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CLINICAL AND LABORATORY EVALUATION OF NEW-GENERATION ADHESIVE SYSTEMS IN THE RESTORATION OF HARD DENTAL TISSUES

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ANNOTATION

Advances in adhesive dentistry have led to the development of new-generation adhesive systems designed to enhance bonding to hard dental tissues and improve clinical outcomes. These systems combine micromechanical retention with chemical bonding, contributing to restoration durability.

Objective: To evaluate the clinical effectiveness and laboratory bond strength of new-generation adhesive systems used in the restoration of hard dental tissues.

Materials and Methods: A clinical study included 60 patients with 120 direct composite restorations. Laboratory testing was performed on 40 extracted human teeth using shear bond strength analysis. Clinical performance was assessed according to modified USPHS criteria. Statistical analysis was conducted using Student's t-test ($p < 0.05$).

Results: The mean shear bond strength of new-generation adhesive systems was 29.4 ± 3.2 MPa, significantly higher than that of conventional adhesives (22.1 ± 2.8 MPa; $p < 0.001$). Clinically, 96.7% of restorations demonstrated excellent marginal adaptation after 12 months. Postoperative sensitivity was observed in 5% of cases and resolved within 7 days.

Conclusion: New-generation adhesive systems provide reliable adhesion to enamel and dentin and demonstrate high clinical and laboratory effectiveness, supporting their use in restorative dentistry.



Keywords-adhesive systems; restorative dentistry; hard dental tissues; bond strength; composite restoration; clinical study.

ANNOTATSIYA

Adgeziv stomatologiya sohasidagi yutuqlar tish qattiq to‘qimalari bilan bog‘lanishni kuchaytirish va klinik natijalarni yaxshilash uchun mo‘ljallangan yangi avlod adgeziv tizimlarini ishlab chiqishga olib keldi. Bu tizimlar mikromexanik ushlab turishni kimyoviy bog‘lanish bilan birlashtirib, qayta tiklashning chidamliligiga hissa qo‘shadi.

Kalit so‘zlar - adgeziv tizimlar, qattiq tish to‘qimalari, bog‘lanish mustahkamligi.

АННОТАЦИЯ

Достижения в адгезивной стоматологии привели к разработке адгезивных систем нового поколения, предназначенных для усиления связывания с твердыми тканями зубов и улучшения клинических результатов. Эти системы сочетают микромеханическое удержание с химическим связыванием, способствуя долговечности восстановления.

Ключевые слова: адгезивные системы, восстановительная стоматология, твердые ткани зубов и прочность связей, композитное восстановление, клиническое исследование.

Introduction

Restorative dentistry is closely related to biological and medical sciences due to its focus on preserving the structural and functional integrity of dental tissues. Adhesive systems play a fundamental role in ensuring stable interaction between restorative materials and biological substrates such as enamel and dentin.

New-generation adhesive systems incorporate functional monomers, including 10-methacryloyloxydecyl dihydrogen phosphate (10-MDP), which provide chemical bonding and increased resistance to hydrolytic degradation. These properties are of particular interest from a biomedical perspective, as they influence long-term tissue–material interaction and restoration success.

Objective To conduct a clinical and laboratory assessment of new-generation adhesive systems in the restoration of hard dental tissues.

Materials and Methods

The study involved 60 patients aged 18–45 years. A total of 120 restorations were performed in teeth affected by carious and non-carious lesions. Cavity preparation followed minimally invasive principles. A universal adhesive system was applied using the selective-etch technique, followed by restoration with a nanohybrid light-cured composite.

Clinical evaluation was performed immediately after treatment and at 6 and 12 months using modified USPHS criteria, including:

- marginal adaptation
- retention
- postoperative sensitivity



- color stability

Laboratory Study

Forty extracted human premolars were divided into two groups:

- Group I: new-generation adhesive system
- Group II: conventional etch-and-rinse adhesive

Shear bond strength testing was conducted using a universal testing machine at a crosshead speed of 1 mm/min.

Statistical Analysis

Data were analyzed using descriptive statistics and Student's t-test. Statistical significance was set at $p < 0.05$.

Results

Clinical evaluation after 12 months showed:

- excellent marginal adaptation in 96.7% of restorations
- complete retention in 98.3% of cases
- absence of secondary caries
- postoperative sensitivity in 5% of patients, which was transient

Laboratory testing revealed significantly higher bond strength values for new-generation adhesive systems (29.4 ± 3.2 MPa) compared with conventional systems (22.1 ± 2.8 MPa; $p < 0.001$).

Discussion

The obtained results confirm that new-generation adhesive systems demonstrate superior bonding performance due to their chemical interaction with dental hard tissues. From a biological and medical perspective, improved adhesion reduces microleakage, secondary caries risk, and pulpal irritation, contributing to long-term restoration success.

Conclusion

New-generation adhesive systems exhibit high clinical reliability and superior laboratory bond strength. Their use enhances the biological compatibility and durability of restorations, making them an effective solution in modern restorative dentistry within the field of biology and medicine.

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