

THE DIFFERENCE OF ZIG-ZAG SHAPED TAG LENGTH OF ORTHODONTIC WIRE IN ACRYLIC PLATE ON THE PRESSURE STRENGTH

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Abstract

Background: The success of the treatment using removable orthodontic appliance not only depends on the patient's will to use it but also on the operator's capability to design and to make an appropriate appliance that may be tolerated by the patient. In orthodontic clinic, the tag can be used in zigzag shape, however, the length of zigzag shaped tag in its construction, so far, is determined based on the taste of the operator and not yet considered efficient length to avoid reducing the elasticity of the plate on the pressure strength. This study is aimed to observe the difference of zigzag shaped tag length of orthodontic wire in acrylic plate on the pressure strength. **Methods:** 18 samples of acrylic plate, divided into 3 groups (G1: the length of the zigzag shaped tag in acrylic plate was 10 mm, G2: 12,5 mm, G3 : 15 mm), with the thickness of 2 mm, 3 x 2,5 using negative casting for each plate, tags were put in line with the space of 1 cm and poured with acrylic resin mixture and subsequently pressed. After being hardened, the resin acrylics were then taken out, softened, and polished. The measurement of pressure strength on the acrylic plate was conducted using Company Universal Testing Machine 30 KN Model TM 133 Essom Limited. The data collected were tested using One way Anova ($p=0,05$), and LSD test to observe the difference among the groups. **Results :** the result of the study showed no difference of pressure strength among the groups. The One way Anova demonstrated value of 0,715 ($p>0,05$). It showed that among the three groups, there was no significant difference on their pressure strength. **Conclusion:** It was due to no difference of the length of zigzag shaped tag in the acrylic plates, the longer tag was the less pressure strength produced.

Key words : acrylic plate, tag, the pressure strength, removable orthodontic appliance.

Introduction

Removable orthodontic appliance is composed of three main components i.e base plate, retentive component, and active component¹. The base plate is commonly made of acrylic resin, clasp as retentive component, and tooth mover i.e orthodontic springs and labial arch constitutes the active components, both materials are usually made of stainless steel wire 18-8 austenitic type. The active components function as force formation employed in the teeth if they are moved. The base plate also functions to pass the reaction from active component to the teeth and tissue put up with the plate².

In general, clasp, labial arch and orthodontic wire spring are usually made by bending the wires, and composed of some parts united. A clasp usually comprises of some parts including clasp shoulders functioning to grip the tooth anchor or the labial arch, and orthodontic clasp functions to move the teeth, shoulder of the clasp is a apart passing interdental area prior to enter acrylic plate. Basis is a part of wire planted in acrylic plate. Due to the adhesive trait between acrylic resin and metal is nil³ then the wire part as the basis of orthodontic appliance planted in the acrylic plate is easily discharged. To strengthen the

adhesion, bends are made as retention parts in the base of clasp, labial arch, and orthodontic springs⁴. Commonly, this base part is also called tag.

Many tag shapes that may be used as base clasp retention, labial arch or orthodontic spring in the making of removable orthodontic appliance^{4,5,6}. From many of the tag shapes, tag may be classified into three groups, i.e L-shaped tag with inclined tip, O-shaped tag with round tip, zig-zag or twisting-shaped tag.

In the making of removable orthodontic appliance, so far, the determination of tag shapes used has been merely based on the operator's taste and not yet considered efficient tag shape and length to avoid elasticity reduction on the pressure strength.

Ardhana revealed that acrylic plate with zig-zag tag shape is more durable on the pressure strength so that it is not easily broken compared to those with other shapes. Thus, it is necessary to conduct a study about pressure strength on the tag length. It is intended to observe the presence of difference on the strength pressure towards the zig-zag shape of orthodontic tag length with different length. The purpose of this study was to observe the difference of pressure strength of acrylic plate on the zig-zag shaped orthodontic wire tag with various length. The result of this study was expected to provide information on the pressure strength of acrylic plate on the zig-zag shaped tag in the patients treated using removable orthodontic appliance⁷.

Methods and Materials

This study was a laboratory experimental research conducted in Material Testing Laboratory, Engineering Faculty, Jember University. The tool used were sliding caliper, pressure strength tester (Universal testing machine), cutting tongs, Adam's tongs, cuvette. The materials used were stainless steel wire Remanium springs hard (Dentaurum Germany) 0,7 in diameter, acrylic resin, orthodontic resin (pink), Cold Mould Seal (CMS) Vertex Divocep Product Dentimex Netherlands, Glass Model, Gyps.

The samples used were 18 samples divided into 3 groups, each group contained 6 samples. In the group 1, the zig-zag shaped tag length in acrylic plate was 10 mm, in the group II was 12,5 mm, and in the group III was 15 mm, with the thickness of 2 mm for each plate. Acrylic plate was made in size of 3 x 2,5 cm. The tag made of stainless steel Remanium springs hard in diameter of 0,7 mm was cut into 36 pieces in 10 mm, 12,5 mm, and 15 mm long. Using negative casting for each plate, tags were put in line with the space of 1 mm and poured with acrylic resin mixture and subsequently pressed. After being hardened, the resin acrylics were then taken out, softened, and polished. From this process we obtained 18 samples of zig-zag shape wire

bends with different length. The measurement of pressure strength on the acrylic plate was conducted using Universal Testing Machine 30 KN Model TM 133 Essom Company Limited. In this test, the specimens were put on the middle and pressured in certain time until fractured. The data resulted were tested using normality test Kolmogrov-Smirnov to determine whether the three sample groups were normal. If the data were normally distributed then subsequently followed with homogeneity test to test the population variety using Levene test. The data obtained were analyzed using One Way Anova with reliability of 95% ($\alpha = 0,05$), and Tukey-LSD (Least Significant Difference) test to observe the differences among the groups.

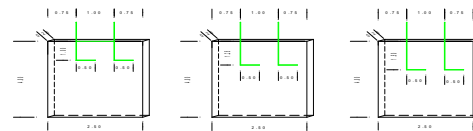


Figure 1. The samples of study, acrylic plate with different tag length

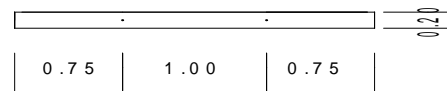


Figure 2. The samples of study acrylic plate from top view

Results

The result of the strength pressure measurement in this study is showed in Table 1.

Table 1. The average of length of L-shaped orthodontic wire tag in acrylic plate on the pressure strength

	Value of Pressure Strength (Mpa)		
	Groups		
	I	II	III
Sample Length	10 mm 6	12,5 mm 6	15 mm 6
Mean	7.17±1,49	6,65±1,76	6,30±2,19

Discussion

In the group 1 with 10 mm length of wire, the mean of pressure strength obtained is 7,175 Mpa, in the group 2 with 12,5 mm length of wire, the mean of pressure strength obtained is 6,65 Mpa, and in the

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group 3 with 15 mm, the mean of pressure strength obtained is 6,3 Mpa. Normality test kolmogrov-smirnov shows that the data are distributed normally ($p>0,05$) and subsequently continued with homogeneity test Levene demonstrating that the three groups are homogeny ($p>0,05$). Furthermore, using Oneway Anova it is obtained value of 0,751. It shows that the three groups do not demonstrate any significant difference upon their pressure strength for the value obtained is ($p>0,05$). It is probably because zig-zag shaped wire possesses the greatest retention compared to the wire with other shapes so that the wire length seems not too influential on the pressure strength of the acrylic plates.

The result shows that group 1 with wire length of 10 mm has the greatest strength compared to the others. However, the result of Oneway Anova test shows that the value among the three is not significantly different ($p>0,05$). It is probably because the pressure strength obtained for each group is different. In the group 1 with wire length of 10 mm, the pressure resulted for each sample in the group is different i.e 28, 35, 45, 40, 29 and 28 kg. In the group 2 with the wire length of 12,5 mm the pressure resulted by every sample in the group is different i.e 28, 32, 20, 15, 25 and 20 kg. In the group 3 with wire length of 15 mm, the pressure resulted by every sample in the group is different i.e 10, 20, 25, 12, 15 and 23 kg. This may probably causes the value of the test result different during the study conducted, although using the same length of wire the result of pressure obtained may be different.

The length of wire inside the acrylic plate may affect the endurance of plate itself. The longer plate used, the lower is its strength because the adhesion of acrylic resin to the metal is nil³. The presence of wire in the plate may also reduce the acrylic volume and plate thickness between the two metals that causes it easily get fractured⁸.

The factor that probably results in different pressure is that because all of plates were made one by one leading to each material possesses different porosity. The solubility of air in the monomer that was not soluble in the polymer of room temperature. The solubility of air in each plate is various. The more air elucidated the higher the porosity of the plate that may affects the strength of the plate.

In the self-cured acrylic resin is not as efficient as heat-cured due to resulting material that possesses less weight of molecule affecting the acrylic resin strength and increase monomer remains. The type of polymerization process of acrylic resin possesses effect in the traits of the material. In general, self-cured acrylic resin is weaker, softer, more porous, unstable

color, and results monomer remains more than 5% after polymerization process⁹.

In this study, the measurement of pressure strength on the acrylic plate was conducted using Universal Testing Machine 30 KN Model TM 133 Essom Company Limited. The machine uses hydraulic pressure operated by an operator. It may also affect the result of the pressure. The operator's speed and exhaustion may affect the result. The more exhausted the operator feels, the less strength he results, although the load provided is the same. The faster pressure provided, the better result it will obtain.

Conclusion

It was due to no difference of the length of zigzag shaped tag in the acrylic plates, the longer tag was the less pressure strength produced.

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