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RESEARCH OF THE BEHAVIOUR OF GLASS IONOMERS CEMENTS UNDER THE OCCLUSAL STRESS

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ABSTRACT. In Pediatric practical dentistry, the dentist must take into account several factors such as morpho-structural peculiarities of temporary teeth, behavioral features of children, the clinical, physician performance and last but not least the quality of the chosen material Thus, we investigated the behavior of glass ionomers cements in occlusal stress by determining their mechanical properties. The study aims to determine the diametrical compressive strength values , which is one of the mechanical properties of filling materials, the strength of materials being useful in the research of occlusal forces exerted on the future restorations. The determination of values of the resistance in diametrical compression are important in choosing the materials for coronal restorations in cavities of first class and second class of Black at children. After a random choice of classes, we had used direct coronary restoration materials, selecting two glass ionomer cements, which then we have tested them to obtain comparative data, of the resistance for diametral compression.
Keywords: glass ionomers, mechanical properties, compression diametrically, temporary teeth, coronary restoring

INTRODUCTION

Preservation of natural tooth health should be the main goal of each dentist. The loss of only one part of the tooth must be considered a serious injury (MARKLEY, 1951).

Modern dentistry has evolved to a non-invasive approach, the decay is seen as an infectious disease, giving more possibilities for operative interventions. The principle is to preserve to maximum the demineralized enamel and dentin, but non-cavitary. (Murdoch-KINCH and McLean, 2005). With infection controlled, extending the patient's risk of cavities and demineralization can be monitored for longer periods of time (Peters and McLean, 200l, Tyas et al., 2000). Choosing direct coronary restoration materials must take in consideration several factors. Peculiarities of caries in the removal process, if temporary teeth and permanent teeth are young, leading to obtain shutter cavities, which can not always take into account the rules of Black. From this point of view the filling material must be one to make a link between tooth and filling. This directs us to direct coronary restoration materials such as glass ionomer cements with added conventional acrylic resin and crown restoration materials such as resin composites and conventional nanocomposites.

Dental adhesive materials enable the preparation of conservational structures using non-invasive dental cavities because these materials do not require implementation shape for retention. There are several types of materials: glass ionomer cements, composite resin or a combination of composite resin with glass ionomer cements, applied with the technique called rolling (BENN et al, 1999).

Due to the characteristics of children's morpho-structural features of the temporary teeth and young permanent and especially the period of time that a temporary tooth has on the dental arch we can return to glass ionomer cements.

Glass ionomer cements have been found in England and first introduced by Wilson and Kent in 1972. Gradually glass ionomers became a very important material in dental restoration and in the remineralization process, maintaining aesthetics. Of all the properties of glass ionomers the most important is the ability to bind to dentin and enamel by chemical ion exchange, the slow release of fluoride ions and to reabsorb, making it a true

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reservoir of fluoride. The main defect is the low resistance to occlusal forces, and could easily fracture.

It has been shown that plaque is not deposited on the surface of glass ionomers such as Streptococcus mutans, plaque's major pathogenic factor, is not active in the presence of fluoride. Glass ionomers are well tolerated by soft tissues. Recent studies suggest that glass ionomers can protect the pulp by the traumatic and mechanical factors, because dentine bridging occurs despite the low pH.

One of the major disadvantages of glass ionomer cements is low resistance to fracture. Compared with hybrid composite resins and dental amalgams, glass ionomer cements have a low resistance and lack rigidity. Between different types of glass ionomer cements are different degrees of resistance.

Glass ionomers cannot stand for long periods of time the occlusal stress . They still can be used as restoration material for direct coronary fillings for the temporary teeth that will be lost in a short period of time from the dental arch. In case of coronary restoration of young permanent teeth and temporary teeth, which must be left on the dental arches for a period of time, can be considered using direct restoration materials that resists to the occlusal stress, which are rigid, having a high resistance to erosion, providing a link with the tooth structure through adhesive, preserving the hard tissues of the tooth structure, strengthening the tooth, and providing a very good aesthetic restoration of the coronary function.

Recent research has led to improved physical properties of glass ionomer cements, some of them being

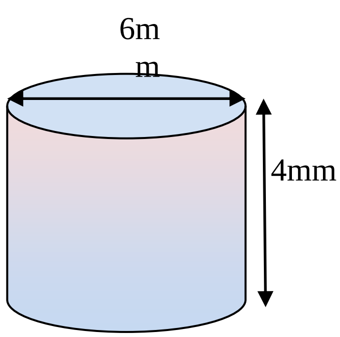

Figure 1. The sketch of the future specimen

In the first stage of the development of models by which patterns will be manufactured, test pieces were made of wax models. Taking into account the fact that wax models can be deformed easily and they request certain temperatures or pressure, we finally realized them of self-curing acrylic models by wrapping wax models and then by condensing the acrylate in the obtained patterns .

with high resistance. Glass ionomer cements resistance under masticatory forces can be shown by several types of tests on which we stopped and focuse to the diametrically compressive strength test, which is relevant in terms of tensions created within them, under masticatory forces.

The determination of diametrically compressive strength values are important in choosing materials for crown restoration, in first and second Black class cavities, supervising the additional information regarding the choice of the direct coronary restoration material in the practice of pediatric dentistry.

MATERIALS AND METHODS

In this study we considered the class of direct coronary restorative of glass ionomer cements. After a random choice we have selected two materials such as Ketac Molar Easymix and Fuji IX.

In order to perform testing of the diametrical strength of the selected glass ionomer cements we went through several stages. Stages of the diametrically compressive strength research are:

- the implementation of models afterwards used as patterns;
- achieving the actual patterns;
- the implementation of specimens to be tested;
- the actual testing of specimens;
- tuition, registration and evaluation of results.

We have made five specimens of each material by realizing a total of 10 specimens. Specimens were made in order to have a diameter of 6 mm and a height of 4 mm (Fig. 1).


Figure 2. The model made from self-curing acrylic material

Models were finished with the mills, so that we get the cylinder diameter of 6mm and the 4mm in height.

Research patterns were created by fingerprinting the models made by self-curing acrylic, resulting a cylinder with an internal diameter (denoted by Φ) of 6 mm and a height (denoted by h) of 4 mm (Figure 3).

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Figure 2. The imprint of the models

Making the specimens was performed by injecting the pattern described above, with the two glass ionomer cements chosen at random. Each type of material was made by five specimens, resulting in the final 10 specimens to be subjected to further testing.

For making glass ionomer cement specimens we had done as follows: we had mixed the liquid with the powder on the waxed paper, in the proportions recommended by the manufacturer, and in accordance with the instructions provided.

Taking into account that this type of crown restoration materials is sticky, the pattern was isolated with vaseline for medical use. After isolation, it is put on a flat surface. To avoid flaws that could affect the structure of the specimen and air bubbles inside it, the pattern was placed on a vibrating table.

Once completely filled, it was covered with a glass plate, on which it was applied a slight pressure to remove excess.

Figure 4. The pattern of Ketac Molar Easymix

Ionomer cement plug was expected. After setting the material, specimens were finished with the cutters and then stored in distilled water for 24 hours. In the first phase we carried out five specimens of Ketac Molar Easymix (Fig. 4) and then proceeded to achieve specimens of Fuji IX (Fig. 5).

Figure 5. The pattern of Fuji IX

After making from the chosen material, the test specimens followed the actual testing phase, to obtain diametrically compressive strength values. Thus to achieve diametrically compressive strength values were tested all specimens taken.

Tests were carried out in the Polytechnic University of Timisoara, Faculty of Mechanical Engineering Department of Materials Resistance under Mr professor Dr.Eng. Liviu Marşavina.

Tests were made with universal testing device Zwick Roell Z005, using special devices for this type of testing.

We had applied the forces on the test specimen. Forces are perpendicular to the diameter of test specimen, a cylinder, with diameter of 6mm and 4mm height (Figure 6).

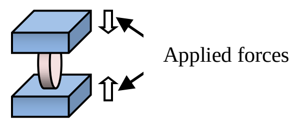

Figure 6. Outlines the applied forces

In the universal testing device Zwick Roell Z005, were mounted two special devices as two parallel plates. Located at the base plate, there were drawn signs, that marked the middle of the plate. Specimens were located in the middle of the base (fig.7).

Figure 7. Test-piece tested on Zwick-Roell Z005universal testing machine.

Each specimen was measured and tested individually for each type of material and findings were recorded. In total there were 10 tests for diametrical compression.

Height (denoted by h) and diameter (denoted Φ) of 10 specimens were measured individually in the tables before testing (Fig. 8).

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		E1	E2	E3	E4	E5
KM	h	4	4	3,9	3,8	3,9
	Φ	5,9	5,9	6	5,8	6
FIX	h	4	3,9	4	3,9	4
	Φ	5,9	6	5,9	6	6

Figure 8 Dimensions of the specimens

Specimens were tested to fulfill the diametrical compressive strength. They were placed between two metal plates in the machine Zwick / Roell Z005. The vertical force applied to the specimens was at a speed of 1mm/minute until the fracture occurred and the amount of force was recorded by the device.

The value of the applied force was recorded by a universal testing device Zwick Roell Z005-as graphs, and tables were recorded with numeric values of the forces.

		E1	E2	E3	E4	E5
KM	F	330	330	327	308	327
FIX	F	424	421	424	421	432

Figure 9. Force that occurred when the specimen fracture

These data was processed and converted into MPa using the formula: CD = F / Φxh. The meaning of formula for calculating the diametrically compressive strength values is: CD is diametrically compressive strength expressed in MPa, F is the force at which fracture occurred, Φ is the specimen diameter and h is the height of the specimen.

RESULTS

All data presented in the tables above have been introduced in the formula for calculating the diametrically compressive strength values. After the calculation, obtained data was entered in the table below (Figure 10).

		E1	E2	E3	E4	E5
KM	CD	13,98	13,98	13,97	13,97	13,97
FIX	CD	17.96	17.99	17.96	17.99	18

Figure 10. Table with diametrically compressive strength

In statistical terms, in the table below (figure11) we introduced the average value for each type of material. Diametrical compressive strength values are expressed in MPa.

Categoria de material de restaurare coronară	Denumirea materialului de restaurare coronară	Valoarea rezistenței la compresiune diametrală în Mpa
ciment ionomer de sticlă	Ketac molar	14 MPa
ciment ionomer de sticlă	Fuji IX	18 Mpa

Figure11. The average value of diametrical compressive strength values

To analyze easily the results for these types of materials, we made a graph (Figure 12), and arising from there are the following:

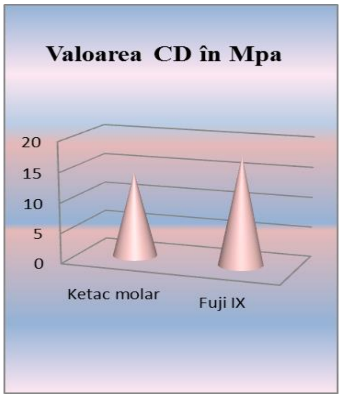

Figure12 The diameters MPa compressive strength

The lowest value of diametrically compressive strength is glass ionomer cement Ketac Molar TM and the highest value of diametrical compressive strength is direct crown restoration material, Fuji IX glass ionomer cement.

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DISCUSSION AND CONCLUSIONS

In addition to information provided by the manufacturer, and clinical indications of these materials we bring additional information regarding the choice of direct coronary restoration material in pediatric practice in certain given clinical situations. The choice of material crown restoration in cavities of a class and second class Black, at the temporary teeth where chewing forces are high, it can be done according to the time which they have on the dental arches. A temporary tooth that has a shorter time period of time in the mouth, can be successfully reconstructed with the Ketac Molar, while Fuji IX can be used for temporary teeth that remain for longer periods of time on arcade.

Although glass ionomer cements can withstand occlusal stress for a period of time, diametral compressive strength values provided by this study suggests the possibility of using these materials in temporary teeth cavities of class I and II children aged Black between 7 and 10 years.

However the two materials tested do not have a very high diametrically compressive strength, so for the temporary teeth that remain for a longer period of time on the dental arcade, we should make then another choice.

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