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EVALUATION OF THE EFFICIENCY OF DIFFERENT TYPES OF CEMENTS FOR FIXATION OF ALL-CERAMIC CROWNS

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ANNOTATION

The effectiveness of orthopedic treatment of patients with the use of fixed dentures depends on their quality fixation on the abutment teeth. In order to improve the adhesion of the material to the tissues of the tooth, in recent years, special attention has been paid to adhesive fixation systems that improve the fixation of prostheses not only with enamel, but also with dentin. Adhesion of dental materials to dentin is difficult due to its heterogeneity.

With the development of adhesive dentistry, all-ceramic restorations have become more widely used. The development and introduction of composite cement into practice have led to a change in the method of fixation of ceramic restorations using adhesive systems. Thus, the problem of choosing a material for fixing all-ceramic prostheses remains relevant. Clinical practice dictates the need for a clear differentiated approach when using modern composite cement, depending on the type of restoration.

Keywords: dentoalveolar arch, fixed prosthesis structures, adhesion of composite cement, adhesive properties of glass ionomer and composite cement, ceramic crowns based on zirconium dioxide, cephalometric analysis, craniofacial complex, X-ray cephalometric parameters.

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ЯХЛИТ КЕРАМИК КОРОНКАЛАРНИ ФИКСАЦИЯ ҚИЛИШ УЧУН ҲАР ХИЛ ТУРДАГИ ЦЕМЕНТЛА САМАРАДОРЛИГИНИ БАҲОЛАШ

АННОТАЦИЯ

Протезларни олинмайдиган конструкцияларидан фойдаланиб беморларни ортопедик даволашнинг самараси уларни таянч тишларга сифатли фиксация қилишга боғлиқ. Тиш тўқималари билан боғланишни яҳшилаш мақсадида охирги йилларда нафақат эмал билан балки дентин билан ҳам фиксацияни яҳшиловчи адгезион тизимларга алоҳида эътибор қаратилмоқда. Дентин бир хилда тузилмагани сабабидан унга стоматологик материаллар адгезия бўлиши қийиндир.

Адгезион стоматология ривожланиши билан бирга яхлит керамик реставрацияларни қўллаш кўлами кенгаймоқда. Амалиётга композит цементларни татбиқ этиш ва уларни ривожланиши керамик реставрацияларни адгезион тизимлар ёрдамида фиксация қилиш услубиятини ўзгаришига олиб келди. Шундай қилиб, яхлит керамик реставрацияларни фиксацияси учун материал танлаш муаммоси долзарб бўлиб келмоқда. Клиник амалиёт замонавий композит цементлардан фойдаланишда реставрация турига боғлиқ аниқ дифференциал ёндошув зарурлигини талаб этмоқда.

Калит сўзлар: тиш-альвеоляр ёй, протезларни олинмайдиган конструкциялари, композит цементлар адгезияси, шиша-иономер ва композит цементларнинг адгезив хусусиятлари, цирконий диоксиди асосида керамик коронкалар, цефалометрик таҳлил, кранио-фациал мажмуа, рентгено-цефалометрик кўрсаткичлар.

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ОЦЕНКА ЭФФЕКТИВНОСТИ РАЗЛИЧНЫХ ВИДОВ ЦЕМЕНТОВ ДЛЯ ФИКСАЦИИ ЦЕЛЬНОКЕРАМИЧЕСКИХ КОРОНОК

АННОТАЦИЯ

Эффективность ортопедического лечения больных с использованием несъемных конструкций протезов зависит от их качественной фиксации на опорных зубах. С целью улучшения сцепления материала с тканями зуба в последние годы особое внимание уделяется адгезионным системам фиксации, улучшающим фиксацию протезов не только с эмалью, но и с дентином. Адгезия стоматологических материалов к дентину затруднительна ввиду его неоднородности.

С развитием адгезионной стоматологии стали более широко использовать цельнокерамические реставрации. Развитие и внедрение в практику композитных цементов, привело к изменению методики фиксации керамических реставраций с использованием адгезионных систем. Таким образом, проблема выбора материала для фиксации цельнокерамических протезов остается актуальной. Клиническая практика диктует необходимость четкого дифференцированного подхода при использовании современных композитных цементов в зависимости от вида реставрации.

Ключевые слова: зубоальвеолярная дуга, несъемных конструкций протезов, адгезию композитных цементов, адгезивные свойства стеклоиономерных и композитных цементов, керамические коронки на основе диоксида циркония, цефалометрический анализ, кранио-фациальный комплекс, рентгено-цефалометрические показатели.

Over the past 30 years, there has been significant progress in the development of denture materials. However, the durability of ceramic restorations depends not only on the properties of the ceramic material itself, but is also determined primarily by the quality of the connection between the ceramic surfaces and the hard tissues of the tooth.

At present, it has already been proven that the adhesive fixation of all-ceramic structures using composite cements has undeniable advantages over conventional cementing. Due to the intensive

development of adhesive technologies, several generations of fixing agents have already changed and the process of their development continues. In order to gain an advantage in the competitive struggle, various manufacturers vying with each other offer their new, as a rule, high-tech and, it should be noted, far from cheap products, which are often comparable in their properties and purpose [1, 5, 17].

In this regard, the problem of choosing the optimal material for adhesive fixation of all-ceramic orthopedic structures is quite relevant. All modern composite cements are more or less in demand by practitioners, but their choice is based, as a rule, on their own clinical experience and the advertising campaign of manufacturers.

The effectiveness of orthopedic treatment of patients who need their use depends on the quality of fixation on the supporting teeth of non-removable prosthesis structures. To improve the adhesion of the material to the tissues of the tooth, in recent years, special attention has been paid to adhesive fixation systems that improve the fixation of prostheses not only with enamel, but also with dentin. Adhesion of dental materials to dentin is difficult due to its heterogeneity [2, 15, 19].

With the development of adhesive dentistry, all-ceramic restorations have become more widely used. New ceramic materials with improved strength properties and a high aesthetic effect were developed, and it became possible to use tooth-preserving preparation [3, 11,7, 21].

It should be noted that the era of the revival of ceramic constructions in orthopedic dentistry occurred not only as a result of the improvement of ceramic materials, but also due to the development of modern cements for fixation.

The high percentage of failures that were observed at the very beginning of the use of all-ceramic restorations, some experts attribute not to the shortcomings of ceramic materials, but to the imperfection of the cements and the techniques used to fix them. At present, it has already been proven that the material for fixation directly affects the long-term result of treatment and the durability of orthopedic structures. The fixing cement must form a strong bond not only with the hard tissues of the tooth, but also with the ceramic surface [9, 17, 26]. When all contact surfaces are connected into a single structure, the masticatory load is distributed more evenly, which significantly reduces the likelihood of fractures and cracks in ceramic structures [4, 14, 22].

Today, a large number of cements are presented on the market of dental products, different in chemical composition and physical characteristics. However, in connection with the development of aesthetic methods of treatment, composite cements have gained the most popularity in recent years, which are used for adhesive fixation of orthopedic structures made of zirconium dioxide [13, 15, 23].

The development and introduction of composite cements into practice has led to a change in the method of fixation of ceramic restorations using adhesive systems. With all the variety of materials for fixing fixed prostheses, there is no universal cement that could be recommended for fixation in all clinical cases.

We have carried out a comparative evaluation of three composite cements intended for the permanent fixation of ceramic structures: Ketac™ Cem Radiopaque, MaxcemElite.

The main criteria for choosing a cement for permanent fixation of all-ceramic structures were the following properties:

- high biological compatibility;
- ease of use;
- absence of air bubbles and homogeneity during mixing;
- spreading up to the thickness of a thin film;
- high mechanical strength;
- low solubility;
- high degree of adhesion to the enamel and dentin of the tooth;
- high degree of adhesion to ceramic surface;
- radiopacity;
- anti-carious activity (due to the content of fluorides).

Important criteria when choosing a material are the properties that characterize its manufacturability (ease of use) [6, 21, 24].

It is known that the properties of composite materials (consistency, radiopacity, shrinkage, thermal expansion, mechanical strength, etc.) significantly depend on the percentage and quality composition of inorganic fillers [8, 16, 25].

Comparative evaluation of the adhesive properties of glass ionomer and composite cements to improve the fixation of orthopedic structures made of zirconium dioxide was the purpose of this study. For the first time, a comparative evaluation of two different cements for the permanent fixation of metal-free orthopedic structures was carried out, in laboratory conditions the main physical and mechanical properties of composite cements (Ketac™ Cem Radiopaque, Maxcem Elite) were studied: compressive strength, film thickness, resistance to acid erosion, data on adhesive strength in bonding various types of cements with hard tooth tissues and ceramic restorative materials.

The results showed that when Ketac™ Cem Radiopaque composite cement was used for adhesive cementation, after a certain time after the treatment, the retention was 100% in all installed structures, when Maxcem Elite cement was used, the retention was 95%.

In the last 10-15 years there have been revolutionary changes in the technology of manufacturing all-ceramic structures, innovative ceramic materials with improved optical and mechanical properties have appeared. To further increase the mechanical strength, a method was developed for manufacturing orthopedic structures from zirconium dioxide, which has an extremely high strength. It has been proven that the addition of 35% zirconium oxide significantly improves the physical properties of ceramics [3, 18, 20]. All mechanical parameters are improved: flexural strength, impact strength and resistance to fatigue failure. It has been reported that the bending strength of the new zirconium oxide material is 600-800 MPa.

A positive property of composite cements is their high mechanical strength. In recent years, it has been possible to significantly improve the physical and optical properties of composite materials, identify new mechanisms of adhesion to tooth tissues, and improve the clinical technique for their application [11, 18, 20].

When fixing ceramic discs to tooth enamel with composite cement (Ketac™ Cem Radiopaque), almost all studied adhesive agents showed the same adhesive bond strength. Composite cements are the most preferred materials for fixation of fixed orthopedic structures. The influence of the type of ceramic material on the quality of adhesive fixation with composite cements of the prosthesis needs further research. When choosing a cement, one should take into account the type of ceramic material, the design of the restorative prosthesis, and coordinate these characteristics with the physical and mechanical properties of cement for fixation [2, 22].

In this regard, the studied properties of the most progressive dental cements for fixation - Ketac ™ Cem Radiopaque, Maxcem Elite, acquire scientific and practical significance.

Determination of the strength of composite cements in compression was carried out in accordance with the requirements of GOST R 51744-2001, the film thickness of cements for fixation was carried out in accordance with the requirements of GOST R 51744-2001, acid erosion of the studied composite cements was carried out in accordance with the requirements of GOST R 51744-2001 by the impact method. jets [11, 26].

For participation in the clinical study, 45 patients (18 men and 27 women) aged 18 to 55 years were selected, for whom 40 all-ceramic orthopedic structures were made for the restoration of teeth on the anterior and chewing teeth. The mean age of the patients was 39.7±3.2 years.

The selection of patients was carried out in such a way that they had teeth adjacent to those to be restored, and the corresponding antagonists. All patients had an orthognathic bite without complaints from the temporomandibular joint and signs of traumatic occlusion.

The condition of each tooth and its periapical tissues, the size and topography of the roots, were clarified using targeted X-ray images obtained using the Image X dental device (Satelec, Finland).

All-ceramic constructions were fabricated using the CEREC 3 system (SIRONA, Germany) [23, 25]. The stage of fitting structures included checking the marginal fit, aesthetics and articulation. After fitting, the prostheses were fixed with one of two composite cements: Ketac™ Cem Radiopaque, MaxcemElite. The materials were used strictly in accordance with the manufacturer's

instructions. Taking into account the properties of composite cements, they provided reliable protection of the surgical field from moisture using a rubber dam [1, 10, 21].

When testing samples with ceramics based on zirconium oxide, a dependence of the adhesive strength of the joint on the type of cement was also observed (рз_7<0.05, р7_ц<0.05, р3.ц<0.05). Very high adhesive strengths have been observed in cases where zirconia ceramics were cemented with Ketac™ Cem Radiopaque. The second place in terms of joint strength was occupied by samples made using MaxcemElite cement - 3.56 ± 0.37 MPa.

When testing samples made with yttrium-zircon ceramics, a dependence of the adhesive strength of the joint on the type of cement was also observed. The highest rates of adhesive strength were noted when Ketac™ Cem Radiopaque was used for fixing yttrium-zircon ceramics - 7.35±0.99 MPa. Adhesive strength comparable with this group was shown by samples made using MaxcemElite - 6.02±1.19 MPa.

When comparing the adhesive properties of composite cements, it was found that Ketac™ Cem Radiopaque cement has the highest adhesive ability, both to dentin and to ceramic materials of all three types.

In the group where Ketac™ Cem Radiopaque cement was used to lubricate the zirconia ceramic, 30% of the fracture occurred at the dentin-cement, 50% along the cement, and 20% at the cement-ceramic interface. .

In the group where Ketac™ Cem Radiopaque cement was used to lubricate the yttrium-zircon ceramic, 30% of the bond failure occurred at the dentin-cement region, 40% along the cement mass, and 30% along the cement-ceramic interface. ".

Thus, the results of the laboratory-experimental study showed that the adhesive strength of the bond with the dentin of oxide ceramic materials depended on the type of cement used for fixation. The strongest adhesive bonds of zirconium oxide to dental hard tissues were obtained using Ketac™ Cem Radiopaque, which was significantly superior to all other cements. MaxcemElite followed in descending order of adhesive properties.

Cements MaxcemElite, Ketac™ Cem Radiopaque provide a choice of different degrees of viscosity of the material. A higher filler content increases the viscous properties of the material, while reducing fluidity and increasing the thickness of the cement film. The more the material is filled with inorganic particles, the less its shrinkage, and the material itself is stronger [6, 15, 19]. A high amount of filler in the fixing material improves the stability of the cemented structure, but the maximum filling of the matrix with microparticles makes the material “dry” and has little plasticity. It becomes more difficult to work with him.

In this regard, for each clinical situation, it is necessary to make a reasonable choice of a fixing agent. The radiopacity of the cement depends on the amount of filler in the organic matrix of the composite and on its properties [16, 12, 20]. This quality of the cement is of great clinical importance, since it can reveal excess cement in the marginal area and detect secondary caries, especially on interproximal surfaces, using x-ray examination. It should be noted that all the cements presented in the work are radiopaque materials.

The analysis carried out shows that both fixing agents are developed taking into account the most modern world technologies, although each material has its own advantages and disadvantages.

A characteristic feature of adhesive joints is the dependence of the strength of the joint on the thickness of the cement film. The thickness of the cement film is an important factor that determines the sealing ability of the cement, the functional and aesthetic properties of non-removable ceramic orthopedic structures. Ideally, cement for fixation should create a layer thickness of no more than 25 μm [6, 15, 19].

When studying the thickness of the cement film formed by two composite materials, we obtained the following results. The smallest film thickness was noted for cement, Ketac™ Cem Radiopaque - 10.0±0.9 μm. The film thickness of the Maxcem Elite material was 15.3 ± 0.6 μm. Since the oral cavity is an aggressive environment in relation to dental materials, in order to ensure reliable fixation of prostheses, cements must not only have high strength, but also be resistant to acid attack. When continuously testing samples of materials for 8 hours, acid erosion was not detected.

After 24 hours of testing, all materials showed high resistance to acids: acid erosion of Ketac™ Cem Radiopaque was only 0.0028+0.0012 mm/h, Maxcem Elite was 0.0030+0.0006 mm/h.

The results of testing the adhesive strength of the connection of ceramic materials with dentin using two studied cements showed that the type of ceramic material and the type of cement have a greater influence on the indicated strength [13, 18, 21].

When testing samples with ceramics based on zirconium oxide, a dependence of the adhesive strength of the joint on the type of cement was observed (p3.7<0.05, p7.c<0.05, p3_c<0.05). Very high adhesive strength values were noted in cases of fixation of yttrium-zircon ceramics with Ketac™ Cem Radiopaque - 8.48+0.66 MPa. The second place in terms of joint strength was occupied by samples made using Maxcem Elite cement - 3.56 + 0.37 MPa.

When testing samples made with yttrium-zircon ceramics, the highest adhesive strength values were noted when using Ketac™ Cem Radiopaque material for fixing yttrium-zircon ceramics - 7.35 ± 0.99 MPa. Adhesive strength comparable with this group was shown by samples made using Maxcem Elite - 6.02±1.19 MPa.

When comparing the adhesive properties of composite cements, it was found that the highest adhesive ability, both to dentin and to ceramic materials of all four types, has VapoNpk cement.

According to the results of an experimental study, Ketac ™ Cem Radiopaque cement has the highest compressive strength - 278 ± 23 MPa. In order of increasing film thickness, the cements are arranged as follows: Ketac ™ Cem Radiopaque - 10.0 + 0.9 microns, Maxcem Elite - 15, 3+0.6 μm. All the cements studied showed high resistance to acids: during continuous testing of samples for 8 hours, acid erosion was not detected, after 24 hours of the experiment, acid erosion of Ketac™ Cem Radiopaque was 0.0028 + 0.0012 mm/h, Maxcem Elite - 0.0030 +0.0006 mm/h.

When joining cements with zircon and yttrium-zircon ceramics, a dependence of the adhesive strength of the joint on the type of cement is also observed. The highest adhesion rates are observed when Ketac™ Cem Radiopaque is used for cement fixation - 8.48 ± 0.66 MPa and 7.35 ± 0.99 MPa, respectively, Maxcem Elite occupies the second place in terms of adhesion - 3.56 ± 0, 37 MPa and 6.02±1.19 MPa.

Therefore, Ketac™ Cem Radiopaque composite cement should be used for adhesive cementation of all-ceramic crowns made of yttrium-zircon ceramic. This cement is particularly recommended for fixing restorations to posterior teeth, as it has high mechanical compressive strength and, in combination with strong oxide ceramic materials, will allow the creation of restorations that can withstand high chewing loads.

Maxcem Elite cement is not recommended for luting all-ceramic zircon and yttrium-zircon ceramics because the adhesive strength of this cement to the surface of these ceramic materials is lower than that of Ketac™ Cem Radiopaque composite cement.

Thus, the problem of choosing a material for fixing all-ceramic prostheses remains relevant. Clinical practice dictates the need for a clear differentiated approach when using modern composite cements, depending on the type of restoration.

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