

Literature Review of the Bonding Strength Measurement Methods of Different Kinds of Oral Adhesives

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Abstract

Objective: To explore the detection method of the adhesive strength of different adhesives in the oral cavity. **Methods:** A computer search of the Chinese National Knowledge Network database and PubMed database about the oral adhesive bond strength test literature, the retrieval time limit is 2000-01/2019-02. **Search keywords:** adhesive, bonding strength, oral cavity, test and adhesive, bonding strength, oral, test. A total of 1465 articles in Chinese and 1895 articles in English were retrieved. Check the title and abstract of each article to conduct a preliminary screening of information. A total of 582 Chinese literature citations and 1,576 English literature citations contain all the information we need. **Results and conclusions:** 1. The first choice for testing the bonding strength of cement adhesives is the launch experiment; the first choice for testing the bonding strength of composite resin adhesives is the tensile strength test; the testing method for the bonding strength of hybrid adhesives The first choice is the peel strength test. 2. At present, the commonly used type of adhesive in oral clinic is self-etching composite resin adhesive.

Keywords

Oral Cavity; Adhesive; Bonding Strength; Test.

1. Introduction

In recent years, with the development of science and technology, the types of oral adhesives have been continuously updated, developed and increased. From the complicated type at the beginning to the simple operation type, the bonding process has become convenient, and the bonding The intensity has become stronger and stronger. The method of measuring the bonding strength is also different. This article summarizes and analyzes the selection of test methods for the bonding strength of different adhesives in the oral cavity.

The classification of adhesives has many forms: according to the classification of parts, it can be divided into enamel adhesives, dentin adhesives, bone adhesives, and soft tissue adhesives; according to the classification of ingredients, it can be divided into cement adhesives and composites. Resin adhesives, hybrid adhesives; according to the type of application, it can be divided into filling repair adhesives, orthodontic adhesives, fixed repair adhesives, maxillofacial defect repair adhesives.

There are five methods to determine the bond strength, including shear strength test, tensile strength test, push-out test, peel strength test and pull-out test.

2. Materials and Methods

2.1 Source

The author used computer technology to search the Chinese "oral adhesive, bonding strength, test" and English "adhesive, bonding strength, oral, test" in the CNKI database and Pub Med database, and the search date was set From 2000-01 to 2019-02.

2.2 Analysis of Included Literature

A total of 1465 Chinese related literatures were retrieved. Check the title and abstract of each article to conduct a preliminary screening of information. A total of 582 citations contain all the information we need. See Table 1 for details. A total of 1895 related documents in English were retrieved, and the review steps were the same as those in Chinese for preliminary screening. A total of 1,576 citations contain all the information we need. See Table 2 for details.

Table 1. Statistics on the number of Chinese documents of different types of adhesives

Type of binder	Number of relevant documents	Percentage of relevant documents in total documents
Cement adhesive	271	46.6%
Composite resin adhesive	435	74.7%
Hybrid adhesive	24	4.1%

Table 2. Statistics on the number of English documents of different types of adhesives

Type of binder	Number of relevant documents	Percentage of relevant documents in total documents
Cement adhesive	291	18.5%
Composite resin adhesive	1359	86.2%
Hybrid adhesive	21	1.3%

Table 3. Statistics on the number of literatures on different types of composite resin adhesives

Detection method type	Shear strength test	Tensile strength test	Launch experiment	total
Self-etching composite resin adhesive	288	399	60	747
Fully etched composite resin adhesive	219	344	51	614
Ordinary composite resin adhesive	258	145	30	433

3. Result

3.1 Table 4 (Chinese Literature Data)

$\chi^2=30.045$, $P < 0.001$, the difference is statistically significant, that is, there is a big difference in the number of literatures when different methods are used to detect the same adhesive. Two-by-two comparison of the data is available: the first choice for the bonding strength test method of the cement adhesive is the launch experiment; the first choice for the bonding strength test method of the composite resin adhesive is the tensile strength test; the bonding strength of the hybrid adhesive The preferred test method is peel strength test. See Table 4 for details.

Table 4. Comparison of different test methods for bonding strength of the same adhesive

Test method Adhesive	Shear strength test	Tensile strength test	Launch experiment	Peel strength test	Total
Cement adhesive	166(38.5)	71(31.0)	34(50.7)	0(0.0)	271
Composite resin adhesive	251(58.2)	153(66.8)	31(46.3)	0(0.0)	435
Hybrid adhesive	14(3.2)	5(2.2)	2(3.0)	3(100.0)	24
Total	431(100.0)	229(100.0)	67(100.0)	3(100.0)	730

Note: (Comparison between cement adhesive and composite resin adhesive, cement adhesive: shear strength test>tensile strength test ($X^2=4.115$, $P=0.043$), launch experiment>tensile strength test ($X^2=9.253$), $P=0.002$). Comparison of cement adhesive and hybrid adhesive, cement adhesive: shear strength test>peel strength test ($P=0.001$), tensile strength test>peel strength test ($P=0.001$), Launch experiment>Peel strength test ($P=0.001$). Comparison between composite resin adhesive and hybrid adhesive, composite resin adhesive: Shear strength test>Peel strength test ($P<0.001$), tensile strength test >Peel strength test ($P<0.001$), launch experiment>Peel strength test ($P=0.001$).

3.2 Table 5 (English Literature Data)

$X^2=146.279$, $P < 0.001$. There is a significant statistical difference, that is, there is a big difference in the number of documents when different methods are used to detect the same adhesive. Two-by-two comparison of the data is available: the first choice for the bonding strength test method of the cement adhesive is the launch experiment; the first choice for the bonding strength test method of the composite resin adhesive is the shear strength test and the tensile strength test; hybrid bonding The first choice for the bonding strength test method of the agent is the peel strength test. See Table 5 for details.

Table 5. Comparison of different test methods for bonding strength of the same adhesive

Detection method glue	Shear strength test	Tensile strength test	Launch experiment	Pullout experiment	Peel strength test	total
Cement adhesive	100(14.1)	95(12.2)	90(50.8)	6(60.0)	0(0.0)	291
Composite resin adhesive	597(84.4)	673(86.7)	85(48.0)	4(40.0)	0(0.0)	1359
Hybrid adhesive	10(1.4)	8(1.0)	2(1.1)	0(0.03)	1(100.0)	21
Total	707	776	177	10	1	1671

Note: (comparison between cement adhesive and composite resin adhesive, cement adhesive: launch experiment>shear strength test ($X^2=112.865$, $P<0.001$), pull-out experiment>shear strength test ($X^2=12.739$, $P<0.001$), launch experiment>tensile strength test ($X^2=137.882$, $P<0.001$), pull-out experiment>tensile strength test ($X^2=15.832$, $P<0.001$). Cement adhesive and hybrid adhesive Comparison, cement adhesive: launch experiment>shear strength test ($X^2=4.290$, $P=0.038$), launch

experiment>peel strength test (P=0.032). Comparison of composite resin adhesive and hybrid adhesive, composite Resin adhesive: shear strength test>peel strength test (P=0.018), tensile strength test>peel strength test (P=0.013), launch experiment>peel strength test (P=0.034).

4. Analysis

4.1 Analysis of Common Methods for Testing Bond Strength

4.1.1 Shear Strength Test

Under pressure in different directions, horizontal shear force is directly applied along the fixed shear surface. This process is the shear strength test. Shear strength is the ultimate strength of the material when it is sheared, reflecting the ability of the material to resist shear sliding. The value is equal to the tangential stress value on the shear surface, that is, the ratio of the shear force formed on the shear surface to the failure area, which can be divided into two forms: single shear and double shear. It is the test method chosen in most cases when testing the bonding strength of the adhesive [1]. Its advantage is that it is easier to observe the complete fracture mode morphology of the bonding interface after shearing, but the disadvantage is that it is not uniformly distributed in comparison with the tensile strength test.

4.1.2 Tensile Strength Test

Tensile test refers to a test method for determining material properties under axial tensile load, which is mainly applicable to the test of metal and non-metal materials. Its advantage is that it can make full use of tooth tissue and control regional differences [2]. Its disadvantages are large workload and high technical requirements, and it is difficult to ensure the consistency of the test objects.

4.1.3 Launch the Experiment

After the adhesive is bonded to the substance, a thin sample is made for experimentation. The disadvantage is poor accuracy.

4.1.4 Pull-Out Test

Pull-out is a kind of shear strength test. This test method is mainly suitable for the test of the bonding strength of fiber posts [3]. The disadvantage is that the scope of application is small.

4.1.5 Peel Strength Test

Peel strength refers to the maximum force required to peel off the unit width from the contact surface of the materials that are pasted together. When peeling off, the angle is 90 degrees or 180 degrees. It is mostly used to determine the bonding strength of facial prosthetic adhesives [4].

4.2 Analysis of Literature Data Results

1. The number of literature on composite resin adhesives in Table 1 and Table 2 is the largest. Combined with the analysis of relevant literature, it shows that composite resin adhesives are widely used in oral medicine and are rapidly developing. The updated development of [5]. The specific classification and the number of different types distributed in the literature are shown in Table 3. 2. The difference between the statistical data of different test methods of the same adhesive in Table 4 and Table 5 shows that the preferred testing method when testing the bonding strength of the cement adhesive is the launch experiment; composite resin adhesive testing the bonding The preferred testing method for strength testing is tensile strength testing; the preferred testing method for hybrid adhesives testing bonding strength is peeling strength testing. 3. It is mentioned in the Chinese literature that in the bonding process, the oral restoration bonding material is mostly resin or zirconia ceramic [6], and the ratio is roughly resin: zirconia ceramic is 6:4.

References

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