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Elastomeric Toothbrushing Aid to Improve the Toothbrushing Skills of Children with Disabilities

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Abstract:- Background: In 12 years old children with disabilities, 30.2% had caries and in 15 years old children it increased by 2.3%.Limited handgrip motor skills in children with disabilities is 0.09% 1.5-3% have such limitations which the incidence is related to socioeconomic status. Therefore, 80-90% of children require assistive devices to facilitate their handgrip motor activities. Objective: To produce a feasible and effective elastomeric tooth brushing aid to improve tooth brushing skills and reduce debris index in children with disabilities. Methods: The study used quasi experimental *(pre-post with control group design)*. The sampling technique was purposive sampling, consisting of 11 children in the intervention group with the application of elastomeric tooth brushing aids and 11 children in the control group with the application of conventional adult toothbrushes, with the length of treatment given 10 days. By making elastomeric tooth brushing aids manually combining elastomeric materials on conventional toothbrush handles. Results: The results of expert validation of elastomeric tooth brushing aids showed a p-value of 0.104 which means that this model is feasible as an effort to improve tooth brushing skills in children with disabilities. This model is effective in improving the teeth brushing skills of children with disabilities (p = 0.041) and reducing the debris index score of children with disabilities (p = 0.000) and reducing the debris index score of children with disabilities (p = 0.000). Conclusion: Elastomeric tooth brushing aids are feasible and effective in improving tooth brushing skills and reducing the debris index of children with disabilities.

Keywords:- *Dental Health, Children with Disabilities, Elastomers.*

I. INTRODUCTION

Dental health is an indicator of overall body health. Dental health conditions that are problematic or unhealthy can affect speech, mastication, and aesthetic functions which can have an impact on a person's activities and quality of life [1]. According to the 2016 Global Burden of diseases (GBD) study, oral diseases affect at least 3.85 billion people worldwide, with permanent dental caries being the most prevalent [2]. The *World Health Organization* shows that the European, Asian and Latin American regions experience more dental caries with differences in the average prevalence of dental caries, namely in the African region (37.3%), in the East Asian region (34.7%) and in the Latin American region (38.6%) [3]. The results of the 2018 Riskesdas show that 57.6% of Indonesians have oral problems with the prevalence of dental caries, which is 88.8% and periodontal disease is 74% with 55.5% experiencing dental caries and 13% getting treatment [4].

Children's dental health problems have long occurred in society. According to the World Health Organization survey data, it is recorded that worldwide 60-90% of children experience dental caries [5]. The phenomenon of child caries also occurs in Indonesia where 76.2% of children have cavities. Furthermore, according to the Indonesian Ministry of Health, 89% of children in Indonesia suffer from dental caries[6].

The impact of dental caries experienced by children will hinder the development of children so that it will reduce the level of intelligence of children, which in the long run will have an impact on the quality of life of the community [7]. The disease will cause disruption to the masticatory function, so that it can interfere with the process of digestion and absorption of food. Dental caries makes children experience loss of chewing power and disruption of digestion which results in less than optimal growth.

Children are vulnerable to caries and other oral diseases that cause reluctance to brush their teeth properly and correctly. Most children tend to brush their teeth carelessly which results in gradual damage to the tooth enamel which ultimately leads to the development of cavities [8]. Children at school age still need the help of parents and family to guide and maintain oral health.

Children with special needs are a group that lacks oral health services. According to United Nations Enable, about 10% of the world's school-age children have special needs. The prevalence of dental caries in children with special needs was found to be 84.6% and the prevalence of periodontal disease was 74.7% [9]. Children with special needs have a low level of oral health compared to normal children. Dental and oral disease is the biggest problem experienced by children with special needs. The prevalence of caries in children with special needs in a study conducted at SLB Taman Pendidikan Islam Medan with 96 children with special needs was 92.71%. It has also been reported that children with special needs in the disability category experience dental caries and oral hygiene, which is 90.87% [10].

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There are 34.9% of motor disorders in children with disabilities in the spastic category (stiffness in the muscles) of the hand grip making it difficult for children to do activities, especially in maintaining dental and oral hygiene. This was encountered in research with the Hand grip method to improve hand muscle ability in spastic category disabled children [11].

Motor limitations in hand grip in children with disabilities occur in the United States according to the Center for Disease Control and Prevention the incidence rate is 3.3% of 1000 children experience these limitations. Whereas in Indonesia according to Riskesdas 2018 children with disabilities who experience motor limitations in hand grip are 0.09% 1.5-3% of 1000 children have these limitations which are related to socioeconomic status. So that 80-90% of some children need assistive devices to make it easier for them to do activities motoriuk hand grip [12].

Children with disabilities, which have an inability of the limbs to carry out their functions caused by the reduced ability of the limbs to function normally due to injury, disease or imperfect physical growth [13]. Children with disabilities are among the most vulnerable populations to oral disease. This is due to the physical inability to clean the oral cavity properly. Children with disabilities also show dependence on parents or caregivers to clean their mouths. Socioeconomic background also affects the dental and oral hygiene of children with disabilities. Research conducted in Turkey on children with disabilities, showed 30.2% had caries and then increased by 2.3% [14].

A global effort to prevent oral health problems in people with disabilities is working with dental organizations and university dental schools by Luc Marcks and Carla Fernandez in Dugoni, San Francisco, USA in 2017. Through the division of oral health and the National Center for Chronic Disease Prevention and Health Promotion, oral health screening and caries prevalence reduction through water fluoridation in people with disabilities were carried out. The results of water fluoridation can reduce the prevalence of caries by 15% and an increase in oral hygiene in care efforts accompanied by parents and caregivers of people with disabilities [3].

According to the Ministry of Women's Empowerment and Child Protection of the Republic of Indonesia in the Guidelines for Handling Children with Special Needs by providing real or functional activities for daily life. The program is structured and consistent. Providing the program must go through stages that are broken down, such as teaching how to brush teeth starting from taking a toothbrush, taking toothpaste, opening the toothpaste lid, pressing the toothpaste tube on the toothpaste cover, brushing the front and back teeth, brushing the left and right teeth and so on [15]. Efforts to improve dental and oral hygiene in children with disabilities have been made by Tiara in 2019, through differences in horizontal and roll brushing methods on plaque accumulation at the Yayasan Pembinaan Anak Cacat (YPAC) Malang. The results showed that, after the brushing method was carried out, the roll method was more effective in reducing plaque accumulation than the horizontal method. Because in the roll method what is done is placing the bristles of the toothbrush on the gingiva leading to the root and with the direction of movement upwards towards the occlusal surface [16].

Recommended in the International journal Mala D, Lousie B M in Melbourne, Australia, this study showed a trend of children being more dependent on caregivers for self-care activities. These recommendations were made regarding the oral health care of children with disabilities namely, greater coordinated efforts should be made between dental, medical and social services to serve their needs. Then individual reminder visits by dental teams to schools should be introduced to take preventive measures, especially for individual children with disabilities who are at high risk of caries or periodontal disease. As well as requiring oral health aids used to provide preventive oral health care [17].

The behavior to maintain oral health is by brushing teeth. It is important for children and parents/teachers to understand when and how to brush their teeth properly. Correct behavior in brushing teeth is related to gender, economic, and residential factors. To avoid oral health problems that occur in the community, especially in children with special needs, the disabled group needs innovation with toothbrush media so that they are able to independently behave in a healthy and clean life in terms of oral health. Therefore, brushing teeth with toothbrush media innovation properly and correctly must continue to be developed specifically in groups of children with special needs, namely the disabled group [18].

Various toothbrush designs have been created to increase the effectiveness of tooth brushing skills. Toothbrush is one of the oral physiotherapy tools that is widely used to clean teeth and mouth. There are manual and electric toothbrushes with various sizes and shapes. Although there are various toothbrushes on the market, the effectiveness of toothbrushes for cleaning teeth and mouth must be considered, such as toothbrush handles that are comfortable to hold / stable, wide enough and thick enough but light enough to be easy to use, soft but strong enough bristle texture, bristle size should not be too wide according to its use, easy to clean and dry quickly, durable and inexpensive [19].

Research on the comparison of manual nion bristle toothbrushes with Thermoplastic elastomer (TPE) bristle toothbrushes in terms of cleaning efficacy and the role of biological potential in gingival health proves the use of Thermoplastic Elastomer brushing aids can reduce plaque index by 21.78%, and reduce OHI-S by 11.59%. In this study, it is also supported that children with special needs physically Thermoplastic Elastomer Bristle Toothbrushes have optimal gingival conditions at the beginning and maintain these conditions after 48 hours of stopping doing dental and oral hygiene at home [20].

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In children with disabilities, there is a functional weakness of the body's organs, especially in this study the lack of grasping function on the toothbrush, so assistance is needed in performing dental and oral hygiene. So a model is needed to help tundaksa children make it easier to do dental and oral hygiene. One of them is media in the form of tooth brushing aids to improve dental and oral hygiene. The combination of toothbrushes with dental materials, namely elastomer, in creating a model of elastomeric brushing aids that make it easier for children with disabilities to perform dental and oral hygiene. With the combination of these balances, it will be able to facilitate the function of the motor organs in the hands and palms of children with disabilities in grasping the model of the elastomeric toothbrushing aid to adjust the grip of their hands to make it more functional when brushing their teeth.

In the first phase of trial research conducted at SLB N Jepara with a problem-solving program for children with disabilities, namely the implementation of toothbrush media with additional elastomeric material to help hold the toothbrush handle in children with disabilities and conduct training to parents or caregivers and teachers at school on how to brush teeth properly and correctly, there were significant changes between the results before and after implementation. The change is that the final data obtained from the debris index examination decreased from 1.53 (poor category) to 1.00 (moderate category).

Based on this background, the researcher is interested in making a tool in the form of a toothbrush with a medical material, namely elastomer combined in the toothbrush handle to adjust the shape of the grip to improve brushing skills in children with disabilities.

II. RESEARCH METHODS AND SAMPLE

This research used *quasy experimental design with pre test and post test control group design*. The sample amounted to 22 children with disabilities consisting of 11 children with disabilities in SLB Negeri Semarang and 11 children in SLB Negeri Ungaran. The sampling technique was purposive sampling.

III. RESULTS AND DISCUSSION

A. Validity Test

The validity test was conducted using the Interclass Correlation Coefisient (ICC) analysis to determine the feasibility of the tooth brushing aids.

Table 1 Expert Validation Test Results

Expert Validation					
Name	**N**	**Value**	**F (%)**	**Average**	**p-value**
Health Promotion Expert	12	58	96.7	95.5	0.104
Pediatric Dental Specialist	12	56	93		
SLB Teacher	12	58	93		

Based on table 1 on the results of the assessment of 3 expert validators, it is known that the data distribution p-value = 0.104, which means that the elastomeric tooth brushing aid is feasible as a media tool for brushing teeth skills in children with disabilities.

B. Univariate Analysis

This study was conducted on 22 respondents of children with disabilities in SLB Negeri Semarang as 11 children as the intervention group and 11 children as the control group.

Table 2 Frequency Distribution of Respondent Characteristics of Intervention Group and Control Group

Variable	Intervention Group		Control Group		Homogeneity Test
	n	(%)	n	(%)	
Gender					
Male	6	54.5	4	36.4	0.275
Female	5	45.5	7	63.6	
Mean ± SD					
Age					
11 years old	6	54.5	0	0	0.107
12 years old	3	27.3	0	0	
13 years old	2	18.3	7	63.6	
14 years old	0	0	4	36.4	
Mean ± SD	2.63± 0.809		3.36 ± 0.504		

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Table 2 The results of the respondent homogeneity test on child gender data in the intervention and control groups obtained a p-value of 0.275 (>0.05) so it can be concluded that the mean gender in this study is the same (homogeneous). In the data on the age of children in the intervention group and the majority control group >11 years, the p-value result is 0.107 (>0.05) so it can be concluded that the average age of children has the same variance (homogeneous).

C. Homogeneity Test

Table 3 Result of Homogeneity Test

Homogeneity		
Variable	**Levene Statistic**	**p-value**
Toothbrushing Skills	0.393	0.759
Debris Index	7.664	0.002

Based on table 3 Homogeneity test on the variable of tooth brushing action of children with disabilities in the intervention group and control group with a p-value of 0.759 (<0.05), meaning that it can be concluded that the action of brushing the teeth of children with disabilities in the intervention group and control group has the same variant (homogeneous). In the variable debris index of the intervention group and the control group with a p-value of 0.002 (<0.05), meaning that it can be concluded that the debris index score of the intervention group and the control group has the same variant (homogeneous).

D. Normality Test

The data normality test aims to determine whether the data collected on each variable is normally or abnormally distributed. Normality testing in this study used the Shapiro-wilk method because the number of samples in this study was less than 50 samples.

Table 4 Data Normality Test of Intervention Group and Control Group

Variable	**Intervention**	**Control**
	p-value	
Pre-test Skills	0,000	0,018
Post-test Skills	0,001	0,018
Pre-test Debris Index	0,302	0,882
Post-test Debris Index	0,126	0,021

Table 4 shows the results of the normality test of children's tooth brushing skills in the intervention group and control group have a p-value <0.05, meaning that the data is not normally distributed so it is continued with non-parametric tests. The results of the normality test of the debris index score of children with disabilities in the intervention group and control group mostly have a p-value> 0.05, meaning that the data is not normally distributed so it is not continued with non-parametric tests.

E. Effectiveness Test

Table 5 Test of Effectiveness of Tooth Brushing Measures for Children with Disabilities

Statistic				
Variable	**Group**	**Mean ± SD Pre test**	**Mean ± SD Post test**	***p-value***
Toothbrushing skills	Intervention	36,91±1,044	40,27±1,421	0,003*
	Control	35,64±1,502	35,82±1,401	0,564*

Table 5 shows that the results of the effectiveness test of paired data on tooth brushing skills of children with disabilities show a p-value in the intervention group of 0.003 (p <0.05), meaning that elastomeric toothbrushing aids are more effective in improving the teeth brushing skills of children with disabilities. The p-value in the control group was 0.564 (p>0.05), meaning that conventional toothbrushes were less effective in improving the teeth brushing skills of children with disabilities. There was an increase before and after treatment, where before being treated the average value of tooth brushing actions of children with disabilities amounted to 36.91 in the intervention group increased to 40.27, in the control group the average value of tooth brushing skills of children with disabilities before treatment amounted to 35.64 to 35.82.

Table 6 Test of Significant difference in Tooth Brushing Skills for Children with Disabilities

Statistic			
Variable	**Group**	**Delta ± SD (Δ)**	***p-value***
Brushing tooth skills	Intervention	3.27±1,104	0.000
	Control	0.55±0,934	

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Table 6 The results of the effectiveness test were significant in brushing the teeth of children with disabilities in the intervention group and control group with a difference value (Δ) in the intervention group of 3.27 and the control group of 0.55 with a p-value of 0.000 (p <0.05), which means that the elastomeric tooth brushing aid media is effective in improving the teeth brushing actions of children with disabilities.

Table 7 Debris Effectiveness Test for Children with Disabilities

Statistic				
Variable	**Group**	**Mean ± SD Pre test**	**Mean ± SD Post test**	***p-value***
Debris Index	Intervention	1.710±0,3533	1.491±0,3270	0.000
	control	1.692±0,3858	1.665±0,3613	0.192

Table 7 shows that the results of the effectiveness test of the debris index of children with disabilities showed a p-value in the intervention group of 0.000 (p<0.05), meaning that the elastomeric toothbrushing aid effectively reduced the debris index of children with disabilities. The p-value in the control group was 0.192 (p<0.05), meaning that conventional adult toothbrushes were also less effective in reducing the debris index of children with disabilities.

Table 8 Effectiveness Test of Significant Difference in Debris Values of Children with Disabilities

Statistic			
Variable	**Group**	**Delta ± SD (Δ)**	***p-value***
Debris Index	Intervention	0,218±0,0603	0,000
	Control	0,045±0,0820	

Table 8 The results of the effectiveness test were significant in the intervention group and the control group with a difference value (Δ) in the intervention group of 0.218 and in the control group of 0.045 with a p-value of 0.000 (p <0.05), which means that the elastomeric tooth brushing aid media effectively reduces the child's debris index compared to conventional toothbrushes.

IV. DISCUSSION

A. Model Test on Children with Disabilities

The model trial in this study was conducted on 22 people who were divided into 2 groups, namely 11 respondents in the intervention group and 11 respondents in the control group. The intervention group was treated using an elastomeric toothbrushing aid while the control group used a conventional adult toothbrush. The model applied to the intervention group and control group was carried out to improve tooth brushing skills in children with disabilities. Based on gender, they were not the same. The gender of the intervention group with a total of 6 boys and 5 girls while in the control group there were 4 boys and 7 girls. The frequency of gender of children with disabilities in this study was mostly female [22].

The age of respondents in this study in the intervention group, 11 years as many as 6 children, 12 years as many as 3 children, 13 years as many as 2 children. While in the control group 11 years as many as 1 child, 12 years as many as 7 children, 13 years as many as 4 children.

B. Tooth Brushing Skills of Children with Disabilities

Given the limited abilities of children with disabilities, they require assistance from others to perform daily activities. The role of parents to teach and guide on how to brush teeth is an effort to maintain oral health for children. Children's behavior is influenced by the role of their parents, and they will imitate the actions of parents at home, especially mothers [23].

Teeth brushing activities are planned and directed efforts in creating an individual or group atmosphere in order to change behavior for the better in maintaining dental health. Factors that can affect the success of a tooth brushing activity are the media or tools used [24].

After being given treatment and trained to brush their teeth for 10 days at home accompanied by parents, children begin to understand and can practice how to brush their teeth, because in this study the respondents were cooperative children with disabilities. Previous research stated that the improvement of tooth brushing skills in children has a focus on maternal behavior in the form of knowledge, attitudes and actions obtained through training [25]. Tooth brushing skills of children with disabilities have changed before the intervention and after the intervention, tooth brushing skills are assessed through a checklist sheet consisting of 15 assessment points with 4 ratings, namely the criteria that the child is able to do with physical assistance with a rating of 1, the child is able to do with the help of gestures with a rating of 2, the child is able to do it independently but still not in accordance with the right recommendations with a rating of 3, and the child brushes the teeth independently and is in accordance with the recommendations with a rating of 4. Before the intervention there were still many stages of brushing teeth that were not done but after the intervention for 10 days at home there was an increase in points from each stage performed in brushing teeth.

Tooth brushing skills in children with disabilities have increased because elastomeric tooth brushing aids have the advantage of adjusting the hand grip of children with disabilities to the toothbrush handle which is motorically limited to the hand grip.

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There was an increase before and after treatment, where before being given treatment using elastomeric tooth brushing aids, the average value of tooth brushing skills of children with disabilities was 36.91 in the intervention group, which increased to 40.27 after being given treatment using elastomeric tooth brushing aids.

In the use of elastomeric tooth brushing aids with materials that do not contaminate the hands of children with disabilities, elastomeric materials are quite elastic and soft so that children are safe in their use and toothbrushes that are suitable and attractive to children so that children become more active in maintaining oral hygiene at home.

Elastomeric toothbrushing aids in children with spastic category (muscle stiffness) hand grips help in facilitating children with disabilities who previously gripped the toothbrush handle less tightly then added with the innovation of elastomeric toothbrushing aids it will be tight enough grip on the toothbrush handle of children with disabilities. It is also hoped that parents will be able to make it independently through the guidebook for making the elastomeric toothbrushing aid.

The control group was given treatment before and after using a conventional toothbrush with an average value of children's brushing skills of 35.64 to 35.82, there was a considerable increase before and after being given treatment with a conventional toothbrush. This is in line with previous research that conventional toothbrushes can also improve the teeth brushing skills of children with special needs [26]. However, it is different from this study where conventional toothbrushes are less likely to improve the teeth brushing skills of children with disabilities whose motor grip is limited.

The results of the effectiveness test of tooth brushing skills of children with disabilities showed a p-value in the intervention group of 0.003 ($p < 0.05$), meaning that elastomeric toothbrushing aids were effective in improving the teeth brushing skills of children with disabilities who were limited in motor grip and in the control group with a p-value of 0.564, meaning that conventional toothbrushes were less effective in improving the teeth brushing skills of children with disabilities who were limited in motor grip.

The results of the effectiveness test mean the difference value (Δ) of tooth brushing skills with a value of 3.27 in the intervention group and 0.55 in the control group with a p-value of 0.000, which means that there is a difference before and after being given treatment using elastomeric tooth brushing aids for children with limited motor grip.

C. Debris Index of Children with Disabilities

The results of the effectiveness test of the debris index of children with disabilities with a p-value in the intervention group of 0.000 ($p < 0.05$) and the control group with a p-value of 0.192 ($p > 0.05$) which means that elastomeric toothbrushing aids are more effective in reducing the debris index in children with disabilities than conventional toothbrushes.

The results of the effectiveness test mean the difference value (Δ) of the debris index with a value of 0.218 in the intervention group and 0.045 in the control group with a p-value of 0.000, which means that there is a decrease in the number of debris indexes before and after being given treatment using elastomeric tooth brushing aids for children with limited motor grip for 10 days at home.

The debris index score in children with disabilities has decreased because children with disabilities have been taught how to brush their teeth properly and correctly using elastomeric brushing aids guided by parents. The debris index number will decrease if the respondent applies a good and correct way of brushing teeth [27]. The ability of children to brush their teeth properly and correctly is a very important factor in maintaining oral hygiene. Success in brushing teeth is also influenced by the use of tools, the frequency of brushing teeth, and the right time and method of brushing teeth [28]. Wrong tooth brushing practices will cause food residue to remain on the tooth surface [29].

Tooth brushing activities using elastomeric tooth brushing aids to improve tooth brushing skills and reduce the debris index of children with disabilities carried out for 10 days at home accompanied by parents. This is reinforced by previous research that repeated training will form a pattern of skills in children with special needs [30].

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