DENTINO
JURNAL KEDOKTERAN GIGI
Vol II. No 1. Maret 2017

COMPARISON OF COMPRESSIVE STRENGTH OFTHE SINGLE CANTILEVER SPRING BY USING ONE AND TWO ROUNDS COIL

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ABSTRACT

Background: *Removable orthodontic appliances have been widely used for correcting malocclusion. It has active components to move a tooth, including a single cantilever spring. Single cantilever spring is indicated for correcting a tooth with a mild degree rotation, moving the individual tooth to labial or buccal direction. In orthodontics, in order to shift the tooth is required aintermitten strength, which one of them is by lengthen the wire with coil addition. An activated spring means performing deflection that produces compressive pressure to shift the tooth.* ***Purpose:*** *To compare the compressive strength of the single cantilever spring by using one and two rounds of coil.* ***Methods:*** *This research was a pure experimentation using post test-only with control design, consisted of two treatment groups, those groups are a single cantilever spring using one round coil and two rounds coil and a control group without using coil. The samples of this study use stainless steel wire with diameter of 0.6 mm, each group is deflected by 2 mm based on millimeter paper block. The compressive strength of each group was measured using a Gauge force meter.* ***Results:*** *Average scoring of the compressive strength was 307.17 gr/mm^2 for the control group, the treatment group with single cantilever spring using one round coil was 197.83 gr/mm^2 and single cantilever spring group using two rounds coil was 117.33 gr/mm^2. The results of LSD test showed that there was significant difference between treatment group and control group.* ***Conclusion:*** *It concludes that the addition of the round coils can decrease compressive strength single cantilever spring.*

Keywords: *compressive strength, coil, deflection, single cantilever spring*

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INTRODUCTION

Malocclusion is an important issue in the field of dental health, especially in orthodontics in Indonesia. Malocclusion is a misalignment of normal occlusion, which, as the result will affect a person's appearance. This misalignment occurs because of the discrepancy between two dental arches during teeth development, either on the upper and lower jaw. Based on the Report of Basic Health Research (RISKESDAS) in 2013, the prevalence of oral and dental problems in Indonesia is about 25.9%. In Kalimantan Selatan, specifically, there are 36.1% oral and dental problems with crowding conditions; about 15,6% problem is found in group of 12-14 years old and about 12,0% in group of 15-24 years old. Furthermore, only 22,2% of the case mentioned before is treated properly. [1,2]

Orthodontic treatment can be applied to improve the condition of occlusal, either to fix the position or the function, acquiring optimal aesthetics and stable treatment results. Orthodontic treatment improves the misaligned teeth by shifting the tooth into the right position. Appliances used for orthodontic treatments are classified into two groups; fixed appliance and removable appliance. Removable appliance is chosen over fixed appliance for its advantage; the appliance can be set and replaced by the patients themselves, and its price is affordable. The removable appliance consists of passive and active components. [3,4,5,6,7]

Spring is the active component commonly used to provide strength in shifting the tooth. The

elasticity of a wire and the force produced by the spring depend on the diameter and the length of the wire used. Coil is required due to the dental arch dimension and the insufficient space of the mouth. By adding the coil, the spring becomes longer more elastic. The coil can be modified either into one round or two rounds. The addition of coil onto the wire is called as cantilever spring. The diameter of the coil added is not more than 3 mm. [6,9]

The orthodontic wire is usually made of stainless steel. The material is used since it is elastic and flexible enough to produce a wide range of action spring. A small diameter wire will be more flexible but it will only produce low pressure. Some operators will prefer the 0.6 mm wire with a lower activation. [5,9]

The pressure or action by the spring on the tooth will be resulted on a balance reaction at different direction. The response of the connective tissue surrounding the tooth toward the pressure will affect the tooth movement, which is highly influenced by the force given. By taking the capillary blood pressure into consideration, the optimum force for tooth movement is about 25-40 gram on single root surface. [4,5,6]

The orthodontic appliances work under the Newt's law of *Forevery action, there is an equal and opposite reaction. This means that when the active component puts pressure or action on the tooth, the response should be identified for an effective tooth movement. Based on the background explained above, the researcher believes it is important to compare the pressure force of single cantilever spring with one round coil and two rounds coil.*

MATERIAL AND METHOD

This is an experimental study with a post-test only with control group design. The researcher used a simple random sampling consisting of two groups with different treatment. The first group used single cantilever spring with one and two rounds coil in which the diameter of the wires are exactly the same. Meanwhile, the control group used non-coil spring. There are six samples in each group. The researcher used Lemeshow formula.

The equipment used in this research are; orthodontic plier, cutting plier, red marker, spatula, bowl, stellon pot, graduated cylinder, depend glass, wax carver,lecron carver, gypsum knife, cellophane bag, small brush, hydraulic press, cuvette and individual press cuvette, spiritus brander, pot, gas stove, millimeter ruler, wood board, meter gauge. The material used is 0,6 mm stainless steel wire, heat cured acyclic resin, could mould seal (CMS), gypsum plaster type II, dental wax,vaseline.The first step of this study is creating the sample of single cantilever spring with one round coil, two rounds coil and without any coil. The 0,6 mm stainless steel wire is used. The spring is planted in a 40x20x2 mm dental wax. After that it is planted in a cuvette by using gypsum plaster type II. Once the setting is completed, the next step is casting away the wax and filling in the heat cured acrylic resin. Next, the cuvette, along with individual press, is boiled in a pot for 30 minute. The cuvette is taken out of the pot once the water inside is cool enough. After that, the gypsum is carefully removed so that the acrylic does not break and the shape of spring finger does not change as well.

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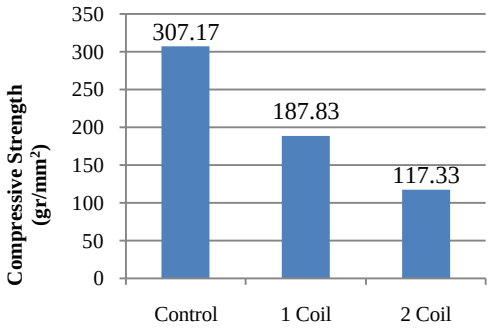
RESULT

The graphic below describes the average value of compressive strength on control group and single cantilever spring with one round and two rounds coil group.



Graphic 1. The average compressive strength of single cantilever spring with one round and two rounds coil

From the graphic above, it can be seen that the average compressive strength on control group is 307,17 gr/mm^2, on single cantilever spring with one round coil group is 187,83 gr/mm^2, and on single cantilever spring with two rounds coil group is 117,33 gr/mm^2. Furthermore, the result of Shapiro-wilk test on single cantilever with one

round coil group is p=0,925, on single cantilever with two rounds coil group is p=0,699 while on control group is p=,295. This means that the sample of the research is normally distributed (p>0,05).

The researcher runs the Levene's test to test the homogeneity of the sample. With the value of p=0,096 (p>0,05), it is concluded that the sample of the study is homogeneous. Parametric analysis of One Way Anova is conducted to test the 95% reliability. The result of the test, p=0,000 (p<0,05), shows that the hypothesis (H1) of this study is accepted which means that there is a significant difference between treatment group and control group. LSD test, then, is used to measure the post Hoc.

The significant value of LSD test on control group and single cantilever spring with one round coil group is 0,000 (p<0,05). While the significant value on control group and single cantilever spring with two rounds coil group is 0,000 (p<0,05). This result means that there is a significant difference between the single cantilever spring with one round coil group and single cantilever spring with two rounds coil group.

DISCUSSION

The average value of compressive strength of single cantilever with one round coil and two rounds coil are different, 187,83 gram and 117,33 gram. This means that the compressive strength might be reduced about 37,5 % due to the addition of coil round which is resulted on the longer wire used. In the other words, single cantilever spring with two rounds produced smaller force than single cantilever with two rounds coil.

The result of this study shows that the compressive strength will be reduced by adding the round of coil of single cantilever spring. This corresponds to the result of the study of Bass and Stevens (1970) which stated that the addition of the wire length will affect the elasticity of the spring. Wire has compressive strength, measured by its modulus of elasticity, which enables the wire to give some force in order to shift the tooth during orthodontic treatment. The pressure given by a spring with certain deflection is directly proportional to the fourth of wire diameter and inversely proportional to the third of wire length. This means that doubling the length of the wire will reduce the pressure up to an eight of its initial pressure. On the other hand, doubling the diameter of the wire will add more force up to sixteen times of its initial pressure.[5,11]

The law of mechanic stated that the internal force inside an item will be equal to the external force given to the item during a test but on a different direction. When the arm of the spring is deflected 2 mm, the toot and the connective tissue surrounding it will get the same amount of force but on different direction. Bending the stainless steel wire will create the residual stress or the rigidity of the wire, which eventually will affect the elasticity of the wire. This is related to the wire deformation process. Wire deformation is a change in wire form, either macroscopically or microscopically. Macroscopic wire deformation is total change in the wire form. The changing occurs due to the compressive force or torsional force. Meanwhile, microscopic wire deformation is a change in the structures forming the wire. To reduce the rigidity, the wire should be bend or changed into an arch. In this study, the researcher forms a coil to reduce the rigidity of the wire. As a result, the elasticity of the wire is increased. [10,12,13,14]

In orthodontic treatment, flexible or elastic wire will give small pressure, which as the result will create continuous shift. However, the non-flexible wire can be used to create a fast movement. The result of this study shows that the compressive strength is big enough to move the anterior teeth, based on the fact that the optimum force to create teeth movement is about 25-40 gram on the surface of single-root. On the other hand, small force requires flexible wire. Increasing the wire length by creating a coil and reducing the wire diameter will increase the wire flexibility.[10,12,15 p]All in all, it can be concluded that single cantilever spring with two rounds coil produces smaller compressive strength that the single cantilever spring with one coil.

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