The effectiveness of brushing the teeth using two shapes of toothbrush

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ABSTRACT

Introduction: Dental and oral health or cleanliness is one indicator to measure the effectiveness of brushing teeth, particularly concerning the shape of toothbrushes and the way of brushing teeth. The study aimed to analyse the effectiveness of plaque index decrease before and after brushing teeth between two different toothbrush shapes. **Methods:** The investigation was carried out using single-blind and parallel quasi-experimental methods. The sample comprises 30 people from Bandung City aged between 6 – 7 years old, selected through purposive sampling. The subjects were directly categorized into two groups of treatment. Patient Hygiene Performance Modification (PHP-M) was used to measure the amount of plaque. The data were analyzed using paired t-test and independent t-test. **Results**: The straight-handled toothbrush yielded a score of 11.967 in the paired t-test. This score was higher than the t-value ($t = 2.160$; $p < 0.05$. The angled-handled toothbrush had a score of 7.385 in the paired t-test. The score was higher than the t-table ($t = 2.131$; $p < 0.05$). The statistical analysis using an independent t-test yielded a score of 1.814, which was lower than the t-table ($t = 2.048$; $p > 0.05$. **Conclusion:** It was concluded that there is no difference in the plaque index before and after brushing teeth using the two shapes of the toothbrush.

Keywords: dental care for children; dental plaque index; toothbrushing; toothbrushes

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INTRODUCTION

Plaque control is determined by several factors, including the patient's knowledge of dental and oral health, teeth-brushing technique, and motivation.[1] Mechanical plaque control is very effective in reducing plaque, which in turn will prevent gum inflammation. Mechanical plaque control can be implemented using a toothbrush, tooth floss, interdental brush, and other tools.[2] Education on healthy life should be delivered at an early age. Behaviors and habits that individuals

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form at the early age of life will significantly affect their behaviors and habits in the future.[3]

Soft motor development in children is related to their ability to touch or hold an object using their fingers. At the age of 6 – 7, children generally have adequate coordination skills to brush their teeth.[4] Children's hands are strong enough to hold an object at this age. Soft motor skills develop rapidly when children reach the age of 8 – 10 years old. At this age, children can use their hands efficiently and accurately.[5]

Three primary factors determine the toothbrush's effectiveness to remove plaque; the shape of the toothbrush, the individual's skill in brushing teeth, and the frequency and duration of brushing teeth.[2] Nowadays, toothbrushes come in various shapes, sizes, and texture. The variation in toothbrushes may cause variation in oral health/ cleanliness.[6,7] The present study focuses on the variation of toothbrush handles, including straight handle, angled handle, offset handle, and angled-offset handle.

The importance of this study is to analyze whether there is a difference in plaque index decrease after brushing teeth using an angled-handled toothbrush and that using a straight-handled toothbrush. Thus, the study aimed to determine the effectiveness of plaque index decrease before and after brushing teeth using two different toothbrush types.

METHODS

The research method used a quasi-experimental method, implementing the techniques of parallel study and single-blind study. The procedure involved assessing the subject's plaque index before and after brushing teeth using two types of brush, a straight-handled toothbrush and angled-handled toothbrush.

The sample was taken using the purposive sampling technique and was assessed using plaque index criteria (PI1) from the medium (1,1-2) to inadequate criteria (2,1-3). Inclusion criteria are children between 6-7 years old and healthy condition. Exclusion criteria are children with fixed orthodontic appliance, special need children and not agree to following research. The plaque index was assessed using the Patient Hygiene Performance Modification (PHP-M) method from Kim and Chung because this method was considered suitable to be implemented and accepted by children.[8] The application of the method itself was relatively easy and represents the children's plaque index reasonably well.[8] Purposive sampling to be used for selective sample and subject consisted of 30 students of 6 – 7 years old in Bandung City, distributed randomly into two groups in the same number; the group used a straight-handled toothbrush and the group that uses an angled-handled toothbrush. Each student was provided with a toothbrush and toothpaste to be used at home two times.

The subjects were given instructions and directions on the technique to brush their teeth, i.e., the fones technique, using phantom media. According to Cancro and Fischman in Lindhe, brushing teeth's effective duration is two minutes.[2] The way to put toothpaste on the toothbrush is by placing the tube's lips on the brush and pressing the tube while dragging it along the toothbrush's head. Hence, the toothpaste gets into the gaps in the brush.

The subjects diet was controlled and the schedule to brush their teeth at home independently. For example, they were supposed to brush their teeth two times a day, the morning after breakfast and the evening before bed.[9] The Brushing Teeth Schedule Sheet was provided for the subjects to complete in four days (on the first day, they were toothbrushing in the evening; on the second and the third days, were toothbrushing teeth twice a day; and on the fourth day, they were toothbrushing in the morning).

Evaluation for effectivity of two types toothbrushing in four days according to plaque formation.The subjects were toothbrushing their teeth using a straight-handled toothbrush or angled-handled toothbrush, in accordance to the group they belong. Pre examination of dental plaque has been done according to PHP-M method. After four days, their plaque index was reassessed for evaluation (second plaque assessment/PI2). Then, the subjects were filling in the final questionnaires with assistance from the researcher or teachers.

Statistical calculations were performed by analyzing the average decrease in plaque index in both groups before and after brushing, using the Paired T-Test. A paired t-test was implemented

to analyze the statistically significant difference of plaque index before and after toothbrushing using a straight-handled toothbrush and angled-handled toothbrush. An independent T-test was implemented to analyze the statistically significant difference of plaque index between straight-handled toothbrush and angled-handled toothbrush. Prior to the study, an ethical approval (527/FKUP-RSHS/KEPK/Kep/EC/2018) had been issued by the Ethical Clearance Committee of the Faculty of Medicine Universitas Padjadjaran, Indonesia.

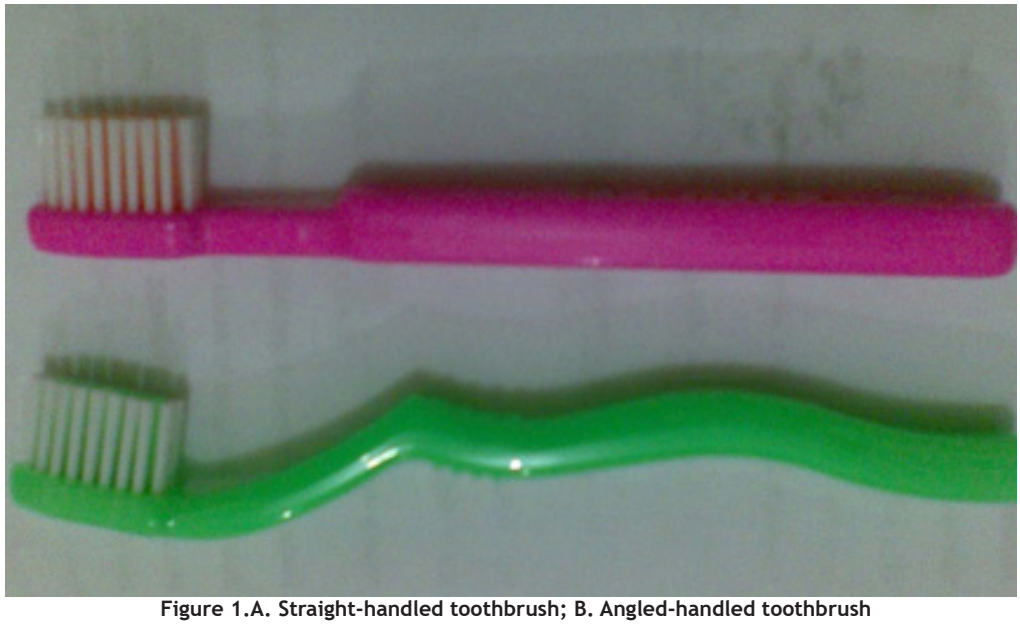

Figure 1.A. Straight-handled toothbrush; B. Angled-handled toothbrush

RESULTS

The data on students' plaque index in Bandung City is obtained through clinical assessment using PHP-M (Patient Hygiene Performance Modification) index. The present study's findings include assessing plaque index before and after brushing teeth using straight-handled and angled-handled toothbrushes on 30 students of 6 – 7 years old. An overview of the data on the difference in plaque index before and after brushing using a toothbrush with straight handle (A) is presented.

Table 1. Index Plaque Average of Straight-Handled Toothbrush and Angled-Handled Toothbrush (n=30)

Group	PI (Before)	PI (After)	Difference
Straight-Handled Toothbrush	4.102	2.263	-1.839
Angled-Handled Toothbrush	4.041	2.644	-1.398

Table 1 shows that the average plaque index after brushing teeth using a straight-handled toothbrush decreases from its previous value. Therefore, we can conclude that the use of a straight-stemmed toothbrush can reduce the plaque index on the teeth. Paired t-test was conducted to determine the statistically significant difference between plaque index before and after brushing teeth using a straight-handled toothbrush,

Table 2. Paired t-Test Before and After Brushing Teeth Using Straight-Handled Toothbrush and Angled-Handled) Toothbrush(n=30

	Plaque Index (PI)	Mean	p-Value
Straight-Handled Toothbrush	Before and after	-1.839	0.000*
Angled-Handled Toothbrush	Before and after	-1.398	0.000*

***significant p-value**

The data in Table 2 shows that the average difference of plaque index before and after using a straight-handled toothbrush was -1.839. Therefore, the negative value (-) on the average difference score indicates decreased plaque index before and after brushing teeth using a straight-

handled toothbrush. The statistical value of the t-score of 11.967 was higher than the t-value of 2.16, with a p-value of 0.000, lower than 0.05. This result supports hypothesis I, which means H0 was rejected, and H1 was accepted. It means that there was a difference in plaque index before and after brushing teeth using a straight-handled toothbrush.

The description of data on the difference of plaque index before and after brushing teeth using an angled-handled toothbrush (B) is presented in Table 3.

Table 3. t-Test of Independent Sample Before and After Using Straight-Handled Toothbrush and Angled-Handled Toothbrush

Treatment	$\bar{b}$	Sb	t-score	t-value (0,05;28)	P-value
Straight-Handled Toothbrush	-1.839	0.575	1.815	2.048	0.08*
Angled-Handled Toothbrush	-1.398	0.733			

***significant p-value**

Table 1 indicates that the average difference of plaque index before and after brushing teeth using an angled-handled toothbrush was -1.398. Thus, the negative value (-) on the difference score indicates decreased plaque index after brushing teeth using an angled-handled toothbrush. The t-score was 7.385, higher than the t-value of 2.131, with a p-value of 0.000, lower than 0.05. This finding supported hypothesis I; the H0 was rejected while H1 was accepted. It means that there was a difference in plaque index before and after brushing teeth using an angled-handled toothbrush. Independent sample t-test analysis was implemented to determine the significance of plaque index difference before and after brushing teeth using a straight-handled toothbrush and angled-handled toothbrush. The result of the statistical analysis is presented in Table 3.

DISCUSSION

There was a difference found in the plaque index before and after brushing teeth using a straight-handled toothbrush and angled-handled toothbrush. In addition, the straight-handled toothbrush did not decrease the plaque index more than the angled-handled toothbrush. The average comparison of the plaque index decrease before and after brushing teeth using a straight-handled toothbrush was -1.839, while the angled-handled toothbrush was -1.398. This comparison indicates that a straight-handled toothbrush decreases plaque index higher than an angled-handled toothbrush. However, the statistical analysis using t-test indicates that the difference is not significant, which means that the two types of the toothbrush have similar effectiveness for reducing plaque.

Some interfering variables cause the insignificant difference between straight-handled and angled-handled toothbrushes. These variables include the individuals' hand coordination skills, inconsistent pressures, the duration and frequency of tooth brushing, diet, and different plaque accumulation tendencies in each individual due to teeth position and jaw curvature. According to Claydon et al.[10], the most dominant factor affecting clean mouth and teeth is individual skills.

The brushing technique used in the present study is the fones technique, which is considered easy to implement by children. However, the young age of the subjects (6 – 7 years old) may cause an optimal understanding of the technique. Also, the motor skills of the subjects are not fully developed yet. These two factors may affect the effectiveness of the brushing teeth mechanism to reduce plaque.

The hand pressure applied when brushing teeth is closely related to the toothbrush's ability to clean the plaque on the teeth' surface. With consistent pressure, it will be easier to remove plaque, particularly in the subjects with high plaque index, i.e., those whose plaque adheres to the teeth' surface. Small or medium pressure levels may remove thin layers of plaque, but they may not eliminate thicker layers.

Therefore, the difference in pressure consistency of the subjects will affect the present study's findings more or less. It is difficult to control this particular interfering variable unless the study employs a pure experimental method using a tool that has consistent pressure to be applied to all subjects.(Table 1). Brushing teeth is one of the forms of soft motor skills, and education on dental and oral health care should be provided at an early age to be a life habit of the children. Dental

and oral health care education may be provided in the form of brushing teeth training. Implementing the training to children will contribute positively to their motor skills development, especially soft motor skills.[11,12,13]

The ability of toothbrushing is according to development of organ. The human body is a complex and fantastic system of organs. All these organs are formed during the prenatal period. Some experts argue that the physical development of an individual consists of four aspects: (1) nervous system that affects the development of intelligence and emotion; (2) muscles that affect the development of physical strength and motor skills; (3) endocrine glands that cause the emergence of new patterns of behaviors, such as in teenagers; and (4) physical/body structure that includes body height, weight, and proportion.[14]It is mention that children can brush the teeth with effectively are conjunctive with this theory.

Children's physical development and growth are marked by motor skills development, both hard and soft skills. Among the critical physical developments during childhood is the continuous development of the brain and nervous system. Although the human brain keeps growing during early childhood, the growth is not as rapid as when he is a baby. From birth to two years old, the average size of the brain is 75% of an adult's brain, and at five years old, the child's brain has grown to approximately 90% of the adult's.[14]

According to Hurlock, when a child reaches five years old, a significant development occurs that allows for better control of smaller groups of muscles used for holding objects, writing, and applying tools. At five or six years old, the coordination of soft motor skills develops rapidly. At this stage, children have been able to coordinate visual-motor movements, such as coordinating the movement of eyes with the movements of hands, arms, and body simultaneously, for instance, when the child writes or draws.[14]

The increase in myelin (nerves cover that helps nerve impulses to move faster) in the central nervous system is reflected in improving hard motor skills during the middle and late childhood period. Children can use their hands and arms better. A six-year-old child can hit objects, lace his shoes, and button up his shirt. At the age of seven, their arms and hands become more vigorous. Children prefer pencils to crayons to write; they also write letters better and smaller. According to Welburry and Duggal, children usually have adequate coordination to brush their teeth effectively at 6 – 7 years old.[14] The frequency and duration of brushing teeth are the following variables that affect the decrease of plaque index on the subjects during the study. Therefore, there is a possibility that brushing teeth' short duration may cause a decrease in its effectiveness to reduce plaque.

Types of food consumed by the subjects affect the rate of plaque adherence on the teeth' surface. For example, high-fibered food is abrasive towards the plaque adhering to the surface of the teeth when it is chewed to help reduce plaque. The higher the starch content in food, the higher the glucose level, which causes caries and periodontal diseases. In addition, the type of food affects the possible level of plaque formed on the teeth.

The fact that the subjects consume rice indirectly suggests that the study's level of plaque formation is relatively high. Another confounding variable is the different tendency of plaque accumulation in each individual affected by teeth position and jaw curvature. At the beginning of the study, scaling was performed on the subjects. Limitation of this study was the inability to be applied for homogenous children in the similar area, which could influence the plaque forming process.

CONCLUSION

There is no difference in plaque index before and after brushing teeth using a toothbrush with two types of handles. The unavailability of dental professionals in the local area may support this finding; despite the subjects' varied initial conditions, their plaque accumulation tendency also varies.

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