Toothbrush Design Appropriate For Pre-Elderly: The Relationship Of The Number Of Toothbrush Bristles To Oral Hygiene

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ABSTRACT

Background: *The increase in the elderly population leads to a decline in their health and affects the productivity and quality of life. Preventive measures must be taken to improve oral hygiene for the elderly starting from the pre-elderly group so that later it will form healthy and productive elderly. One of the efforts to improve dental hygiene and health is through mechanical tooth cleaning with a toothbrush. However, currently, there is no toothbrush design that is suitable for the condition of the pre-elderly oral cavity. Therefore, it is necessary to analyze the design of the number of toothbrush bristles as initial research to obtain an appropriate toothbrush design for the elderly.*
Method:*The study was conducted on 30 participants using a toothbrush with a number of toothbrush bristles paths: with 4 paths, 3 paths, and 2 paths. The effectiveness of tooth brushing hygiene was measured through the debris index before using a toothbrush and after brushing.*
Result: *The results of the Kruskal Wallis test showed a significance value of 0.01 (p <0.05), indicating significant differences in the 4-paths, 3-paths, and 2-paths toothbrush bristles groups. To find out the differences between groups, it was continued with the Mann-Whitney test. The results of the Mann-Whitney test show that there is a significant difference in the ability to clean debris on 3-path and 2-path toothbrush bristles.*
Conclusion: *3-paths toothbrush bristles have better effectiveness than 4-paths and 2-paths toothbrush bristles.*

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INTRODUCTION

Life expectancy in developed countries has increased sharply and the proportion of elderly in the population is increasing.[1,2] According to the World Health Organization (WHO), the elderly are classified into four groups: pre-elderly between 45- 59 years, elderly between 60-74 years, elderly between 75-90 years, and very old elderly at 90 years and above.[3,4] The number of elderly people in Indonesia in 2019 was 9.6% or around 25.6 million Indonesians and is predicted to increase to 48.2 million in 2023.[4]

The increase in the elderly population raises complex problems, especially health problems. Declining health affects the productivity and quality of life of the elderly.[5] Oral health of the elderly is important because it can cause other diseases.[4] Tooth loss is a common oral health problem in the elderly, which has a negative impact on the quality of life.[6,7] Oral health plays an important role in obtaining general health and quality of life of the elderly. Riskesdas (2018) showed that the prevalence of tooth loss in the 45-54 age group was 23.6%, the 55-64 age group was 29% and increased to 30.6% in the over 65 age group.[8] This shows that dental disease increases with age and has an impact on the decline in health and quality of life. The greater the number of missing teeth can interfere with the comfort of the elderly when eating. The elderly tend to prefer soft foods and when consuming hard foods sometimes cause pain. The elderly who have lost their teeth tend to use their gums to bite or chew food.[9] Therefore, preventive measures must be taken to improve the oral hygiene of the elderly community. In this preventive framework, efforts to improve the dental hygiene and health of the elderly must start from the pre-elderly group.[1] The hope is that later when the pre-elderly get older and enter the elderly period even until the old elderly period, their oral health remains optimal. This condition will support the digestive system and the quality of life of the elderly.

One of the efforts to improve dental hygiene and health is through mechanical tooth cleaning with a toothbrush. The method used to maintain oral hygiene mechanically is through cleaning using a toothbrush. Toothbrush is an oral cleaning tool that is most often used by the public. The American Dental Association (ADA) states that one of the requirements of a toothbrush is the number of paths of the toothbrush bristles between 2-4 paths.[10] The results of our previous research conducted on pre-elderly and elderly groups stated that one of their problems was an ineffective toothbrush.[11] This is due to considerable tooth loss and the remaining teeth are in a state of caries and root residue, so a toothbrush that suits their condition is needed.[4,11,12] Currently, there is no toothbrush design that is suitable for oral conditions and specifically used for the elderly. Therefore, the purpose of this study was to analyze the design of the number of toothbrush bristles paths on the dental hygiene of the elderly. These results will form the basis of a toothbrush design specifically used by the entire elderly group.

RESEARCH METHOD

The research method is experimental with a pre test and post test design. All the procedures done in this empowerment were approved by This study was conducted after obtaining approval from The Ethical Committee of Medical Research, Faculty Of Dentistry, University of Jember (number 1649/UN25.8/KEPK/DL/2022). The population of this study was pre-elderly people who came to the elderly integrated healthcare center. The criteria for research respondents include: The respondents aged 45-59 years, still have teeth 11, 16, 26, 31, 36, and 46, in good physical and mental health. Based on Roscoe's guidelines for determining sample size obtained the number of respondents were 30.[13] The respondents who fulfilled the criteria were selected by cluster random sampling method . A total of three groups of elderly were randomly selected and respondents were randomly assigned to each group. The respondents filled out questionnaires and debris index were carried out before brushing and after brushing. The study variables consisted of the number of toothbrush bristle paths and the debris index. The number of toothbrush paths consisted of 3 groups, namely: 4 toothbrush bristle paths, 3 toothbrush bristle paths, and 2 toothbrush bristle paths.

Each respondents was examined for debris index before using a toothbrush and after brushing. After data collection on brushing with 4 paths of toothbrush bristles, the respondents were instructed to rest and eat the food before starting the debris index examination. The debris index measurement was based on the calculation by Greene and Vermilion, as follows: The examination was carried out on 6 teeth, namely on the facial surfaces of teeth 16, 11, 26, 31, and on the lingual surfaces of teeth 36 and 46. DI-score per person was obtained by summing up all the results of the debris index of the teeth divided by the number of teeth examined.

The examination used an explorer which was placed incisal and then moved cervically to get the score on the teeth examined, with a score of 0-3 on each tooth examined (Figure 1).
Score 0: No debris or stain was found on the tooth surface.
Score 1: Debris is found at 1/3 incisal cervical or stain covering the tooth surface
Score 2: Debris is found up to 2/3 incisal cervical
Score 3: Debris exceeds 2/3 of the incisal cervical

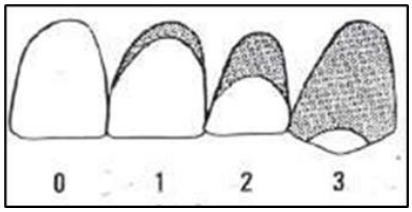

Figure1. Debris-Indexed Criteria

Clinical levels of dental and oral hygiene levels of debris are categorised as follows:
0.0 - 0.6 = Good
0.7 - 1.8 = Moderate
1.9 - 3.0 = Poor
The data obtained, namely the debris index before and after brushing with a 4-path, 3-path and 2-path toothbrush bristles were analysed by statistical analyze.

RESULTS

The elderly as participant of this study come from the Jember Regency area without distinguishing their region of origin. To facilitate data collection, the research was conducted on pre-elderly groups. The results of measuring the ability of 4 path toothbrush bristles, 3 path toothbrush bristles, and 2 path toothbrush bristles can be seen from the difference in the value of the debris index before brushing teeth and after brushing teeth. The percentage of debris index scores on each toothbrush can be seen in Figure 2.

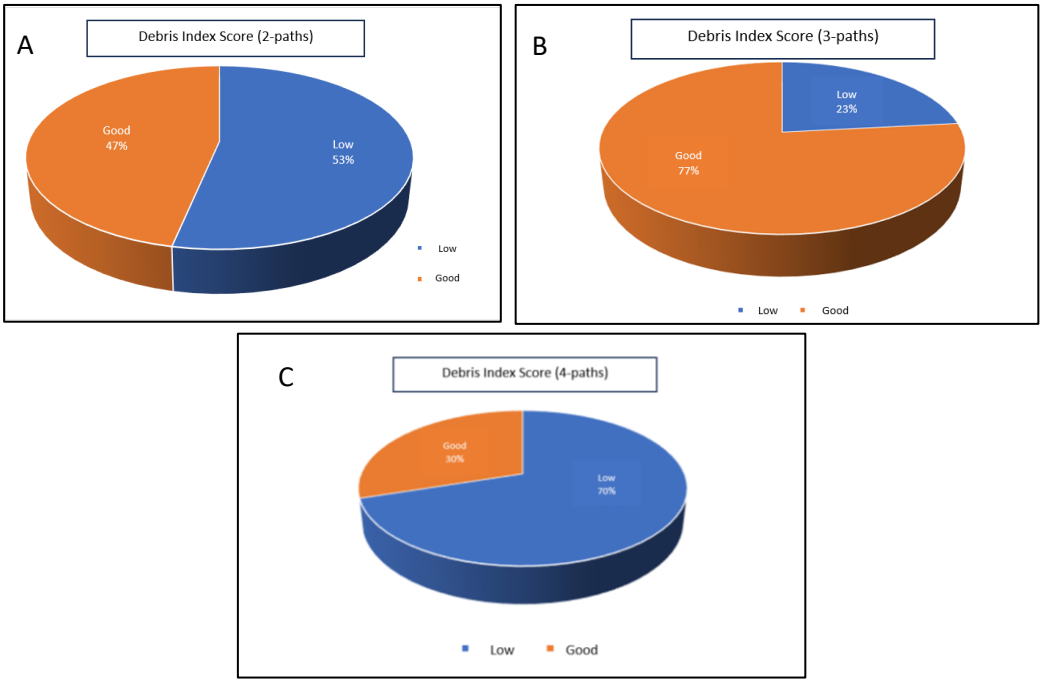

Figure 2. Percentage of Debris Index Score Before Using a Toothbrush (a) 4-paths; (b) 3-paths, (c) 2-paths

Based on Figure 3 showed that the oral hygiene of the pre-elderly included good and moderate categories. This result is the average pre-elderly debris index score before using various types of toothbrush bristles with the same toothbrush duration technique. The results of measuring the effectiveness of tooth brushing on the three types of toothbrush bristles path obtained from the gain between the before and after brushing teeth scores. The measurement results showed in Table 1 and Figure 3.

Table 1. Statistical value of the effectiveness of each type of toothbrush

	n	Mean	Highest Score	Lowest Score	Gain
4 paths	30	0,55	0,97	0,00	0,97
3 paths	30	0,60	1,33	0,27	1,06
2 paths	30	0,28	0,70	0,22	0,42

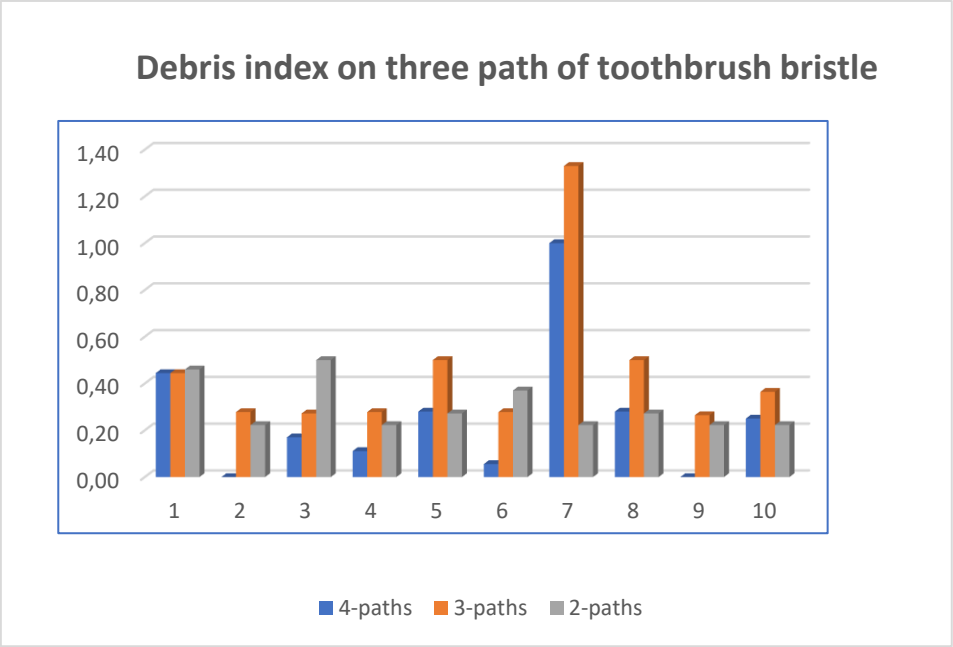

Figure 3. Mean of Difference in Debris Index Pre and Post Toothbrushing in Each Type of Toothbrush

The data that has been obtained then tested for normality and homogeneity to determine whether the distribution of data is normal or not. The results of the statistical analysis show that the normality value for the 4 path toothbrush bristles has a value of $p>0.05$, which means that the data is normally distributed, while the others are not normal ($p<0.05$). The results of the homogenity test showed that the significance of the three types of toothbrushes was 0.00 ($p<0.05$), which means that the data was not homogeneous. To determine the existence of a relationship within the group, the Kruskal Wallis non-parametric test was carried out. The results of the Kruskal Wallis test showed a significance value of 0.01 ($p <0.05$) so there were significant differences in the 4-paths, 3-paths and 2-paths toothbrush bristle groups. To find out the differences between groups, it was continued with the Mann-Whitney test. The results of the Mann-Whitney test show that there is a significant difference in the ability to clean debris on 3-paths and 2-paths toothbrushes.

Table 2. Convenience level of using different type of toothbrush

	n	Pain	No Pain	Uncomfortable	Comfortable
4 Paths	30	20	10	7	5
3 Paths	30	5	15	3	25
2 Paths	30	5	5	20	0

Table 2 shows that out of a total of 30 respondents, there were 20 (66%) participants felt pain when using a toothbrush with 4 paths fiber, and 5 participants (17%) also felt pain when using a 3-paths and 2-paths

toothbrush, and did not there were participants who felt pain when using a double row toothbrush. In addition, there were 7 participants who found it difficult to brush their teeth when using a 4-paths toothbrush, 3 participants found it difficult to brush their teeth when using a 3-paths toothbrush, and 10 participants found it difficult to brush their teeth when using a 2-paths toothbrush.

DISCUSSION

Poor dental and oral hygiene is caused by the presence of debris and plaque that can lead to the onset of gingivitis and long-term exposure to plaque can lead to loss of periodontal attachment.(prasetyowati) Toothbrushing is the most general index of oral hygiene, it can affect the cleaning ability and abrasivity of a tooth surface depending on the hardness of the bristles.[13] Therefore the most important factor that affects brushing effectivity in plaque removal is the toothbrush type.[14] The toothbrush is a prominent tool in mechanical plaque control. Choosing a suitable toothbrush has to be considered on an individual's needs. In tooth brushing, various aspects need to be considered. Choosing the appropriate bristle type is especially important because bristles come in contact with the teeth and gums.[14]

Based on the results, the comparison of the different types (4-paths, 3 paths and 2-paths) of toothbrushes in this study revealed a significant relationship. This study shows that all types of toothbrushes are able to clean the debris, as shown by the difference between the debris index before and after brushing. The bigger difference (gain), the effectiveness of tooth brushing more increase, this is indicated by the decreasing debris index score after tooth brushing.

Three paths toothbrushes have better effectiveness than 4-paths and 2-paths toothbrushes (table 1 and figure 2) because the surface area of the three paths toothbrushes is smaller so that toothbrush can more easily reach the posterior area of the oral cavity. This can be seen from the questionnaire regarding difficulty when brushing teeth. In total, there were 7 respondents who found it difficult to brush their teeth with a standard ADA toothbrush and 3 respondents with a 3-paths toothbrush. Respondents also responded that a 3-paths toothbrush could more easily reach the posterior area of the oral cavity. In addition, the reduced surface area of the toothbrush causes discomfort when the elderly brush their teeth as well. This can be seen from the results of a questionnaire regarding comfort when brushing your teeth. As many as 2 respondents felt no pain when using a standard ADA toothbrush, 7 respondents felt no pain when using a 3-paths toothbrush, and 12 or all participants felt no pain when using a two-row toothbrush. The reduced pain in the oral mucosa caused the participants to be more courageous in brushing the cervical area of their teeth. Therefore, a 3-path toothbrush is more effective for cleaning plaque in the cervical region of the teeth.

Although all participants did not feel pain when brushing their teeth with a 2-paths toothbrush, this toothbrush actually had the worst. This is because a double-row toothbrush has the smallest surface area, so it takes more time to clean the plaque that sticks to the surface of the teeth. In addition, due to the small surface area of toothbrushes, the bristles of 2-paths toothbrushes are less dense when compared to standard ADA toothbrushes and triple-row toothbrushes. As a result, double-row toothbrushes are not good for cleaning plaque in the cervical region of the teeth because they are not strong enough to lift the plaque in the cervical region. This was also supported by a questionnaire about difficulty brushing teeth. This can be seen from the questionnaire regarding the difficulty of brushing teeth. In total, there were 10 respondents who found it difficult to brush with a double-row toothbrush. Based on the respondent's responses, although a double-row toothbrush can reach the posterior area of the oral cavity easily, a 2-paths toothbrush feels less dense and less able to put pressure on the tooth surface. As a result, respondents not only had to brush their teeth longer to keep their teeth clean, but they also had to use more force so that the pressure of the 2-paths toothbrush was strong enough to clean the plaque attached to the surface of the teeth. By increasing the range of choices in toothbrush design, the oral hygiene status of the nation, including the elderly may be improved.[15] Toothbrush design influences an individual's ability to remove dental plaque. The numerous toothbrush designs with a variety of bristles, could affect the efficacy of removing dental plaque.[16,17,18] This will have an impact on dental health and systemic health status in the elderly.

This study has some limitations. The users' skill may result in superior plaque removal irrespective of toothbrush design. We excluded participants who were prone to having problems with motor function. We

suggest that future investigations of the newly designed toothbrushes for elderly individuals should be conducted over a longer duration using an elderly population sample with various levels of manual dexterity.

CONCLUSION

Three-path toothbrush bristles are more effective for cleaning plaque in the cervical region of the teeth and have better effectiveness than four paths and two paths toothbrush bristles.

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