

ORIGINAL ARTICLE

LABORATORY METHODS OF RESEARCH OF ADHESIVE SYSTEMS

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ABSTRACT

The aim of out research was to determine the effectiveness of the sealing property of adhesive systems V and VII generations by studying the depth of curing, water absorption and water solubility of their samples.

Materials and methods: The study was performed according to ISO / TS 11405: 2015 at the Central Factory Laboratory of JSC "CTOMA", Kharkiv, Ukraine, Certificate of Attestation No. 100-062 / 2015 dated 03/04/2015.

For the study we used specially prepared laboratory samples which were made in the form of plates from adhesive system "DC Adhesive NF" (Dental Central) of V generation "Single bond Universal" (3M ESPE) of VII generation. A monitor and analyze the results obtained used micrometer MK-25, №4694, №03 / 5321 from 08/18/17; caliper SC-1, No. 267447, No. 03/5322 from 08/18/17; scales AP 210, №112144137, №87027 / 9 from 24.11.2017

Results: According to the results of the investigation the following results were obtained: 1) the average curing depth of V and VII generation of adhesive systems was 4.08mm and 3.51mm respectively at the rate of 2mm; 2) average water absorption: 45.97 μg/mm^3 and 30.89 μg/mm3 for V and VII generations respectively; 3) the average water solubility was 6.94 μg / mm3 and 4.17 μg / mm3, respectively.

Conclusions: According to the results of our laboratory studies, it can be concluded that adhesive systems of V and VII generations can be used for restoration of lesions of tooth hard tissued. Along with this, it can be recommended to use V generation adhesives in closed defects where direct polymerization should be performed and oral fluid access is minimal. Adhesive sysyems of VII generation can be recommended in such cases as: opened restorations, pregingival areas of teeth, cases where a permanent contact of restorations with oral fluid be found along with the cases of autonomic application of adhesive system.

KEY WORDS: adhesive system, depth of curing, water absorbtion, water solubility

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INTRODUCTION

Modern technologies allow to provide qualified dental care to the population. A variety of filling materials are widely represented in dental practice. However, in order to ensure the durability and biomimetic properties of restorations, light curing composite materials are preferred. Composite material should be accompanied with an adhesive system. The last one provides reliable and long-lasting adhesion of material to enamel and dentin, isolation of tooth pulp from all types of irritants. The choice of proper adhesive system could be an issue considering the variety of available adhesive systems. The problem of ensurance of reliable and long-lasting bonding of composite materials to tooth structures is still unsolved completely and is still being improved [1].

Dental fillings withstand a significant influence of mechanical and chemical factors in the oral cavity. Therefore, in order to prevent the marginal leakage and prevention of secondary caries of restored teeth the quality of the adhesive system is crucial [2,3,4]. Unfortunately, instructions only indicate the indications for usage while researches which were conducted by manufacturing companies are protected with property`s rights. In addition, most modern adhesive systems are claimed to be universal and can be used with any composite material [1,5,6]. Therefore, we decided to conduct our own laboratory studies of the V and VII generations of adhesive systems, which are most commonly used by practitioners in dental practice.

THE AIM

The purpose of out research was to determine the effectiveness of the sealing property of adhesive systems V and VII generations by studying the depth of curing, water absorption and water solubility of their samples.

MATERIALS AND METHODS

The study was performed according to ISO / TS 11405: 2015 at the Central Factory Laboratory of JSC "CTOMA", Kharkiv, Ukraine, Certificate of Attestation No. 100-062 / 2015 dated 03/04/2015.

For the study we used specially prepared laboratory samples which were made in the form of plates from adhesive system "DC Adhesive NF" (Dental Central) of Vth generation "Single bond Universal" (firm 3M ESPE) of VII generation. A monitor and an-

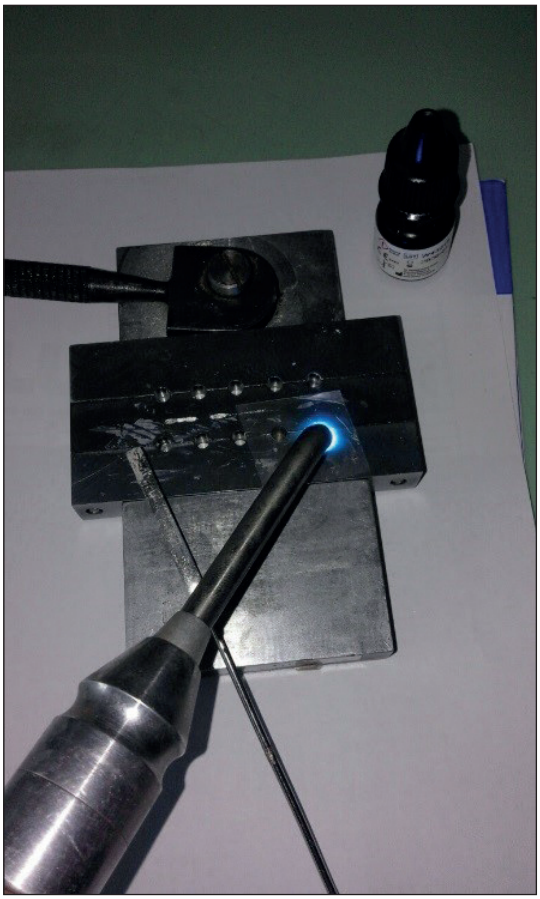

Fig.1. Polymerization of adhesive in the metal matrix

Fig.2. The stage of immersing adhesive plates in distilled water.

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RESULTS AND DISCUSSION

1. DEPTH OF CURING

PREPARATION OF SAMPLES FOR TESTING

Avoiding air bubbles appearance a metal matrix for samples producement (in the form of cylinders with a height of 6 mm and a diameter of 4 mm) was filled with an adhesive with a small excess. The matrix was coated with a lavsan film and pressed with a glass plate on top in order to remove the exceeds of material. Then the glass plate was removed and place the output window of the photopolymerizer in front of the matrix socket, light cured the adhesive for 40 seconds. The film and the sample was removed and a layer of uncured material was removed with a scalpel and a paper towel.

TESTING

The test was performed with a micrometer.

The material was counted as the one that passed the test if four or five specimens had a curing depth of more than 2mm. The results were recorded as the arithmetic mean of five cases.

2. DETERMINATION OF WATER ABSORPTION AND WATER SOLUBILITY OF ADHESIVES "DC ADHESIVE NF" BY DENTAL CENTRAL, VTH GENERATION)AND "SINGLE BOND UNIVERSAL" BY 3M ESPE, VIITH GENERATION FOR 7 DAYS

PREPARATION OF SAMPLES FOR TESTING

In order to obtain samples a metal matrix lubricated with silicone fluid which rendered samples the form of disks with a diameter (20,0 ± 0,1) mm and thickness (1,0 ± 0,1) mm was used. On the back side of the matrix a sheet of lavsan film was applied. Then the matrix was overturned, the adhesive was placed into the matrix and covered with a second lavsan film. Each sample was light cured with a photopolymer for 40 s. The film was removed and the edges of the specimen were cleaned if necessary. For each case 3 samples were prepared for testing. The diameter and thickness of specimens in their central part was measured.

TESTING

The samples were placed in a desiccator with anhydrous calcium chloride, which was placed in an dryer at (37 ± 2) °C. In 24 hours the specimens were removed from the dryer and kept for 1 hour in the same desiccator at (23 ± 1) °C. Then the specimens were weighed on a balance with a margin of error not exceeding 0.2 mg. This cycle

Table 1. Depth of curing of adhesive systems samples of V and VII generation.

Parameter	Sample	DC Adhesive NF by Dental Central (Vth generation)	«Single bond Universal» by 3M ESPE (VIIth generation)
Depth of curing, mm	1	4.05	3,50
	2	4,12	3,51
	3	4,10	3,49
	4	4,09	3,53
	5	4,03	3,50
	Mean, mm	4,08	3,51

Table 2. Water absorbtion and water solubility of adhesive systems samples of V and VII generation.

Parameter	Sample	DC Adhesive NF by Dental Central (Vth generation)	«Single bond Universal» by 3M ESPE (VIIth generation)
Water absorbtion, mcg/mm^3	1	48,61	31,75
	2	45,65	33,49
	3	43,66	27,42
Mean, mcg/mm^3		45,97	30,89
Water solubility, mcg/mm^3	1	6,37	3,14
	2	7,55	5,31
	3	6,89	4,06
Mean, mcg/mm^3		6,94	4,17

was repeated until a constant mass was obtained. Record the resulting mass as m1. The samples were immersed in distilled water for 7 days so that the samples did not touch the walls of the glass beaker and each other. After this time, the specimens were removed and carefully wiped with a dry clean cloth and weighed with the same accuracy 1 min after the sample was removed from the water. Resulting mass was recorded as m_2. After weighing, the samples were conditioned again to constant mass in the desiccator as described above. Constant mass was recorded as as m_3.

Water absorption (μg / mm^3) was calculated according to formula:

$Wc = m_2 - m_3 / V\ 106$, where

m_2 - mass of a sample after extraction from water, g;

m_3 mass of a sample after drying, g;

V - sample volume, mm^3.

Water solubility (μg / mm^3) was calculated according to formula:

$Wp = m1 - m3 / V \cdot 106$, where

m_1 mass of a sample before being immersed in water, g;

m_3 mass of a sample after drying, g;

V - sample volume, mm^3.

As a result of the study an arithmetic mean of three tests was taken. Also, the analogues were compared.

The results obrained after the testing were set to the table 1.

In this study the material was supposed as one which passed the test if four or five specimens have had a curing depth of more than 2 mm. All in all, the results were good enough for both adhesive systems. However, when analyzing parameters of both groups the preference should be given to the V generation DC Adhesive NF (Dental Central).

According to result of testing on water absorption and water solubility of adhesive systems samples, the adhesive system of VII generation "Single bond Universal" (3M ESPE) has proved to be better. The results of the research results are represented in table 2.

CONCLUSIONS

According to the results of our laboratory studies, it can be concluded that adhesive systems of V and VII generations can be used for restoration of lesions of tooth hard tissued. Along with this, it can be recommended to use V generation adhesives in closed defects where direct polymerization should be performed and oral fluid access is minimal. Adhesive sysyems of VII generation can be recommended in such cases as: opened restorations, pregingival areas of teeth, cases where a permanent contact of restorations with oral fluid be found along with the cases of autonomic application of adhesive system.

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Conflict of interest:
The Authors declare no conflict of interest.

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