



INGENIOUS DESIGN OF TOOTHBRUSH TO AMELIORATE ORAL HEALTH CARE

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Abstract –

The toothbrush, a fundamental tool used for maintaining good oral hygiene is used for accomplishing the goals of plaque control. The continuous invention of new technologies has paved the way for innovation of Rotatable toothbrush for the purpose of removing deposits that build up on tooth surfaces or between the teeth in inaccessible areas. The product design objective in this paper is concentrated on a toothbrush which has an integrated brush head assembly having an upper end, a lower end, a plurality of brush bristles configured on a surface of the upper end; and a handling member rotatably configured with lower end of the brush head assembly. The toothbrush is coupled through a socket ball arrangement to the handling member which allows rotatable head and the handling member to rotate with respect to another.

Keywords: Oral hygiene, Toothbrush, Rotatable Head, Ball and socket mechanism, Inaccessible areas.

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INTRODUCTION:

Oral health is one of the major concerns of dental health care professionals. Promotion of regular oral hygiene can contribute to the maintenance of a functional dentition throughout life.

Dental plaque, an archetypical biofilm composed of a complex microbial community is the aetiological agent for

major dental diseases such as dental caries and periodontal disease. Therefore, regular personal and professional plaque removal measures are important in maintaining oral health. Of all the oral hygiene methods available, toothbrush and dentifrices have been practiced by almost every population and culture around the



world since the distant past for maintaining good oral health.

Since the invention of modern toothbrush in 1930s [Beals D et al 2000], there have been advances in bristle and toothbrushbody material and in the technology of embedding bristles in the toothbrush body to increase their efficiency and promote healthier teeth. As a result of continuous research and development, recently more advanced toothbrushes such as electric rotation-oscillation, sonic, and solar-powered toothbrushes have been invented. These toothbrushes helps to clean teeth more effectively than traditional instruments such as fingers, sticks, and twigs. Tooth brushing efficacy for plaque removal relies on several parameters: motivation and skills of the subject, the use of a brush that fits the mouth allowing it to reach all areas, as well as proper oral hygiene education with instructions on movement, duration and frequency of brushing [Frandsen A et al 1986].

In general, upper and lower labial surfaces have been found to harbour the least amount of plaque, while posterior teeth and interproximal surfaces have the greatest accumulation. However, most brushing techniques commonly employed are not particularly suitable for cleaning posterior teeth and lingual, Palatal surfaces because of complexity with access. Thus it was pivotal to design a toothbrush to compensate and proffer better access to those areas to the farthest extent.

INDICATIONS OF THE PRESENT INVENTION:

To control Plaque

1. At Inaccessible areas of oral cavity
2. In Patients with Poor Manual Dexterity
3. In Individuals with Malocclusion and Ectopically erupted teeth.
4. In Patients with Gingivitis, Periodontitis, Caries

Brushing is more optimal for cleaning facial surfaces of teeth compared to interproximal surfaces [Christou V et al 1998]. This is significant as interdental sites present the highest risk of plaque accumulation, whether anteriorly or posteriorly in the mouth [Lang N.P 1973]. Thus, interproximal surfaces being the predominant sites of residual plaque, are at higher risk of developing periodontal lesions and caries [Claydon N.C et al 2008; Loe H et al 1978]. Clinically, gingivitis and periodontitis are usually more pronounced in interproximal areas than facial aspects.

Innovation is recognized as a mandatory requirement to enhance, distinguish and differentiate the products offered to create additional value as perceived by the patient within the fast changing business environment. Hence an attempt was made to design an ergonomic novel rotatable toothbrush. The present innovation relates to improvement in toothbrushes. In particular, it relates to an improved toothbrush provided with a rotatable head for the purpose of removing deposits that build up on tooth surfaces or between the teeth in inaccessible areas.

To aid in plaque control, the proposed toothbrush includes an interdental brush that may be detachably attached at a lower end of the handling member. Such an interdental brush is convenient for the patient to have all the features in a single-handle as this also enables cleaning of the interdental areas.

DESIGN PHILOSOPHY –

a.Mission statement-

To sophisticate the predefined activity of brushing teeth on a daily routine and subdue the limitation of generic toothbrush in terms of extending out to the inapproachable areas of the oral cavity.



b. Project goals

To create an affordable and enhanced toothbrush to enhance accessibility to Posterior teeth along with lingual and Palatal surfaces of teeth and also to support the BASS technique of brushing which will also overcome the limitations of the traditional toothbrush.

c. Product description-

The present Invention relates a toothbrush comprising [Figure 1]: a brush head assembly having an upper end, a lower end, a plurality of brush bristles configured on a surface of the upper end; and a handling member rotatably configured with lower end of the brush head assembly.

The toothbrush is coupled through a socket ball arrangement to the handling member which allows rotatable head and the handling member to rotate with respect to another. The brush head assembly includes a first portion comprising a brush that may be replaceable and a second portion which is rotatably configured with the handling member. Replacing head will be a plug and play, which snugs in and becomes ready to use.[Figure 1.1]

The brush head assembly is configured to rotate at any angle varying 0 degree to 360 degree with respect to one another at about an axis (also referred to as a 15 rotating axis).[Figure 1.2] In other words, one of the handling member and the brush head assembly may be stationary and another one may rotate with respect to the stationary element. When the brush head assembly rotates with respect to the handling member, the rotating axis is parallel to the length of the handling member. The toothbrush comprises an interdental brush detachably attached at a lower end of the handling member.[Figure 1.1]

The brush head may be configured to bend towards the handling member maintaining a bending angle [15 degrees] between an axis along the length of the brush head and an axis along the length of the handling member.[Figure 1.2] Holding the handling member between thumb and index finger and rotating the handling

member makes it easier to rotate in three dimensions, thereby making the toothbrush user friendly

Thus, the present invention provides an improved toothbrush as the rotation and bending of the brush head makes it easier to adapt and brush the lingual and palatal surfaces of teeth which are inaccessible and difficult to perform wrist arm motion. The improved toothbrush facilitates manoeuvring and brushing teeth at an angle to remove plaque in between the gingival lines and also reaches to the posterior tooth in the human jaw. Ergonomic gripping helps users to manoeuvre the toothbrush with their thumb and index finger. Other three fingers are pressing the handling member against the palm to acquire a firm grip of the toothbrush. As a result, sweeping the brush downwards and upwards through wrist arm motion is avoided. The proposed toothbrush is especially useful for patients dexterity issues like arthritis patients.

d. Expected characteristics

- Same size as standard toothbrushes in the market
- Rotatable and Replaceable toothbrush head
- Cost effective
- Similar materials as the standard toothbrush

e. Avenues for creative design

- Improve the maneuvering capabilities.
- Improve ergonomics of holding a toothbrush over a time

f. Project scope/Limitations

Project scope is to improve the brushing techniques in daily life overcoming restricted wrist movement. Limitation of the brush is a small learning curve using this innovation.

2. QUALITY FUNCTION DEPLOYMENT

The QFD method is used to find important engineering parameters in the design of toothbrush. Standard QFD method is applied with 10 WHATs and 10 HOWs



parameters. AURELLE TOOB and UltiBrush [3] are used as references. QFD shows following parameters are more important in design.

1. Moderate length of toothbrush
2. High bristle quality
3. Less force to operate and refill
4. Easy assembly

3. CONCEPT GENERATION AND EVALUATION

The process of concept generation comes with understanding user needs and converting needs into the insightful requirement for the functions of the product.

Rapid ideation and prototyping with users we have generated 2 concepts.

- Widely spread bristles that cover the major surface of the teeth and can bend backward and forward from the neck holding the position as set.
- Keep the bristles similar as standard toothbrushes adding a ball socket mechanism at the neck. Which certainly allows you to manoeuvre a toothbrush with two fingers and overcome the limitation of wrist movement.

4. DESIGN AND ANALYSIS

Structural and mechanism design includes an

1. Interchangeable toothbrush head
2. Brush head mount
3. Ball and socket mechanism
4. Toothbrush grip
5. Interdental toothbrush

Working of tooth brush:

As shown below in the Diagram 1, Toothbrush consists of standard bristles head which is mounted on a connecting socket making it replaceable. Part A and B can be fused together and made one while manufacturing. Toothbrush grip is integrated with the ball and socket with the brush head mount. Coming together these mechanisms allows one to move brush head smoothly 360 degree on its axis bending up to 15 Degrees. Every action in the product is controlled by Index finger

and Thumb which overcomes wrist movement limitation and offers better reachability to all surfaces of the teeth.

ADVANTAGES OF THIS INVENTION:

1. The present invention provides a toothbrush having a head that can rotate as well as bend with respect to the handling member so that accessibility to all the surfaces of teeth is made easy
2. This toothbrush has a head that has replaceable heads of small, medium, and large size depending on preference of the user.
3. Interdental brush is attached at the lower as it makes convenient for the patient as it makes convenient for the patient to have all the features in a single-handle

Summary and Outlook:

Proper technique of toothbrushing is most impactful to oral health. Design of a toothbrush is accomplished by a well known product design principles which enhances designers intuition. The toothbrush designed consists of a rotatable head which rotates 360 degrees and also bends at an angle of 15 degrees to gain accessibility to all surfaces of teeth for enhanced plaque removal. It also has a n interdental brush which makes it user friendly as it combines all the features in a single handle. What makes the brush special is when you grip the handle, it automatically positions the bristles at a 45-degree angle to the gum line which is the best angle for effective brushing as stated by scientific evidence.

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FIGURES:

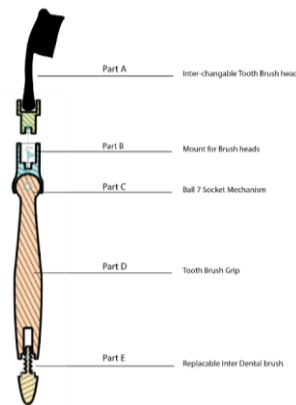


Diagram 1

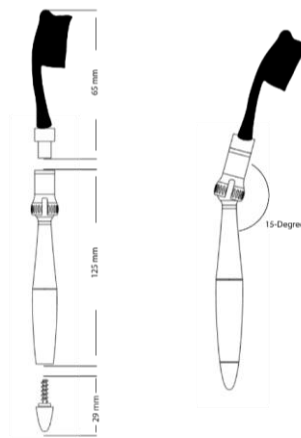


Diagram 1.1

Diagram 1.2

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1. Dr. Gowri Pendyala- concept and design
2. Dr. Saurabh Joshi- concept and design
3. Dr. Ganesh GK- Data collection and Analysis
4. Dr. Dhananjay Gandage- writing the paper
5. Dr. Ameet Mani- Editing the Paper