INDONESIAN JOURNAL OF PROSTHODONTICS

ORIGINAL ARTICLE

Disinfection effect of chlorhexidine and castor oil based on usage time on the impact strength of denture base heat polymerized acrylic resin

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Keywords: Castor Oil, Chlorhexidine, Disinfection, Heat polymerized acrylic resin, Impact Strength

ABSTRACT

Heat polymerized acrylic resin is the most frequently used type of acrylic resin because it has several advantages. Heat polymerized acrylic resin dentures must be disinfected to maintain cleanliness and prevent diseases caused by wearing unclean dentures.. The chemical method is a good and easiest method to do by immersing the dentures in a disinfecting solution. The immersion will clean the surface of the denture and reach the undercut area of the denture. Chlorhexidine and castor oil are ingredients that have substances that can clean dentures, but the content in these materials has an influence on the properties of dentures, one of which is mechanical properties. This study aimed to know the effect of disinfection of chlorhexidine and castor oil based on time of use on the impact strength of heat polymerized acrylic resin denture bases with simulations of 3, 4, and 5 years. The sample was tested using a Charpy Impact Tester to determine the impact strength value. This study showed that there was an effect of castor oil on the impact strength of heat polymerized acrylic resin, but the change still above the minimum value, so this can be suggested as a disinfection material. (IJP 2024;5(2):157-159)

Introduction

Tooth loss is a condition of detachment of one or more teeth from their sockets caused by extraction due to caries or periodontal disease, trauma, and systemic diseases tooth loss usually occurs in the elderly and can result in impaired masticatory function, temporo mandibular joint (TMJ) function, and psychological, namely aesthetic and speech function.c A denture is a removable replacement for missing teeth and surrounding tissues. Two types of dentures available are complete and partial dentures. Complete dentures are used when all the teeth are missing, while partial dentures are used when some natural teeth remains.[2] One of the components of the denture is the denture base, where these components will be located in the soft tissues of the mouth. Denture base material can be made of metal or non-metal.[3] Heat polymerized acrylic (HPA) Resin is the most commonly used type of acrylic resin to be a denture bases because it has several advantages such as good color stability, non-irritating, non-toxic, good aesthetic quality, low residual monomer economy, small porosity, and easy manufacturing and repair processes. Heat polymerized acrylic Resin also has disadvantages, namely the presence of residual monomers, has microporosity, can absorb water or liquid, easily absorbs food or chemical residues, and is easy to fracture if hit on a hard surface or due to material fatigue due to prolonged use and discoloration after some time in the mouth. To keep denture bases clean, the denture bases must be desinfected. Denture disinfection methods can be divided into mechanical, chemical or combined methods. Mechanical methods with toothbrushes, chemical methods using disinfecting agents in the form of alkaline hydrochloride, alkaline peroxide, chlorhexidine, enzymes, and natural oils, as well as combination methods by combining the two.[4-6]

The chemical method is a good and easy method by soaking the denture in a disinfection solution. The immersion will clean the surface of the denture and reach the undercut area of the denture. A frequently used denture disinfection agent today is chlorhexidine. Chlorhexidine is an antiseptic and disinfectant chemical that is active against various types of bacteria, viruses and fungi such as Candida albicans.[7] Chlorhexidine has fungicidal and fungistatic effects that will cause nucleoprotein coagulation to occur and affect the cell wall causing cytoplasmic components to escape through the cell plasma membrane. Research conducted by Apriasari ML et al (2009) showed that disinfection of dentures with 0.2% chlorhexidine for 5 minutes can suppress the growth of Candida albicans colonies.[8] Castor oil (Ricinus communis) is biocompatible and has bactericidal and fungicidal effects. Castor oil is colorless and odorless. These characteristics together with the detergent action make its use as a denture disinfectant possible. the main component of castor oil is sodium ricinoleate that inhibits the formation of biofilms. According to de Andrade, et al (2012), the detergent action in castor oil against microorganisms is associated with cell wall damage that allows the

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DOI 10.46934/ijp.v5i2.158

Table 1. Impact Strength Value of Heat Polymerized Acrylic Resin after Disinfection Using Aquades, 0.2% Chlorhexidine, and 10% Castor Oil

No	Impact Stregnth (x 10-3 J/mm2)								
	3 years			4 years			5 years		
	A1	B1	C1	A2	B2	C2	A3	B3	C3
1	21.41**	18.24*	19.02*	17.46*	14.46	17.46**	15.94**	12.29	15.19
2	19.81	18.24	19.02	17.46	13.73*	16.69	15.94	13.01**	15.94**
3	19.81	19.02**	19.02	18.24**	15.94	17.46	15.94	11.59*	13.73*
4	19.02	18.24	19.81**	17.46	15.94	15.94*	15.19*	13.01	14.46
5	19.02*	19.02	19.02	17.46	16.69**	15.94	15.94	13.01	15.19
X ± SD	19.81 ± 0.97	18.54 ± 0.42	19.17 ± 0.35	17.61 ± 0.34	15.35 ± 1.21	16.70 ± 0.76	15.79 ± 0.33	12.58 ± 0.63	14.90 ± 0.84

Table 2. Effect of 0.2% chlorhexidine disinfection and 10% castor oil on the impact strength of hot polymerized acrylic resin denture bases for 3, 4, and 5 years

Duration	group	X ± SD	p
3 years	A1	19.81 ± 0.97	0.030*
	B1	18.54 ± 0.42	
	C1	19.17 ± 0.35	
4 years	A2	17.61 ± 0.34	0.04*
	B2	15.35 ± 1.21	
	C2	16.70 ± 0.76	
5 years	A3	15.79 ± 0.33	0.0001*
	B3	12.58 ± 0.63	
	C3	14.90 ± 0.84	

loss of cytoplasmic components and results in cell death.[9-11] Based on its function, the heat polymerized acrylic resin denture base has strength characteristics, one of which is impact strength. Impact strength is the resistance of a material not to fracture when it gets a large and sudden force in the form of compression, for example falling on a hard surface. The minimum value of the impact strength of a denture base is 5 x 10-3 J/mm2. research on the impact strength of the denture base acrylic resin heat polymerized with disinfection using castor oil has never been done, so the comparison of the results of research used as a reference is research with other materials that have the same compotitions. According to Chairunnisa R and Chailes S (2015) there was a decrease in impact strength caused by immersion of heat polymerized acrylic resin in 0.01% lerak fruit extract (containing phenol) for 2, 3, 4, 5, and 7 days. The longer the soaking time, the lower the impact strength of the heat polymerized acrylic resin.[5,12]

The purpose of this study was to determine the disinfection effect of chlorhexidine and castor oil based on usage time on the impact strength of denture base heat polymerized acrylic resin.

Material and Methods

This experimental laboratory with post test only with control group design used heat polymerized acrylic resin disinfected with chlorhexidine 0,2%, castor oil 10%, and aquadest (control). The number of sample for each group is 5, the total group of disinfection is 9, so the total sample for 9 group is 45 samples. The size of custom made model metal used for impact strength according to ADA specification no.12 is 65 x 10 x 2,5mm.

Samples was made through the process of making molds, filling acrylic in molds, curing, and polishing. After the sample is finished by polishing, the sample will be divide into 9 group which A1, B1, and A3 for 3 years disinfection, A2, B2,and C2 for 4 years disinfection, and A3, B3, and C3 for 5 years disinfection. The "A" group is for aqueadest (control), the "B" group is for chlorhexidine 0,2%, and the "C" group is for castor oil 10%. After the sample divided into each group, every group will be put inside the incubator at 370C for 25, 20, and 25 days (converted from 3, 4, and 5 years). After that, the sample will be cleaned and ready to be tested with charpy impact test machine.

Measurement of impact strength is using charpy impact test machine (HungTA-HT8014). The sample is placed on horizontal posisition on the test placement. After the arm of the tester impact the sample broke into half, the result of energy will be showed on machine and recorded for measurements.

Results

Impact strength values after 3 years of immersion in group A1 were in the interval 19.02 – 21.41 x 10-3 J/mm2 and the mean and standard deviation was 19.81 ± 0.97 x 10-3 J/mm2, group B1 was at intervals of 18.24 – 19.02 x 10-3 J/mm2 and the mean and standard deviation is 18.54 ± 0.42 x 10-3 J/mm2 and group C1 is at intervals of 19.02 – 19.81 x 10 -3 J/mm2 so that the mean and standard deviation is 19.17 ± 0.35

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x 10-3 J/mm2. The Impact Strength value after 4 years of immersion in group A2 has an interval of 17.46 – 18.24 x 10-3 J/mm2 so that the mean and standard deviation is 17.61 ± 0.34 x 10-3 J/mm2, group B2 is at interval interval 13.73 – 16.69 x 10-3 J/mm2 so that the mean and standard deviation is 15.35 ± 1.21 x 10-3 J/mm2 and group C2 is in the interval 15.94 – 17.46 x 10 -3 J/mm2 so that the mean and standard deviation is 16.70 ± 0.76 x 10-3 J/mm2. The Impact Strength value after 5 years of immersion in group A3 has an interval of 15.19 – 15.94 x 10-3 J/mm2 so that the mean and standard deviation is 15.79 ± 0.33 x 10-3 J/mm2, group B3 is at interval 11.59 – 13.01 x 10-3 J/mm2 so that the mean and standard deviation is 12.58 ± 0.63 x 10-3 J/mm2 and group C3 is in the interval 13.73 – 15.94 x 10- 3 J/mm2 so that the mean and standard deviation is 14.90 ± 0.84 x 10-3 J/mm2.

The effect of disinfection of heat polymerized acrylic resin denture base with 0.2% Chlorhexidine and 10% Castor oil on impact strength was analyzed using a one-way ANOVA test. Previously, normality data was tested using Shapiro-wilk to know the data is truly homogenous..

The one-way anova test result gained significance result for all group with p <0,05, which p = 0,030 for 3 years group, p = 0,04 for 4 years group, and p = 0,0001 for 5 years group, then H0 is rejected and Ha accepted. This means there is a significant effect on changes in impact strength on heat polymerized acrylic resin denture bases disinfected with 0.2% chlorhexidine and 10% castor oil based on usage time.

Discussion

Table 1 shows the impact strength values for all HPA resins samples that have been disinfected with 0.2% chlorhexidine and 10% castor oil for 3, 4, and 5 years. group A1 the lowest impact strength value was 19.02 and the highest was 21.41 and the mean value and standard deviation was 19.81 ± 0.97, in group B1 the smallest impact strength value was 18.24 and the highest was 19.02 so that the mean and the group standard deviation was 18.54 ± 0.42, and in group C1 the smallest impact strength value was 19.02 and the largest was 19.81 so that the mean value and standard deviation were 19.17 ± 0.35. Disinfection for 4 years showed a decrease in value where in group A2 the lowest impact strength value was 17.46 and the highest was 18.24 with the mean value and standard deviation at 17.61 ± 0.34, in group B2 the lowest impact strength value was 13.73 and the highest is 16.69 so that the mean value and standard deviation is 15.35 ± 1.21, and in group C2 the smallest impact strength value is 15.94 and the highest is 17.46 so that the mean value and standard deviation in the group is 16.70 ± 0, 76. The 5 year disinfection showed a decrease in value where in group A3 the lowest impact strength value was 15.19 and the highest was 15.94 with a mean value and standard deviation of 15.79 ± 0.33, in group B3 the smallest impact strength value was 11.59 and the highest is 13.01 so the mean value and standard deviation is 12.58 ± 0.63, in group C3 the smallest impact strength value is 13.37 and the highest is 15.94 so the group's mean and standard deviation value is 14.90 ± 0.84. The result shows that the lowest value for each years is from chlorhexidine 0.2% group (B1, B2, and B3), followed by castor oil 10% group (C1,C2, and C3), and the highest value is aquadest (A1, A2, and A3).

Based on the data in table 2 from the results of the one-way anova test, there was a significant influence on disinfection of HPA resin impact strength with chlorhexidine 0,2% and castor oil 10% which p = 0.030 for 3 years group, p = 0.04 for 4 years group, and p = 0.0001 for 5 years group. The result of this study are similar to the results of research conducted by Chailes S who use 0,01% lerak extract (contain Fenol) for soaking HPA resins for 2, 3, 4, 5, and 7 days. Her research shows that the more of time of immersion, the lower value of impact strength.

The variation of impact strength of each sample can due to various factors, including the process of combining the polymer and monomer of HPA resins that cant be done in 1 time for all samples and the process still in manual which causes the sample cant be controlled perfectly.

The decrease of impact strength value for every HPA resins sample caused by the HPA resins sample properties which water absobtion. The disinfection materials

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