

## Era of "Smart Toothbrushes"

Kuldeep Sharma<sup>1\*</sup><sup>1</sup>Post Graduate Student, Department of Orthodontics, Rajasthan Dental College, Jaipur, India.

## ABSTRACT

**Background:** Toothbrushes are an adjunct part of daily life being oldest and simplest method for maintaining oral hygiene. Explaining correct way of brushing and to keep a check on it, was a challenging task for the dentists in the past. This problem led to dental as well as periodontal problems. Now the new smart technology is used in toothbrushes that not only offer different brushing modes for polishing, massaging and cleaning but can also wirelessly connect to a mirror-mounted LCD display which monitors for regular brushing with timer and pressure measuring sensor. New Ionic toothbrushes have also been introduced which are helpful in removing plaque more effectively.

The purpose of this paper is to discuss how the technological advancements have entered in dentistry and to show the future of oral hygiene maintenance in patients for keeping a record of every patient for better patient compliance and to prevent periodontal problem and hence delivering better treatment.

**Keywords-** Oral Hygiene, Smart toothbrush, Ionic toothbrush

## INTRODUCTION

The toothbrush as we know it today was not invented until 1938. However, early forms of the toothbrush have been in existence since 3000 BC. Ancient civilizations used a "chew stick," which was a thin twig with a frayed end. These 'chew sticks' were rubbed against the teeth. The bristle toothbrush, similar to the type used today, was not invented until 1498 in China. The bristles were actually the stiff, coarse hair taken from the back of a hog's neck and attached to handles made of bone or bamboo.

Boar bristles were used until 1938, when nylon bristles were introduced by Dupont de Nemours.<sup>8</sup> The first nylon toothbrush was called Doctor West's Miracle Toothbrush. Later, Americans were

influenced by the disciplined hygiene habits of soldiers from World War II. They became increasingly concerned with the practice of good oral hygiene and quickly adopted the nylon toothbrush.

Some other interesting toothbrush facts<sup>7</sup>:

- The first mass-produced toothbrush was made by William Addis of Clerkenwald, England, around 1780.
- The first American to patent a toothbrush was H. N. Wadsworth, (patent number 18,653,) on Nov. 7, 1857.
- Mass production of toothbrushes began in America around 1885.
- One of the first electric toothbrushes to hit the American market was in 1960. It was



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\*Correspondence: Dr. Kuldeep Sharma

Plot No. 287, Tagore Nagar, Near, Ajmer Road, Heerapura, Jaipur, India.

E-mail: nowkuldeeps@gmail.com

marketed by the Squibb company under the name Broxodent.

This article reviews about tooth-brush history, recently used toothbrushes and then gives light on futuristic approach to toothbrushes.

## 2. Historical background

Ancient religious and medical texts have described cleaning teeth using twigs of aromatic trees, sponges, cloths, mouthwashes, and dentifrices. Pig bristle from China and Russia was used in toothbrushes until the 1940s, when shipments were interrupted by World War II and synthetic filament took its place. Chinese are credited with the invention of the bristle toothbrush in 1498.

The toothbrush handle was fashioned from either bone or bamboo and its bristles came from the neck of a boar or hog. Boar bristle toothbrushes remained as standard until the nylon bristle was invented and mass-produced in 1938. A variety of oral hygiene measures have been used since long.<sup>2</sup> A recent archaeological dig has found that the earliest use of toothbrushes may have occurred in Africa. It was discovered that a bristle toothbrush had been used there as early as 1600 B.C.

The first non-bristle toothbrush was found in China during the Tang Dynasty (619–907) and used hog bristle.<sup>3,4</sup> In 1223, Japanese Zen master Dōgen Kigen recorded on *Shōbōgenzō* that he saw monks in China clean their teeth with brushes made of horse-tail hairs attached to an ox-bone handle. The bristle toothbrush spread to Europe, brought back from China to Europe by travellers.<sup>5</sup> It was adopted in Europe during the 17th century.<sup>6</sup> Many mass-produced toothbrushes, made with horse or boar bristle, were imported to England from China until the mid-20th century.<sup>5</sup> The earliest identified use of the word toothbrush in English was in the autobiography of Anthony Wood, who wrote in 1690 that he had bought a toothbrush from J. Barret.<sup>7</sup>

### 2.1 18<sup>th</sup> Century Toothbrushes

In 18<sup>th</sup> century bone handled toothbrush was used. The handle was oval in cross-section, slightly curved, with a rounded and angled end. The head of the brush was missing, having broken off

where the handle narrows. While it was possible the bone handle was from some other personal item belonging to Jefferson, it more closely resembled toothbrushes of that period than any other type of toiletry implement. In 1723 hog bristle toothbrush came in use.<sup>7</sup>

### 2.2 Moving Towards 19<sup>th</sup> Century

This 19th-century bone toothbrush was excavated from the site of the Public Hospital. The hospital was the first mental institution built in English North America

The first patent for a toothbrush was by H. N. Wadsworth in 1857 (US Patent No. 18,653) in the United States, but mass production in the United States only started in 1885. The rather advanced design had a bone handle with holes bored into it for the Siberian boar hair bristles. Unfortunately, animal bristle was not an ideal material as it retained bacteria and did not dry well, and the bristles often fell out. In the United States, brushing teeth did not become routine until after World War II, when American soldiers had to clean their teeth daily.

### 2.3 20<sup>th</sup> Century

During the 1900s, celluloid handles gradually replaced bone handles in toothbrushes.<sup>3</sup> Natural animal bristles were also replaced by synthetic fibers, usually nylon, by DuPont in 1938. The first nylon bristle toothbrush, made with nylon yarn, went on sale in February 24, 1938<sup>7</sup>. As of the turn of the Twenty-First Century, nylon had come to be widely used for the bristles, and the handles were usually molded from thermoplastic materials.<sup>2</sup>

Johnson & Johnson, a leading medical-supplies firm, introduced the "Reach" toothbrush in the middle 1980s. It differed from previous toothbrushes in three ways: First, it had an angled head, similar to dental instruments, to reach back teeth; second, the bristles were concentrated more closely than usual to clean each tooth of potentially carogenic (cavity-causing) materials; and third, the outer bristles were longer and softer than the inner bristles to clean between teeth. The Reach toothbrush was the first to have a specialized design intended to increase its effectiveness.

Many unique design features intended and promoted as being, more effective than the basic toothbrush design that had been employed for years. (Fig.1)

### **a) Electric toothbrushes achieve much greater reliability using reed sensors**

The first electric toothbrush, the Broxodent, was invented in Switzerland in 1954<sup>10</sup>. For years manufactures of electric toothbrushes have used mechanical slide switches to power the toothbrush on and off. The mechanical slide switches are subject to very harsh environments having to deal with chemically active toothpastes, acidic saliva, and running water at various temperatures and acidity/alkalinity levels. This environment attacks the electrical contacts in the slide switch and in many cases, after a short time the slide switch fails to turn the toothbrush on and off. Going to a Reed Sensor has eliminated this problem. (Fig.2)

#### **Features**

- Contacts dynamically tested
- Magnet and switch are isolated by the toothbrush casing
- Permanent magnet is not affected by the environment
- Millions of operations reliably
- Reed contact is sealed in the casing of the toothbrush
- Reed contact never comes in contact with the outside environment
- Reed switch is hermetically sealed
- Surface mount or through hole mounting

### **b) INTERDENTAL BRUSH**

An interdental brush, also called an interproximal brush or a proxy brush, is a small brush, typically disposable, either supplied with a reusable angled plastic handle or an integral handle, used for cleaning between teeth and between the wire of dental braces and the teeth. Brushes are available in a range of widths, color coded as per

ISO 16409. Interdental brushes are classified according to ISO standard 16409:2006. The ISO brush sizes range from 1 to 7. The ISO brush size is determined by the Passage Hole Diameter (PHD) in mm. This PHD is the minimum diameter of a hole that the interdental brush will pass through without deforming the brush wire stem.(Fig.3)

### **3) 21<sup>st</sup> CENTURY-Smart Era Smart Toothbrushes**

#### **a) ULTRASONIC TOOTHBRUSHES**

Emmi-dent is the first ULTRASONIC toothbrush which works motionlessly with its non-abrasive nano-bubble toothpaste to kill bacteria, reduce periodontal disease, and remove stains. As an ultrasonic rather than an electronic toothbrush, It reduces plaque and periodontal disease by destroying bacteria, It removes stains of coffee, wine, nicotine and food, returning teeth to their natural white color within days. It works under braces by cleaning and removing stains.

After dental reconstruction or any kind of oral surgery, one can brush once teeth with no fear of pain, bleeding, abrasion or wear factors and gentle for children. It cleans gingival pockets that even dental floss cannot reach. Researchers have designed a toothbrush that cleans teeth by creating a solar-powered chemical reaction in the mouth, doing away with the need for toothpaste Dr. Kunio Komiyama, a dentistry professor emeritus at the University of Saskatchewan, designed the first model of the unconventional toothbrush 10 years ago.

The Soladey-J3X has a solar panel at its base that transmits electrons to the top of the toothbrush through a lead wire. The electrons react with acid in the mouth, creating a chemical reaction that breaks down plaque and kills bacteria. The toothbrush requires no toothpaste, and can operate with about the same amount of light as needed by a solar-powered calculator. The researchers have already tested the toothbrush in cultures of bacteria that cause periodontal disease, and demonstrated that the brush causes "complete destruction of bacterial cells," Komiyama said. (Fig.4a,4b)

#### **b) Ultra Violet Sterilized Toothbrush System**

The ultra violet sterilized toothbrush system concept will certainly be helpful for those

who have the habit of keeping everything clear and germ-free. On an average 10,000,000 bacteria live on a toothbrush. With this UV –Sterilized toothbrush system, UV base will help to sterilize the toothbrush whenever it is placed & can hold up to a quartet of UV pods to keep a small family's toothbrushes safe & bacteria free whenever they are not in use. These toothbrushes have color-coding.

### **c) Ionic Toothbrush that Uses Light and Water to Clean Teeth**

Ionic toothbrushes were developed in Japan and have now become increasingly popular in the US and other countries. Soladey Ionic Toothbrush use novel technology that cleans your teeth using light and water.

Use of the the toothbrush is simple as one just have to expose it to any light source and rinse in the water. This ionic toothbrush is claimed to remove plaque, reduces gum bleeding and bacteria more effectively than traditional toothbrushes.

### **d) Chewable toothbrush**

A chewable toothbrush is a miniature plastic molded toothbrush that can be used when no water is available. They tend to be very small but should not be swallowed. They are most commonly available from bathroom vending machines. They are available in different flavors such as mint or bubblegum and should be disposed of after use. Other types of disposable toothbrushes include those that have a small breakable plastic ball of toothpaste on the bristles, can be used without water and hence proved to be quite handy to travelers<sup>6</sup>.

### **e) End-tufted brush**

An end-tufted brush is a type of toothbrush used specifically for cleaning along the gum line adjacent to the teeth<sup>6</sup>. The bristles are usually shaped in a pointed arrow pattern to allow closer adaptation to the gums. An end-tufted brush is ideal for cleaning specific difficult-to-reach areas, such as between crowns, bridgework and crowded teeth. These End-tufted brushes may also be used around fixed orthodontic appliances, such as braces.

### **f) Beam Toothbrush**

The beam brush is first application connected toothbrush with a sensor embedded to record & map brushing behavior as a saved data which can be used in a personnel management, clinical & gamification environment. It was launched in 2010& its advanced version came in 2012 from beam technologies. Beam brush can collect up to 3 weeks brushing data & upload it wirelessly on android mobile that can be sent or shared with the dentist or can be recorded for subjects own regular check purpose.

Along with tracking record for oral health it use all active two-minute brushing with quadrant indicator which is helpful in oral health information.

### **g) Caries Detection toothbrush**

#### **C-SMART: Toothbrush for Earlier Dental Caries Detection**

C-SMART, an improved version of the modern toothbrush that will be able to tell the users whether they have caries developing on their teeth. To detect the caries, C-SMART uses laser technology that collects reflected light from the caries that is sent to a microcomputer chip in the toothbrush handle. (Fig. 10) This toothbrush is under experimentation & still has to be launched by C-SMART company.

### **CONFLICT OF INTEREST**

No potential conflict of interest relevant to this article was reported.

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Fig 1: Shows different type of toothbrushes

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