information on CVD and oral health.

care practices for three weeks. Oral self-care was resumed in the last two weeks of the study. All participants were systemically healthy, with no active or previous history of periodontal disease, chronic aphthous ulcers, or tonsillitis, and no more than four active or filled cavitated lesions. Saliva, tongue, subgingival, and supragingival plaque samples were collected over seven weeks.

Taxonomic groups spanning ten phyla demonstrated consistent abundance shifts, including a significant decrease in *Streptococcus*, *Neisseria*, and *Actinomyces* populations, and an increase in *Prevotella*, *Fusobacterium*, and *Porphyromonas* populations. Samples showed a return to bacterial community baseline after oral self-care practices were resumed. The results were largely consistent with previous experimental gingivitis model studies.

The importance of this research includes:

- May help develop bacterial prognostic tests and probiotics for severe oral disease (e.g., which species to introduce to help manage oral inflammation).
- Stronger temporal changes in subgingival and supragingival plaque suggest these sample types may be preferred over tongue plaque or saliva samples for future prognostics.
- Temporal correlations presented may help identify bacterial taxa that are clinically relevant to gingivitis and periodontitis.
- The diversity of bacterial taxa that respond to oral self-care practices, with significant dynamics spread across ten phyla.
- The complex bacterial dynamics in gingivitis and its resolution. [24]

Interdental cleaning

Toothbrushing can remove supragingival plaque on the facial, lingual/palatal, and occlusal surfaces, but other devices (e.g., floss, small brushes, sticks, irrigators) are often needed to clean interdental areas.

A Cochrane review (2019) evaluated the effectiveness of at home interdental cleaning devices. The study included 35 RCTs (3,929 adult participants). Studies were at high risk of performance bias as participant blinding was not possible. Only two studies were at low risk of bias. Many participants had a low level of baseline gingival inflammation. No trials assessed interproximal caries, and most did not assess periodontitis.

The authors concluded:

- Using floss or interdental brushes in addition to toothbrushing may reduce gingivitis or plaque, or both, more than toothbrushing alone.
- Interdental brushes may be more effective than floss.
- Available evidence for oral irrigators and tooth cleaning sticks is limited and inconsistent.
- There is some evidence oral irrigation may be better than flossing for reducing gingivitis (but not plaque) in the short term (approximately 4-6 weeks).
- Toothbrushing plus oral irrigation may reduce gingivitis in the short term, but there was no evidence for this in the medium term (approximately 3-6 months). There was no evidence of a difference in plaque.

- Using wooden tooth cleaning sticks may be better than only toothbrushing for reducing gingivitis but not plaque in the medium term (only 24 participants).
- Rubber or elastomer tooth cleaning sticks may be better than only toothbrushing for reducing plaque but not gingivitis in the short term (only 30 participants).
- Interdental brushes may be better than flossing for gingivitis at one and three months. The evidence for plaque was inconsistent. There was no evidence of a difference between the devices for periodontitis measured by probing pocket depth.
- Available evidence for interdental cleaning sticks did not show them to be better or worse than floss or interdental brushes for controlling gingivitis or plaque.
- Studies that measured adverse events found no serious effects and no evidence of differences between study groups in minor effects (e.g., gingival irritation).
- Future trials should report participant periodontal status according to the new AAP periodontal diseases classification,[4] and last long enough to measure interproximal caries and periodontitis. [25]

Shi et al. (2023) evaluated the association between interdental cleaning (e.g., dental floss or other devices) and untreated root caries among middle-aged and older adults in the US. Data were obtained from the National Health and Nutrition Examination Survey (NHANES) (2015-2016 and 2017-2018). Adults aged ≥40 years who underwent full mouth examination and root caries assessment were included. Participants were classified based on their interdental cleaning frequency as none, 1-3 days/week, and 4-7 days/week.

The researchers found interdental cleaning 4-7 days/week was associated with fewer untreated root caries among middle-aged adults. Interdental cleaning may help prevent root caries by:

- Mechanically removing plaque from adjacent tooth surfaces that are difficult to access by toothbrush, thereby reducing root caries risk.
- Reducing periodontal disease interproximally by removing plaque, thereby decreasing root surface exposure risk and subsequent root caries development. [26]

Moore et al. (2023) conducted a 6-week, single-blinded, RCT to determine if using an interdental brush, with or without a tracking device, was more effective than an oral irrigator in improving interproximal PD, CAL, PI, gingival index (GI), BOP, and inflammatory markers.

The clinical trial included 76 participants with severe periodontitis (stages III–IV, grade B) receiving periodontal maintenance. Participants were randomized into the following groups: interdental brush alone, interdental brush with a tracking device, and an oral irrigator. Data from the interdental brush tracking device were collected on participants' smartphones.

After six weeks of once-daily use, all groups showed significant improvements in the PDs, CAL, BOP, and GI. Plaque reduction was more pronounced in the interdental

[4] Refer to Episodes 49 and 50 for information on the AAP classification of periodontal diseases.

brush and the interdental brush plus tracking device groups. Interleukin-1β (IL-1β)[5] levels in gingival crevicular fluid decreased in all the groups.

Overall, interdental brush and oral irrigator use improved the periodontal parameters in participants with severe periodontitis in the short term. The addition of a tracking device did not significantly improve the assessed clinical parameters. [27]

Bacterial colonization of oral irrigators

Research has shown oral irrigators are safe to use, with no detrimental effects on the attachment, junctional epithelium, or pocket depth. [28]

Nevertheless, studies have indicated some oral irrigators may become unavoidably colonized by oral bacteria after a short period of use (e.g., 3-6 weeks), which can be transmitted via the water jet. [29] [30]

Contamination of certain oral irrigators with *Streptococcus mutans* was found in >95% of the samples, while periodontal pathogens were detected in 19-56% of the samples. Neither using the device exclusively with a mouthrinse (i.e., essential-oil-based), nor any cleaning procedures prevented bacterial colonization (especially *S. mutans*) within the device and failed to disinfect the device. [30]

Colonization with oral bacteria is not surprising, since the oral irrigator nozzle tip comes in contact with the oral cavity and colonization with bacteria has been previously reported for toothbrushes from use and improper storage. [31]

Currently, it is recommended that one device may be used by more than one person and only the nozzle should be exchanged (i.e., each family member/partner should have their own nozzle). However, based on these reports, the authors recommend this common recommendation should be reconsidered. Specifically, it should be suggested each family member have their own device. Whether bacterial colonization also applies to other oral irrigators still needs to be determined. [29]

Environmental impact of toothbrushes

Healthcare has a significant carbon footprint and oral healthcare is no exception. Services and products designed to improve oral health come with an associated environmental cost that will ultimately impact global human health. Thus, it is important, to consider ways to make oral healthcare more environmentally sustainable. [32]

Environmental sustainability can be measured in different ways. Carbon foot printing is the most common measure and relates to climate change potential from the collective greenhouse gases of a product or service. Life cycle assessment (LCA) is a more comprehensive assessment of a product's environmental footprint.[6] Also known as

[5] Refer to Episodes 44 and 45 for information on interleukins and the immune system.

[6] Life cycle assessment or analysis (LCA) is a comprehensive assessment of a product's environmental footprint that encompasses climate change as well as a range of measures relating to global human health (e.g., ionizing radiation, ozone depletion, respiratory disease from particulate matter), ecosystem

cradle-to-grave analyses, LCAs consider the environmental impacts assessed from raw material extraction and processing (i.e., the “cradle”) and the product’s manufacture, distribution, use, recycling, and final disposal (i.e., the “grave”). [32]

New products with “eco-friendly” branding have come to market, including products made from bamboo. However, joint studies have shown bamboo toothbrushes may not be the most environmentally friendly option and plastic manual toothbrushes with replaceable heads may be the best type for the planet and associated with human health. [33] [34]

Lyne et al. (2020) compared the sustainability of four different types of toothbrushes: a plastic manual toothbrush, a bamboo manual toothbrush, a plastic manual toothbrush with a replaceable head, and a power toothbrush. Researchers performed a LCA to measure the environmental impact of these toothbrushes over five years. [35]

According to Duane et al. (2020), the power toothbrush was comparatively harmful to both the planet and to the people involved in its manufacturing and distribution processes. It causes 10 hours of disability measured in disability-adjusted life years (DALY), which is five times more than a normal plastic toothbrush. [34]

The plastic manual replaceable head toothbrush and the bamboo manual toothbrush performed better than traditional plastic manual and power toothbrushes in every environmental impact outcome measured. However, a hypothetical continued recycled plastic toothbrush was the most environmentally sustainable toothbrush (i.e., one which uses plastic that is recycled in a continuous process). Plastic brushes which can be recycled is not like bamboo which requires much land and water to grow. Also, bamboo toothbrushes may stop land from being put to better use (e.g., increasing biodiversity, or in growing trees to offset carbon emissions). [35]

The results of the studies could be used to inform individual consumer choice, oral health recommendations, procurement of toothbrushes for public health programs, and toothbrush manufacturers. Also, there needs to be a system where plastic toothbrushes can be collected like batteries and then recycled into new products. If the plastic escapes the recycling chain, it needs to be able to be easily and naturally broken down into harmless products. [33] [34] [35]

Environmental impact of interdental cleaning aids

The market for interdental cleaning aids was valued at $3 billion USD in 2020, and projected to increase to $4 billion USD by 2031. [36]

There are a range of interdental cleaning aids available. Traditionally, floss and interdental brushes were made from plastic. However, other options are now available and the environmental impact of interdental cleaning aids has not been previously quantified.

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quality (e.g., freshwater ecotoxicity, marine eutrophication, terrestrial acidification), and planetary resource use (e.g., land use, fossil fuel use, water use). [32]

Abed et al. (2022) compared the environmental footprint of eight different interdental cleaning aids using LCA methodology. The baseline scenario of an individual person using interdental cleaning aids every day over five years to effectively prevent and/or manage periodontal disease was used to compare the different products. The 5-year period was chosen to aid in comparing the results from the LCA study of toothbrushes by Lyne et al. (2020). Sixteen environmental categories were assessed (e.g., impact on climate change, ozone layer depletion, water and fossil fuel use).

A sample product was chosen to represent each type of interdental cleaning aid. Products were chosen from the Amazon UK website, with the best-selling product chosen for each type. All product brands and manufacturers were anonymized in the study. In the analysis, it was assumed all products would be clinically effective to manage and/or prevent periodontal disease.

The following product types were selected for the study:

- Regular floss (roll of nylon floss in a plastic dispenser).
- Sponge floss (precut lengths of spongy or expanded floss).
- Floss picks (nylon floss fixed to a plastic handle, designed for single use).
- Bamboo floss (roll of bamboo floss in a glass jar).
- Regular interdental brush (plastic handle with nonreplaceable head, entire brush changed weekly).
- Interdental brush picks (rubber brush head on plastic handle, designed for single use).
- Replaceable head interdental brush (reusable handle, replaceable brush heads changed weekly).
- Bamboo interdental brush (bamboo handle, entire brush changed weekly).

The study found single-use floss picks had a worse environmental impact in 13 of 16 categories, followed by the interdental brush picks. There was no single best environmentally friendly product. However, the bamboo interdental brush had the lowest environmental impact in 5 of 16 categories, including climate change.

Therefore, if floss is clinically recommended, regular, sponge, or bamboo floss products are preferable for the environment over floss picks. If interdental brushes are clinically recommended, weekly interdental brushes are preferable over daily ‘single-use’ brush picks, and those with a bamboo handle or a plastic reusable handle are preferable over regular interdental brushes with plastic handles. The bamboo interdental brush was overall the most environmentally effective interdental cleaning aid in this study. The researchers concluded oral health clinicians should consider the environmental impact, clinical need, and cost, when recommending interdental cleaning aids to clients. [32]

Food allergens in oral care products

Food allergies are a growing concern and can dramatically impact the quality of life of affected individuals. In recent years, different food allergens have been added to oral care products to improve product properties. Since small doses of food allergens can trigger allergic reactions, clinicians should be aware of product ingredients and client allergies to protect client health. [37]

Allergic reactions can affect the entire body, with symptoms ranging from mild to moderate (e.g., hives; cough; swelling of the face, tongue, or lips; abdominal pain; skin rash tingling sensation; hoarse throat; difficulty swallowing; vomiting; diarrhea) to severe anaphylactic reactions.[7] [37]

Previous case reports have noted reactions to toothpaste flavouring ingredients, such as contact dermatitis. Sodium lauryl sulfate, the foaming agent found in some toothpastes, have been linked to oral mucosal irritation, inflammation, desquamation, and increased incidence of recurrent aphthous ulcers. [38] [39] [40] [41] [42]

Coimbra et al. (2023) investigated the presence of food allergens in oral care products through surveying product labels. The researchers evaluated 387 oral care products. A total of 299 of these products could be bought over the counter (e.g., chewing gum, cleaning tablets, denture creams, mouthwash, oral gels and sprays, orthodontic waxes, toothpastes). The remaining 88 products were used at oral healthcare offices (e.g., alginates, fluoride varnishes, plaque-revealing gels, toothpastes, topical creams, gloves). The products were searched for additives, such as nuts, shellfish, dairy (e.g., cow's milk proteins, lactose), gluten, soy, oats, fruits, and spices/herbs (e.g., cinnamon, peppermint).

The researchers found possible food allergens in 46% (179 items) of oral care products. Most of the products (81%) contained one food allergen. In oral healthcare office products, the highest prevalence of allergens was found in fluoride varnishes, alginates, toothpastes, topical creams, and gloves. In client purchased products, allergens were predominant in toothpaste, chewing gum, and orthodontic waxes. Most frequently, the food allergens were fruits and spices/herbs. The authors noted the absence of references to food allergens in the list of ingredients does not eliminate the possibility of their presence.

The researchers advised clinicians to be alert to food allergies, be aware of the risks to the client's health, and include questions about food allergies in their medical history to make a conscious and careful selection of products to be used by the clients. Considering food allergies may occur because of erroneous information or a lack of labelling, manufacturers should be more rigorous in declaring allergens on product labels to help ensure client and consumer safety. [37]

Miswak use

Miswak (also know as siwak or chewing sticks) is obtained from several different plant species, including the lime tree, orange tree, and Neem tree and most commonly from the root, stem, and twig of the Arak tree. Miswak is widely used among Western Asia and Muslim populations globally. Some adults use it in conjunction with a toothbrush.

The stem or root is softened by soaking in water for a couple of minutes and is chewed to fray the end to make a brush-like instrument to clean teeth. In developing countries,

[7] Refer to Episode 45 for additional information on allergic reactions.

many rural populations use miswak as an oral hygiene tool because of its low cost and easy availability. The preference for miswak can also be linked to religious belief. [43]

Several studies have reported miswak to have mechanical and pharmacological properties that benefit oral health. However, miswak use has been associated with gingival recession and CAL. Improper use of miswak over a long period can result in a risk of oral tissue injury. [43]

Ramli et al. (2022) conducted a systematic review and meta-analysis to determine the effectiveness of miswak in reducing plaque and gingivitis among adults. In total, 150 studies were screened, with ten RCTs included and nine utilized in a descriptive meta-analysis. The findings claimed miswak offered similar outcomes to toothbrushing when considering mean plaque score and mean gingivitis score. A further significant secondary outcome was noted, showing reduced mean plaque score and reduced gingivitis score when miswak was used in addition to toothbrushing.

The authors concluded miswak sticks may offer similar plaque reduction to brushing and may reduce plaque-induced gingivitis when used as an adjunct to toothbrushing. However, more research is required on the advantages and proper method of miswak use for optimum outcome and safety. [44]

Oil pulling

There have been reports in mainstream media on oil pulling and its benefits for oral and general health. The claims state oil pulling (swishing oil in the mouth) whitens teeth, and improves both oral and overall health. [45]

Oil pulling is an ancient, traditional folk remedy that has been practised for centuries in India and southern Asia. The practice involves swishing or “pulling” a tablespoon of an edible oil (e.g., sesame, olive, sunflower, coconut) through the teeth and mouth for anywhere from 1-5 minutes to up to 20 minutes or longer. [45]

A few side effects have been reported from oil pulling, including lipid pneumonia associated with oil aspiration and nausea from accidentally swallowing the oil. More trial data is required to provide evidence of possible side effects. Consideration should be given to spitting out the oil into a tissue before disposing to avoid oil build up and drain pipe blockage. [46] [47] [48] [49]

Woolley et al. (2020) conducted a systematic review to assess the effect of oil pulling with coconut oil in improving oral health and oral hygiene. Electronic searches yielded 42 eligible studies, of which four RCTs (182 participants) were included. The studies lasted between 7 and 14 days. No meta-analysis was performed due to the clinical heterogeneity and differences in data reporting among the included studies. The authors noted the data were insufficient for conclusive findings, the quality of studies was mixed, and risk of bias was high. The review highlighted the absence of high-quality evidence in the literature. Consequently, it is difficult to determine whether oil pulling with coconut oil has an actual beneficial effect. More well-designed RCTs are required to determine the impact of oil pulling with coconut oil on oral health. [50]

Raja et al. (2021) conducted a systematic review of RCTs to determine the oral health effects of oil pulling. The authors concluded the quality of evidence was low to recommend oil pulling as a suitable adjunct to other conventional oral hygiene methods, as most of the included studies had high or unclear risk of bias. Well-designed, high-quality clinical research with longer study duration is needed to improve the level of evidence in this area of research. [51]

Peng et al. (2022) conducted a meta-analysis to investigate the effect of oil pulling on oral health. Nine RCTs (344 participants) were included in the study. The included studies varied in their risk of bias. Although the included articles were RCTs, there were four studies that were considered low-quality after risk of bias assessment.

Results showed salivary bacterial colony counts were significantly reduced in the oil pulling group compared to water or chlorhexidine (control group). There was no significant difference between the two groups in PI and GI scores.

Limitations of this systematic review included the number of included studies were small, and three of the studies were reported by the same author, which may introduce biases in outcome assessment.

The authors concluded oil pulling may have possible benefits in reducing salivary bacterial colony count. However, oil pulling had no significant effect on PI outcome and GI scores. Therefore, more evidence from well-designed, large-scale, RCTs is needed to confirm these results. [52]

Overall, there are no reliable scientific studies to show oil pulling reduces dental caries, whitens teeth, or improves oral health. Thus, oil pulling should not replace conventional self-care practices, such as brushing and flossing. [45]

Take home messages

- Selection of the type of toothbrush and toothbrushing technique should be based on client hand coordination, their clinical need, and preference.
- When a power toothbrush is indicated, it is important to provide client-specific education on its use.
- It is essential to maintain a complete medical history, including allergies to protect client safety.
- Consider the environmental impact, cost, and client preferences when recommending oral self-care products

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Client resources

Brushing, Flossing, Rinsing, ODHA factsheet
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Additional Resources

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