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THE SOLUTION IS NOT THE ANSWER, BUT THE QUESTION IS! ... MECHANICAL PLAQUE CONTROL

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ABSTRACT

Dental disorders, the most prevalent being periodontal disease and tooth caries are multifactorial in etiology. Dental Plaque is closely related to the formation and development of dental caries and diseases of the periodontium. Recent research clearly shows that there is a considerable correlation between an individual's overall health and oral inflammation. Plaque control measures have been deployed in an array of ways, which can be broadly divided into mechanical and chemical techniques. It forms a part of Phase-I therapy which is also known as the non-surgical phase. Mechanical Plaque Control forms a pre-requisite for the prevention and control of oral diseases. Mechanical plaque control measures include manual toothbrushes, power-driven toothbrushes, sonic and ultrasonic toothbrushes, disposable toothbrushes, laser toothbrushes, solar-powered toothbrushes, and interdental cleaning tools. This review paper outlines the different mechanical aids that have been available in the past and their current advancements.

KEYWORDS: Plaque control, mechanical, toothbrushes, interdental aids.

INTRODUCTION

Dental disorders, the most prevalent being periodontal disease and tooth caries are multifactorial in etiology. Dental Plaque is closely related to the formation and development

of dental caries and diseases of the periodontium. Recent research clearly shows that there is a considerable correlation between an individual's overall health and oral inflammation.[1] It has been established that dental biofilm is a major cause of gingivitis, which can progress to periodontitis. Individuals must be aware that maintaining proper oral hygiene is the first step towards having healthy teeth and periodontal tissue.

Plaque control is defined as the regular removal of microbial plaque and the prevention of its accumulation on the teeth and adjacent gingival surfaces. It forms a part of Phase-I therapy which is also known as the Non-surgical phase, Preparatory phase, Etiotrophic phase, or Cause Related Therapy. It refers to the removal of already formed or the control of the formation of microbial biofilm. Loe and associates established the cause-and-effect link between supragingival plaque and gingivitis in 1965.[2]

Sanders (1962) conducted a study and found that the rate at which calculus formation takes place is slowed down by plaque removal. Thus, it is imperative to identify strategies for plaque control which can be accomplished either by the use of mechanical, chemical, or combination of these methods. Human history predates the invention of mechanical plaque control. It mainly includes the use of toothbrushes, interdental aids, oral irrigators, etc.

Plaque management entails maintaining the health of the periodontium, providing the best care possible for periodontal illnesses, and, last but not least, preventing the disease from recurring in patients who have had periodontal diseases.[3]

Subgingival recolonization occurs within 4–8 weeks following scaling and root planning if there is insufficient effective plaque management throughout the healing or maintenance period.[4] On the other hand, adequate supragingival plaque control appears to be effective in stopping subgingival recolonization-induced disease relapse or recurrence. Additionally, peri-implant disease, stability of guided tissue regeneration, and failure of periodontal surgery are all significantly impacted by poor oral hygiene.[5]

Therefore, to improve patient oral hygiene, this review paper outlines the different mechanical aids that have been available in the past and their current advancements.

History

Before the invention of toothbrushes, the Neem plant, reputed to have therapeutic benefits, was commonly used in India as a toothbrush. Prehistoric men used fingernails and splinters

of wood to remove the deposits around the teeth. In the Middle East, a fragrant plant twig known as miswak was used.[6] The first toothpick dates back to 3000 BC and comes from the Sumerian civilization. Whilst the precise origin of toothbrushes is unknown, the earliest known toothbrushes date to 1498 and were found in China made up of ivory handles and natural bristles. Later on, in the late eighteenth and early nineteenth centuries, Natural bristles were gradually replaced by less expensive nylon filaments in the 1930s, and bone handles were swapped out for plastic and wood.[7] Further in 1960, soft nylon bristle brushes were developed. The first electric toothbrushes were available in the early 1960s. They were added to help with the negative effects of improper tooth brushing habits.[8] The recent boom in smart toothbrush sales can be attributed to their improved efficiency and lower cost.

Classification

Plaque control measures have been deployed in an array of ways, which can be broadly divided into mechanical and chemical techniques.[9]

Mechanical Plaque Control forms a pre-requisite for the prevention and control of oral diseases. The use of a toothbrush, good oral hygiene practices, and professional prophylactic interdental cleaning are examples of mechanical means of preventing plaque.[10] Various mechanical aids include- Toothbrushes, Dentifrices, interdental aids, and oral irrigators.

Chemical plaque regulation is employed in addition to mechanical techniques, not as a substitute which includes the use of antiplaque agents and antibiotic solutions.

Mechanical Plaque control

The goal of mechanical plaque control is to lessen the number of pathogens that cause various kinds of oral disorders. Mechanical Plaque control measures are classified as shown in Fig 1.[9,11]

Classification of Mechanical Plaque control

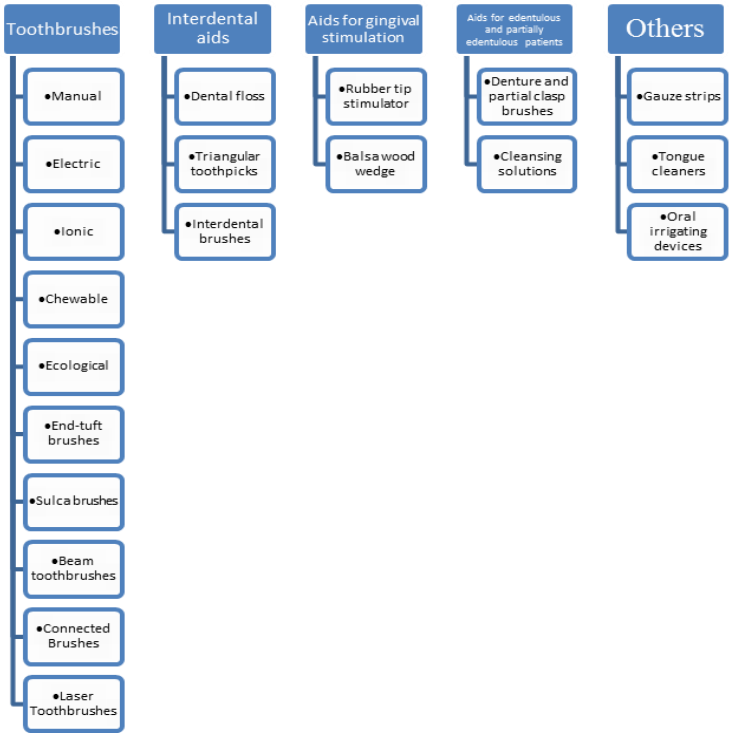

Fig 1.

TOOTHBRUSHES

It is the most commonly used mechanical aid. A single kind of manual brush with a multi-tufted toothbrush head was sold in the 1980s. Then, in the 1990s, a variety of toothbrushes with various head designs, angulations, forms, sizes, and bristles were created. These changes improved the ease and effectiveness of the toothbrush's ability to remove plaque. Numerous changes have been made to the manual toothbrush design, including adjustments to the handle, bristle quality, and size and form of the toothbrush heads. William Addis made the first modern toothbrush discovery. Further, H N Wadsworth invented the nylon toothbrush with three rows. The first electrical toothbrush was called Broxodent.[12]

Manual Toothbrush

It consists of a Handle, shank, and head. Based on the handle it is classified as straight or contra-angled. The bristles are arranged in either curved, straight, or zig-zag patterns. It is the gold standard and the most commonly used toothbrush.

ADA SPECIFICATIONS OF TOOTHBRUSH[13]

Length:1-1.25 inches

Width: 5/16 – 3/8 inches wide

Rows: 2-4 rows

Tufts per row- 5-12

Bristles per tuft- 80-86

Diameter: soft: 0.2mm, medium-0.3mm, hard: 0.4mm

Electric Toothbrush

The first Electric toothbrushes were developed in the 1960s as a replacement for manual toothbrushes. They are beneficial for those with various degrees of physical and mental dexterity abnormalities. The brush head is compact compared to manual toothbrushes and is capable of producing oscillating, back and-forth, elliptical, circular, or a combination of these movements. Current toothbrushes have a pressure-sensitive, timer, oscillating or rotating motion.[14] They are classified according to speed into Standard, Sonic (Speed- 20Hz to 20,000Hz), and Ultrasonic(>20,000Hz). Sonic waves create high-speed scrubbing strokes and remove subgingival and interdental plaque by cavitational, fluid streaming, and acoustic vibrations. Ultrasonic (Speed- greater than 20,000Hz) works on the principle of piezoelectric emitter and helps in stimulation of the Gingival Crevicular fluid.

Ionic Toothbrush

Ionic toothbrushes work on the principle of iontophoresis and electrophoresis by changing the brushing experience through the use of electric charges. The toothbrush releases ions as they move across the teeth, the majority of them being negative ions.[15] The positively charged particles on the teeth, such as plaque and bacteria, are drawn to and neutralized by the negative ions. The lithium battery present in the toothbrush provides the anions and prevents the bonding by inhibiting the coupling between pellicles and bacteria that is mediated by calcium bridges.

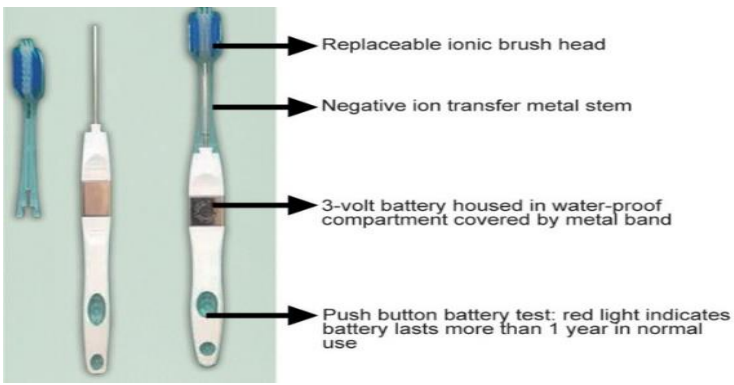

Fig 2: Ionic toothbrush.

Image Courtesy: Int J Clin Pediatr Dent. 2019 Sep-Oct; 12(5): 375–378.[15]

Solar powered toothbrushes

The Soladey-3 solar toothbrush was the first to be developed in Japan. The toothbrush handle is equipped with a solar panel that collects light-emitting electrons and transfers them to the tooth surface. Additionally, it creates a negatively charged shield around the teeth that prevents plaque from sticking between brushes.[16]

Fig 3: Solar powered toothbrush.

Image Courtesy: https://www.coroflot.com/frankd/solar-electric-toothbrush

Laser Toothbrushes

Dentinal Hypersensitivity is one of the most common dental issues. To overcome this, Power-driven toothbrushes have been upgraded to include lasers, which help alleviate hypersensitivity.[17] Using low-level laser therapy (LLLT), the laser toothbrush is a cutting-edge dental tool. It utilizes a low-level, safe semiconductor laser to target the afflicted area. It works by stopping the conduction of impulses through dentinal tubules and thus helps in reducing dentinal hypersensitivity.

Fig 4: Laser toothbrush.

Image Courtesy: Low-Level Laser Therapy in Dentistry. International Journal of Laser Dentistry.[17]

Disposable Toothbrushes

These are single-use toothbrushes with disposable heads that are suitable for travellers, and hospital patients.[18] A disposable toothbrush typically measures between 6 and 7 inches in length. Some are "pre-pasted," meaning that a smaller amount of toothpaste has already been applied.

Chewable Toothbrushes

These unique toothbrushes are designed to be chewed, making them ideal for travel or outdoor activities. They are Miniature plastic molded toothbrushes.[19] Frequently employed when traveling, and there is no availability of water. Every brush arrives in its capsule and is ready to use right away which is simple, effective, and efficient.

Fig 5: Chewable toothbrush.

Image Courtesy: Efficiency of chewable toothbrush in reduction of dental plaque in students.[20]

Ecological toothbrushes

The materials utilized in the manufacturing of these brushes are biodegradable. The primary goal is to make these toothbrushes eco-friendly.[21] It is available in various varieties, including ones that fold up and contain plant seeds in the handle that, when buried, sprout into a plant. Another kind of biodegradable toothbrush with a hollow handle that comes from nature is the manual toothbrush made of polyhydroxyalkanoate (PHA).

Specialized Orthodontic Toothbrushes

When receiving fixed orthodontic treatment, teeth are bound in braces, bands, and wires, which can make it challenging to brush correctly and practice good oral hygiene with traditional toothbrushes.[22] As a result, orthodontic toothbrushes have a different design than regular toothbrushes to overcome these challenges. Orthobrushes have bristles that are shorter in length, placed in a V shape and zigzag pattern, and inclined to help with a thorough cleaning.

Toothbrushes With Infused Mineral

Minerals have recently been added to a lot of toothbrushes that are sold commercially; these additions may help with gingival health and oral hygiene. These toothbrushes come in varieties such as those infused with charcoal or neem.

Sulcabrushes

They are made especially to clean teeth around the edges of the gingiva, used to access hard-to-reach places like orthodontic appliances, bridges, crowded teeth's interdental spaces, and third molars.

Connected toothbrush

The connected brush is a developed version of the powered toothbrush. It is linked to a program by wireless technology. Big data analytics and artificial intelligence are coupled with brushing information to improve patient experience and provide feedback on brushing techniques. Smartphone apps for toothbrushes can support behaviour modification by reminding users.

Fig 6: Connected toothbrush.

Image Courtesy: Sonicare Flexcare Platinum Connected Toothbrush » Gadget Flow (thegadgetflow.com)

Interdental cleansing aids

Although brushing is currently the most popular technique for eliminating plaque, Van der Weijden et al.'s systematic evaluation revealed that self-performed mechanical plaque, removal using a manual toothbrush was insufficiently effective for adults with gingivitis.

According to a recently published systematic review by Slot et al., the average effectiveness of plaque removal after brushing is about 42%.

It has been demonstrated that meticulous supragingival plaque control can change the amount and make-up of subgingival and supragingival bacteria. Dahlen et al. provided evidence of this when they discovered that total viable counts of bacteria in both deep and shallow pockets, as well as important species like Porphyromonas gingivalis and Aggregatibacter actinomycetemcomitans, decreased 24 months after the start of a supervised oral hygiene program. A variety of interdental cleaning tools are utilized to help control plaque. These consist of oral irrigators, wooden interdental aids, dental floss, and interdental brushes. Marchesan et al.'s current study offers solid evidence in favor of interdental cleaning devices as a means of fostering positive oral health outcomes.[23] A higher frequency of interdental cleaning (4–7 times per week) was also linked to reduced interproximal periodontal disease. The study also indicated that interdental cleaning is associated with less coronal and interproximal caries, fewer missing teeth, and decreased periodontal disease.

1) Dental floss

It is a thin, flexible strand composed of nylon or plastic filaments. Its purpose is to mechanically eliminate food particles and plaque that become lodged between teeth, particularly in those difficult-to-reach areas.

The creator of contemporary dental floss is Dr. Lewis Spread Parmeley. The American Dental Association states that it can eliminate up to 80% of interdental plaque.[24] Powered or manual flossing devices use battery-operated nylon tips that slide between teeth and help to remove dental plaque. Dental floss is offered in a variety of forms, each meeting distinct needs and preferences.

A) Unwaxed floss

Unwaxed floss is frequently referred to as "regular floss." It is among the most widely utilized kinds of floss. This floss is ideal for patients with narrow areas between their teeth.

In comparison to many other types of dental floss, unwaxed floss is thinner however, it has high chances to break or shred more readily than other materials.

B) Waxed floss

Waxed floss is made up of several thin nylon strands that have been twisted together and coated in wax. The wax strengthens and improves the floss's ability to slide between your teeth.

C) Dental Tape

Dental tape is similar to a floss. Dental tape comes in both waxed and unwaxed varieties. Dental tape is typically useful for those whose teeth are widely apart.

2) Triangular toothpicks

They are available in wooden and plastic forms. The wooden toothpicks are constructed from birch or balsa wood, which moisten in the oral cavity thus making its use more comfortable to the patient. They are used in embrasures classified as Class II or III.

3) Interdental brushes

Interdental brushes are used to clean areas that standard toothbrushes are unable to access, such as the spaces between teeth and the gum line.[25] The bristle head of these brushes is made especially to fit into the spaces between teeth. Compared to floss or sticks, interdental brushes are slightly larger in diameter than the gingival embrasure, they exert pressure on the surfaces of teeth in a wide interproximal space and aid in better plaque control and removal. They are made up of bristles fixed to an angled plastic grip and color-coded from 1 to 7 based on their sizes.

4) Tongue cleaners

A tongue cleaner is a dental hygiene tool used to remove coating from the dorsal surface of the tongue. It is also referred to as a tongue scraper or tongue brush.[26] Anatomical characteristics of the tongue such as its large surface area and lingual papilla help to retain food particles, saliva, dead epithelial cells, and a plethora of microorganisms which mainly include Pervotella intermedia, Spirochetes, P gingivalis, and Candida albicans, all of which must be regularly removed to preserve good oral health and reduce oral malodor. Individuals suffering from periodontal disease are more likely to have a thicker coating on their tongues and a microbial flora that produces more volatile sulphur compounds aggravating the

halitosis, dental caries, and periodontal disease, necessitating the consistent use of a tongue cleaner to preserve appropriate oral health. Tongue cleaners come in a wide variety of forms. They can be circular handles or "rakes" made of plastic or metal straps. Their effectiveness is dependent on the form, size, arrangement, material and contact surface quality.

Oral irrigation devices

An oral irrigator is a device that is frequently referred to as a dental water jet or water flosser. It was originally made available to the public in the 1960s and primarily uses a pulsating water stream to mechanically remove soft debris and detached plaque.[27] Through the assistance in the removal of detached plaque and the dilution of bacterial toxins, it improves gingival health and reduces the pathogenic bacterial load. The mechanism of action involves two phases- The decompression phase and the Compression phase. In the Decompression phase, the water or solution penetrates subgingivally followed by the compression phase wherein the bacteria and debris are expelled from the periodontal pocket. They are available with different irrigating solutions and can be purchased in corded or cordless versions.

Eg Waterpik

The recommended pressure for healthy gingival tissue is 90 psi; if inflamed gingiva is present, a pressure of 50–70 psi is advised. According to Bhaskar et al., the gingiva can tolerate up to 160 psi for 30 seconds at its maximum.

CONCLUSION

Plaque management is one of the key facets of dentistry practice. Without periodontal care, it is impossible to achieve or preserve optimal dental health. The most common technique for removing and managing plaque is mechanical plaque control, in which toothbrushes play a major part. From sticks to brushes, we've come a long way, and incorporating technology into this profession now has the potential to significantly improve people's overall dental health.

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