



Effect Of Microwave Disinfection Time On Transverse Strength Of Acrylic Resin Denture Repair

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Abstract

Acrylic resins have been used to manufacture dentures because of their aesthetics, strength and relatively low cost. However, when using acrylic dentures, fractures can occur, so repairs are needed. In the event of a fracture prosthesis in the dental clinic, instruments and prosthetic materials must be properly disinfected to avoid cross-contamination among dentists, patients, assistants and technicians in the dental laboratory. This study aims to determine the effect of microwave disinfection time on the transverse strength of acrylic resin denture fracture repair.

There were 60 specimens in this study and a beam measuring 65 mm long x 10 mm wide x 2.5 mm thick. The data obtained were analysed using a two-way ANOVA test and further tested by Tukey's post hoc.

The analysis results showed an effect of microwave disinfection time on the transverse strength of acrylic resin denture fracture repair. There was a significant difference ($p < 0.05$) in the transverse strength of acrylic resin after being disinfected by microwave 650 W for 3 minutes and 6 minutes. The non-significant difference was found in acrylic resin without disinfection with 650 W microwave disinfection for 6 minutes with $p > 0.05$.

Keywords: Acrylic Resin: Fracture

Preparation: Microwave Disinfection

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Introduction

Polymethylmethacrylate (PMMA) is a material that is often used for dentures due to aesthetic, physical factors and is also relatively more economical (Santoso et al., 2020). However, in its use, fractures can occur either in the mouth due to design factors, manufacturing methods, and continuous pressure in the mouth. In the event of a fracture or fracture of the prosthesis in the dental clinic, instruments and prosthetic materials must be properly disinfected to avoid cross-contamination among dentists, patients, assistants and technicians in the dental laboratory. In addition to patient-induced cross-contamination, prostheses can be contaminated during various stages of manufacture. The prosthesis must be disinfected with chemical solutions to eliminate or reduce cross-contamination.

Repair of broken dentures must be strong enough, have good dimensional stabilisation, be easy to work with and not too expensive. Dentures often fracture in the midline. Therefore, the results of denture repair must have sufficient strength, one of which is transverse strength, namely the strength to withstand transverse forces that occur in the mouth (Supriyana et al., 2018). The transverse test can obtain an overview of the strength of the denture base in accepting the load during mastication. However, the weakness of the repair is that it can often occur again in the parts that have been connected (Alvarez et al., 2021). In the event of a fracture or fracture of the prosthesis in the dental clinic, instruments and prosthetic materials must be properly disinfected to avoid cross-contamination among dentists, patients, assistants and technicians in the dental laboratory. In addition to patient-induced cross-contamination, prostheses can be contaminated during various stages of manufacture. To eliminate or reduce cross-contamination, prostheses should be disinfected with chemical solutions or disinfection



using a microwave. Prosthetic materials sent from the dental clinic to the dental laboratory are contaminated with pathogenic bacteria,

Meanwhile, other studies have shown that disinfection using a microwave can affect the transverse strength (da Costa et al., 2020). Several researchers conducted a study using a 650 W microwave for three minutes and its effect on the transverse strength with the results showing no effect on the transverse strength (Wemken et al., 2020). The microwave disinfection technique also reduced the load required to break the specimen, deformation at fracture, transverse strength, modulus of elasticity except disinfection at 5 min dry conditions, toughness, and impact strength (Martinez et al., 2021).

Methods

This type of research is an experimental laboratory study to get a picture of the interdependence (Kot & Rajiani, 2020) on the effect of long disinfection using a microwave on the transverse strength of acrylic resin fracture repair of dentures. A total of 60 specimens were repaired. The first group was not disinfected with acrylic materials A and B. The second group was disinfected using a 650 W microwave for 3 minutes, the third group was disinfected using a 650 W microwave for 6 minutes. SPSS Windows version 21 program computer and statistical test using two way ANOVA followed with Tukey's post hoc test under a significance level of $p < 0.05$.



Results and Discussion

In this study entitled "The Effect of Microwave Disinfection Time on the Transverse Strength of Acrylic Resin Fracture Repair" to find out how the transverse strength of the denture base and the duration of disinfection in fracture repair using a microwave. The material used is heat curing acrylic resin, consisting of two different brands, namely the Strella® and Vertex® brands. The specimens used were blocks with a length of 65 mm x width 10 mm x thickness 2.5 mm.²⁵ Then, they were disinfected in a microwave at different times. A 650 W microwave for six minutes can kill *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Bacillus subtilis* and colonised *Candida albicans* bacteria. But is there a change in transverse strength between three and six minutes? According to previous studies, six-minute disinfection is more effective.

In contrast to other studies (Wemken et al., 2020) microwave disinfection of 650 W for three minutes did not decrease the transverse strength, this means that the acrylic resin was not fractured. Each brand is divided into three treatment groups, the tool used to test this specimen is a three-point bending test with a universal testing machine. This tool is to test the transverse strength.

The transverse strength of acrylic resin disinfected using a microwave was tested by considering the time: without disinfection, disinfection for three minutes, and disinfection for six minutes, the results can be seen in Table 1 statistically using SPSS Windows version 21. The results obtained are the average transverse power.



Table 1. Average Transverse Strength and Standard Deviation

Type of sterilisation	Flexural Strength (MPa) and (Standard Deviation)	
	Strella	Vertex
Not sterilised	76.02 (5.79)	74.78 (8.26)
3 minutes sterilisation	65.08 (3.43)	66.23 (7.01)
6 minutes sterilisation	75.23 (4.96)	67.38 (7.02)

In this study, statistical analysis was carried out using a two-way ANOVA starting with the Normalistic Test . Kolmogorov-Smirnovwith test result is 0.290 more than ($p > 0.05$), indicating that it is normally distributed. Further testing is carried out Homogeneity Levenne's Test with a significance value of $p > 0.05$. A value of 0.211 was obtained so that this data was homogeneous because $p > 0.05$ could meet the requirements to continue the two-way ANOVA test.

In the two-way ANOVA test, it was shown that between the two heat-curing acrylic resin materials, there was no significant difference in the transverse strength of the acrylic resin with a result of 0.109. Post-Hoc Tukey's follow-up results showed a significant difference between non-disinfection, three-minute disinfection and six-minute disinfection, as shown in Table 2.

Table 2. Post Hoc Tukey test results

(I) Disinfection (J) Disinfection	Sig.
Not disinfected Disinfection 3 minutes	.000
Disinfection 6 minutes	.107
Disinfection 3 minutes Not disinfected	.000
Disinfection 6 minutes	.017
Disinfection 6 minutes Not disinfected	.107
Disinfection 3 minutes	.017



The transverse strength that was disinfected for three minutes experienced a significant decrease compared to without disinfection; this might be due to the absorption of hot water resulting in reduced Van der Waals force bonds between polymer chains (Xu & Fu, 2019). The decrease in the Van der Waals force can result in a decrease in the transverse strength. However, the increase in transverse strength in the six-minute disinfectant was due to the possibility of unreacted monomers trapped between polymer chains being released and polymerisation occurring again due to an increase in temperature. Increasing the temperature will cause the movement of unreacted monomer molecules to be polymerised to form new polymer chains, thereby increasing the degree of conversion and increasing molecular weight. The increased molecular weight can increase the mechanical strength so that the six-minute disinfectant has an increase in transverse strength. The increase in transverse strength may also be due to the complete polymerisation process (Pulido et al., 2021). Another possibility is that it can also be caused by an increase in water-soluble monomers during the disinfection process so that shrinkage occurs which causes the chain distance to be closer so that it can increase the transverse strength. Therefore the six-minute disinfectant showed significant transverse power. The increase in transverse strength may also be due to the complete polymerisation process (Pulido et al., 2021). Another possibility is that it can also be caused by an increase in water-soluble monomers during the disinfection process so that shrinkage occurs which causes the chain distance to be closer so that it can increase the transverse strength. Therefore the six-minute disinfectant showed significant transverse power. The increase in transverse strength may also be due to the complete polymerisation process (Pulido et al., 2021). Another



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Conclusion and Recommendation

A. Conclusion

1. The effect of disinfection time using a 650 W microwave on the transverse strength of heat curing acrylic resin fracture repair was found.
2. The transverse strength of the two heat-curing acrylic resin brands did not have a significant difference.
3. The transverse power with 6 minutes of disinfection had significantly higher strength than 3 minutes of disinfection.

B. Suggestion

1. For dental health practitioners to use microwave disinfection should take six minutes because it does not significantly differ from the transverse strength without disinfection.
2. Further research is needed on the effect of microwave disinfection on dimensional changes in acrylic resin fracture repair.



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