RESEARCH ARTICLE

Analysis of bristle design of commercially available tooth brushes by using scanning electron microscope

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Abstract

Objective: To compare the bristles of five toothbrushes types and to recommend the best design among them.

Methods: The study was conducted at Hamdard University Dental Hospital, Karachi, from June 2017 to February 2018, and comprised five different types of commercially available manual toothbrushes. Five toothbrushes from each of the selected brands were procured from a supermarket taking care that all brushes from similar brands had the same manufacturing batch number and date of manufacturing. The five types were coded as SN, SHD, CG, OB and PAD. Each of the bristle obtained from the toothbrushes was mounted on a glass slide and secured using cover slip. Scanning Electron Microscope was used to check the morphology of the bristle which was scored with Silverstone and Featherstone scale. SPSS 22 was used for data analysis.

Results: Of the 356 bristles obtained, there were SN 72(20.2%), SHD 64(18%), CG 76(21%), OB 78(22%) and PAD 66(19%). Morphology of SN was 66(91.66%) and that of CG62(81.57%), followed by SHD51(79.68%), OB 48(61.53%) and PAD 38(57.57%).

Conclusion: Within the limitations of the study, SN toothbrush showed best bristle-end morphology.

Keywords: Toothbrushes, Bristle design, Scanning electron microscope. (JPMA 70: 248; 2020) **https://doi.org/10.5455/JPMA.11418**

Introduction

Dental hygiene is one of the most important aspects of dental caries prophylaxis and a very important factor to preserve healthy teeth.[1] This disease may be prevented through professional and personal oral hygiene measures.[2] Among all the methods of maintaining good oral hygiene, toothbrushing is one of the most common and the most popular method.[2] To achieve good oral hygiene, good toothbrush, regular use and correct technique are equally important.[2] Irrespective of shapes and designs, toothbrush are most commonly used as a toothcleaning tool.[3] In the last decade, various designs of toothbrush have been available, with all of them claiming superiority over the rest in terms of plaque removal ability.[4] In preventing the initiation and progression of periodontal diseases, the role of toothbrushes has been well established.[5] It is commonly seen that the accumulation of microbial plaque results in the development of gingival inflammation and daily removal of plaque may resolve this problem in just a few days.[6,7] Usually patients who do not take professional advice regarding the type of brush to be used choose brushes based on advertising claims, availability, family tradition or habit and cost.[8,9] Different designs of toothbrushes available in the market may confuse the common man but the best choice of design can only be accomplished through professional advice.[10] While selecting a good toothbrush, bristle design is perheps the most important consideration.[11] Most common bristle designs include multilevel, flat trim, zigzag and wavy design but there is no evidence of superiority of one design on the other design.[6,12,13] New manufacturers make newer designs and claim it to be the best, but dental professionals must have knowledge about these brands so that they may advise their patients properly.[14] Regarding the efficacy of manual toothbrushes, several studies have been conducted.[7,12]

The results, however, are inconsistent, as some studies have reported some brands to be superior, but overall consensus is that there is no one superior design of toothbrush available for plaque removal.[15] The current study was planned to compare the bristle design of five different types of toothbrushes and to recommend the best design among the selected brands.

Material and Methods

The study was conducted at Hamdard University Dental Hospital, Karachi, from June 2017 to February 2018, and comprised five different types of commercially available

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Table-1: Evaluation criteria for scoring Scanning Electron Microscope.

S.No.	Score	SEM Evaluation criteria
1	Score 1	New appearance, acceptable round ended bristles, smooth bristle surface, no surplus acrylic, bristles standing straight and even, no split ends.
2	Score 2	Slight signs of wear, bristles standing rounding to flattening, but recognizable end rounding (only few not rounded or badly rounded bristles), no surplus acrylic, little surface roughness, no split ends yet.
3	Score 3	Clear signs of wear, bristles worn on one side (lance formed), tapered bristle ends, surplus acrylic, a lot of surface roughness, order of tufts no longer recognizable, slight end splitting
4	Score 4	Clear signs of wear, bristles worn on both side (lance formed), tapered bristle ends, surplus acrylic, a lot of surface roughness, order of tufts no longer recognizable, slight end splitting

manual toothbrushes. These toothbrushes were different in their pattern of bristle arrangement. The toothbrushes were purchased from a supermarket having the same manufacturer batch number coded. Number of rows and tufts were counted in each toothbrush. Middle tufts were taken and bristles were counted. Each toothbrush was given a code to eliminate biasness in the study. Sensodyne was coded SN, Shield SHD, Colgate CG, Oral B OB and Protect ABC Dino was PAD. Bristles were obtained from all the toothbrushes. While removing the bristle of the toothbrushes with surgical scissor, every precaution was made not to damage the morphology of the bristle design. Each bristle was mounted on a glass slide and covered with the cover slip carefully. Scanning Electron Microscope (JSM -6380A JEOL, Japan) was used to check the morphology of the bristles which were scored using Silverstone and Featherstone scale (Table-1).[16]

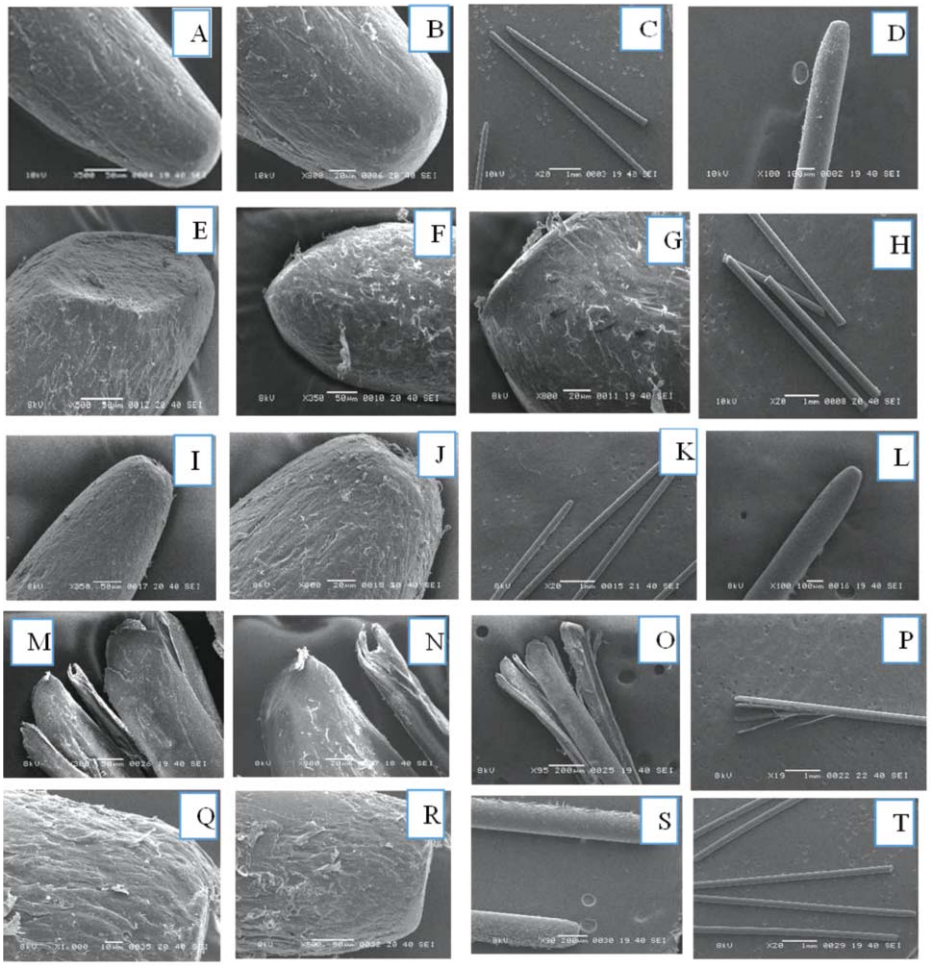

Figure: A, B, C, D showing Sensodyne (SN) toothbrushes; E, F, G, H showing images of Shield (SHD) toothbrushes; I, J, K, L showing images of Colgate (CG) toothbrushes; M, N, O, P showing images of Oral B (OB) toothbrushes; and Q, R, S, T showing images of Protect ABC Dino (PAD) toothbrushes.

Data was analysed using SPSS 22. Descriptive analysis was used to assess the end-rounding morphology to differentiate between the acceptable and non-acceptable bristles.

Results

Of the 356 bristles obtained, there were SN 72(20.2%), SHD 64(18%), CG 76(21%), OB 78(22%) and PAD 66(19%). Morphology of SN was 66(91.66%) and that of CG was 62(81.57%). Both these types had round-ended, smooth texure bristles standing straight and even, and there was no split-end. Morphology of SHD was 51(79.68%). It had acceptable bristle morphology with slight signs of wear. The bristles were standting rounding-to-flattening with recongnizable end-roumding, but there were no split-

Table-2: The number and percentage of acceptable versus non-acceptable bristles of five toothbrushes.

Tooth brush	No of bristle examined (n)	Acceptable (%)	Non Acceptable (%)
SN	72	66(91.66%)	6(8.33%)
SHD	64	51(79.68%)	13(20.31%)
CG	76	62(81.57%)	14(18.42%)
OB	78	48(61.53%)	30(38.46%)
PAD	66	38(57.57%)	28(42.42%)
Total	356		

SN: Sensodyne
SHD: Shield
CG: Colgate
OB: Oral B
PAD: Protect ABC Dino.

ends. OB 48(61.53%) had acceptable bristle morphology with tapered bristle design, surplus of acrylic, a lot of roughness and considerable split-ends, while PAD 38(57.57%) had flat-ended bristles and rough texture. But there werr no split-ends (Figure).

Discussion

Toothbrush plays an important role in maintaining oral hygiene. To reduce gingival tissue damage, round-tipped bristle are remommended.[17] Other shapes are associated with cementoenamel junction and gingival recession.[11] Therefore, while replacing old toothbrush with a new one, these factors should be kept in mind. Collectively, every toothbrush is designed for mainataining good oral hygiene irrespective of the brushing technique used[8.] These different bristle designs help in removing the plaque from the tongue and the interproximal area as well.[19]

In the current study, bristle design morphology was evaluated using scanning electron microscope due to its high magnification. There was a vast variation in bristle design morphology ranging from rounded ends to sharp edges, which is also mentioned in literature.[20]

The percentage of acceptable bristle morphology varied among the 5 different brands studied, ranging from 57.57% to 91.33% which is in agreement with a study[16] which found acceptable range of filament between 22% and 88%.[16] Moreover, in line with previous studies, the current study also showed that the percentage of acceptable versus non-acceptable bristle design morphology differed in each brand. However, the current study showed that CG had a better bristle tip design morphology than OB, which is in agreement with a previous study.[21] This difference may be due to the worsened bristle morphology of the OB toothbrush. In the present study SN toothbrush showed the highest acceptable percentage i.e. 91.33%.

However, PAD showed spiky bristle-end. Sometimes these spiky-end microfine bristles may be acceptable and related to those individuals with sensitive teeth and sometimes they are classified as unacceptable since they are not compatible with the criteria used. OB and SHD also had less acceptable bristle morphology. Such round-end morphology of the bristles of these brands may be due to wear.[22] Moreover, some studies have reported that the risk of soft tissue trauma is caused by unacceptable bristle morphology design which can increase in handicapped individuals owing to uncontrolled brushing movements.[12] The same fear should apply to healthy children, since individuals under 8 years of age lack adequate manual skills.[3] It is not necessary that soft toothbrush with unacceptable bristle morphology will lead to soft tissue injuries.[3,23]

Limitations of this Study

Study is that only five brands of toothbrushes were used and only one gadget i.e. Scanning Electron Microscope were used to check the morphology of the bristle design.

Conclusion

Within its limitations, the study found SN toothbrush to have the best bristle-end morphology.

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Conflict of Interest: None.

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