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MODERN APPROACHES TO RESTORING ENDODONTICALLY TREATED TEETH USING ADHESIVE TECHNIQUES




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АДГЕЗИВ ТЕХНОЛОГИЯЛАРДАН ФОЙДАЛАНГАН ҲОЛДА ЭНДОДОНТИК ДАВОЛАНГАН ТИШЛАРНИ ТИКЛАШГА ЗАМОНАВИЙ ЁНДАШУВЛАР

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СОВРЕМЕННЫЕ ПОДХОДЫ К ВОССТАНОВЛЕНИЮ ЭНДОДОНТИЧЕСКИ ЛЕЧЕННЫХ ЗУБОВ С ИСПОЛЬЗОВАНИЕМ АДГЕЗИВНЫХ ТЕХНОЛОГИЙ

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Резюме. *Адгезив стоматология соҳасидаги ютуқлар эндодонтик даволанган тишларни (ЭДТ) тиклаш стратегияларини сезиларли даражада ўзгартирди. Штифтлар ва қистирмаларининг қуйма тизимларига анъанавий йўналиш аста-секин толалар билан мустаҳкамланган штифтларга ўз ўрнини бўшатиб берди, бу нафақат материалларда, балки реставрация фалсафасида ҳам парадигманинг ўзгаришини акс еттиради. Аввалги ёндашувларда механик мустаҳкамликка устуворлик берилган бўлса, ҳозирда йемирилиш моделларига, хусусан, ҳалокатли, тикланмайдиган синишлар хавфига - ҳатто толали штифтли тизимлардан фойдаланилганда ҳам тобора кўпроқ еътибор қаратилмоқда. Ушбу танқидий шарҳда ЭДТда адгезив тикланиш стратегиялари бўйича замонавий маълумотлар умумлаштирилган бўлиб, тиш тож қисмининг турли даражадаги йўқолиши ҳолатларига алоҳида еътибор қаратилган. Кўриб чиқиладиган асосий мавзулар қисман ва тўлиқ реставрацияларни таққослаш, феррул эффектининг аҳамияти, штифт туриниг йемирилиш табиатига таъсири ва эндокоронкалар ва тўғридан-тўғри ёпишқоқ ўстиришлар каби штифсиз муқобилларнинг самарадорлигини ўз ичига олади. Қолган тиш тўқималарининг миқдори ва сифати ЭДТнинг клиник муваффақиятида ҳал қилувчи рол ўйнайди деган умумий фикрга қарамай, илдиз синишининг олдини олишда штифт тизимларининг роли ва штифт қўйишдан тўлиқ воз кечишнинг нисбий афзалликлари ҳақида қарама-қарши маълумотлар сақланиб қолмоқда. Ушбу ноаниқликни ҳисобга олган ҳолда, замонавий штифциз адгезив усулларнинг анъанавий штифтли усулларга нисбатан самарадорлиги ва ишончлилигини тасдиқлаш учун кейинги узоқ муддатли клиник тадқиқотлар зарур.*

Калит сўзлар*: тиш, невитал, стоматологик материаллар, коронкалар, тишлар реставрациясининг муваффақияцизлиги, тишларни маҳкамлаш.*

Abstract. *Advancements in adhesive dentistry have significantly transformed the restoration strategies for endodontically treated teeth (ETT). The traditional reliance on cast post-and-core systems has gradually given way to fiber-reinforced posts, reflecting a paradigm shift not only in materials but also in restorative philosophy. While earlier approaches prioritized mechanical strength, contemporary focus has increasingly turned to failure patterns, particularly*

the risk of catastrophic, non-restorable fractures—even with fiber post systems. In response, postless restorative concepts have emerged, aiming to enhance the reparability and long-term prognosis of ETT. This critical review synthesizes the current evidence regarding adhesive restoration strategies for ETT, with particular emphasis on cases involving varying degrees of coronal tooth structure loss. Key topics addressed include the impact of partial versus full-coverage restorations, the significance of the ferrule effect, the influence of post type on failure modes, and the viability of postless alternatives such as endocrowns and direct adhesive build-ups. Despite a general consensus that the quantity and quality of remaining tooth structure are pivotal to the clinical success of ETT, conflicting data persist regarding the role of post systems in preventing root fractures and the relative benefits of avoiding post placement altogether. Given these uncertainties, further long-term clinical investigations are warranted to validate the effectiveness and reliability of modern postless adhesive techniques in comparison to conventional post-based methods.

Keywords: *tooth, nonvital, dental materials, crowns, dental restoration failure, dental bonding.*

Introduction. The optimal method for restoring endodontically treated teeth (ETT) continues to be an area of clinical controversy and scientific discussion. Such teeth demonstrate significant alterations in their mechanical behavior compared to vital teeth, primarily due to cumulative structural loss resulting from caries, trauma, crack propagation, and extensive hard tissue removal during access cavity preparation and endodontic instrumentation [1–7]. These structural and biomechanical alterations weaken the natural resistance of the tooth to masticatory stress, thereby increasing its vulnerability to fracture.

A major clinical concern involves selecting the most reliable restorative approach for ETT, as these teeth inherently exhibit a higher probability of biomechanical failure than vital ones. From a biomimetic perspective, the preservation of intact dental tissues plays a crucial role in maintaining equilibrium between the biological, mechanical, adhesive, and functional aspects of the tooth-restoration complex. Therefore, minimally invasive restorative concepts that prioritize the conservation of sound enamel and coronal dentin are strongly recommended. Excessive removal of hard tissues during endodontic or restorative procedures may disrupt the biomechanical integrity of the tooth and negatively influence its long-term prognosis [11].

Quantitative studies, such as those by Dietschi et al., [4] have emphasized the impact of cavity depth, isthmus width, and overall cavity configuration on residual tooth stiffness and fracture resistance. Among these factors, the presence of a vertical coronal dentin band—commonly referred to as the *ferrule*—has been consistently identified as a critical determinant of favorable stress distribution and structural integrity in ETT. [12–16] Nevertheless, in many clinical situations, sufficient coronal tooth structure may be absent, rendering the establishment of an adequate ferrule challenging or unfeasible.

In recent years, the development of reliable adhesive systems has significantly broadened the spectrum of restorative options available for ETT. Traditional materials such as cast metal posts and amalgam cores are increasingly being replaced by more conservative alternatives, including fiber-reinforced posts, direct composite cores, and adhesive full-coverage restorations made from ceramic or composite resins. [17–18] Moreover, the emergence of postless restorative concepts—such as endocrowns and direct adhesive build-ups—has gained traction due to their minimally invasive nature and simplified clinical workflow. [19–20]

Despite these advancements, clinicians are still confronted with a critical decision: should an ETT be restored with or without a post? This question underscores the need for an evidence-based understanding of how different restorative techniques affect tooth longevity and failure modes.

The aim of this critical review is to evaluate the current literature on adhesive restorative strategies for ETT, with particular emphasis on recent trends favoring minimally invasive and postless techniques. Special attention is given to the role of the remaining tooth structure, the ferrule effect, and the clinical implications of various adhesive materials and protocols.

Preserving the coronal structure. The replacement of dental restorations often initiates a self-perpetuating cycle of increasing structural compromise—a phenomenon known as the "restorative cycle of death," first described by Elderton in 1988 and later expanded upon by Simonsen in 1991. In this cycle, restorations are progressively replaced with larger and more invasive ones, eventually necessitating the use of post-and-core systems and, in many cases, culminating in tooth loss. This pattern highlights the importance of adopting restorative strategies that prioritize the long-term preservation of tooth structure. The philosophy of minimal intervention dentistry, originally developed to preserve healthy tissue during caries management, has increasingly gained traction in the context of endodontically treated teeth (ETT). Contemporary adhesive techniques facilitate conservative preparations and selective tissue removal, aligning with this principle and supporting a more biologically respectful approach to restoring ETT.

A strong correlation exists between the amount of preserved tooth structure and the fracture resistance of ETT. Conserving dentin and enamel not only enhances the biomechanical stability of the restored tooth but also reduces the incidence of catastrophic, non-repairable failures, thereby extending the tooth's functional lifespan. A critical strategy in

breaking or at least slowing the restorative cycle involves avoiding excessive reduction of healthy tooth structure. This can be achieved through the use of modern adhesive partial restorations—such as onlays and overlays—which preserve sound coronal tissue. This stands in contrast to the outdated "extension for prevention" philosophy, which promoted full-coverage crowns and led to substantial volumetric loss of tooth material.

However, in situations where full-coverage crown preparation is necessary and significant coronal tissue has already been lost, preserving the remaining vertical dentin—known as the *ferrule*—becomes paramount. Numerous studies have demonstrated that an adequate ferrule significantly enhances the mechanical performance and survival rate of ETT. In addition, advancements in magnification tools, electric handpieces, and adhesive protocols now allow clinicians to perform highly precise, minimally invasive restorations. These technological aids further support tooth structure conservation during restoration replacement, contributing to more favorable long-term outcomes.

Partial restorations versus full crowns on ETT. In contemporary restorative dentistry, there is a growing preference for direct composite and partial adhesive restorations over traditional full crowns, particularly for endodontically treated teeth (ETT). Adhesive techniques offer the advantage of being additive rather than subtractive, which allows the preservation of remaining coronal tooth structure and may reduce the risk of root fracture.

Historically, the standard protocol for ETT restoration has involved the placement of a post, core, and full-coverage crown following endodontic therapy. While this approach has been widely practiced and supported by various in vitro studies and clinical trials, a recent Cochrane review found insufficient evidence to support or refute the superiority of crown placement over direct restorations in cases of severely compromised ETT. This lack of high-quality evidence underscores the need to reconsider conventional practices in light of modern adhesive capabilities.

The development of adhesive dentistry has had a profound impact on treatment strategies for endodontically treated teeth (ETT). Earlier restorative protocols relied on traditional post-and-core systems designed for cement-retained full crowns, such as porcelain-fused-to-metal crowns and cast post-and-core restorations, which required extensive mechanical preparation to ensure macromechanical retention. In contrast, modern adhesive restorations—both direct and indirect—enable a more conservative approach. When bonded to the remaining coronal tooth structure, particularly enamel, these restorations can achieve strong retention and resistance without the need for excessive removal of dental tissues.

A systematic review conducted by Suksaphar et al. evaluated the survival rates of posterior ETT restored with either full crowns or resin composite restorations. The review incorporated data from a randomized clinical trial, a prospective cohort study, and a retrospective analysis. Reported survival rates ranged from 94%–100% for teeth restored with crowns and 91.9%–100% for those with resin composite restorations. Although a meta-analysis was not possible due to methodological variability among the studies, the authors concluded that when the loss of tooth structure is minimal or moderate, both restoration types provide comparable survival outcomes.

After endodontic treatment, especially in cases where marginal ridges are lost and extensive access preparations have been carried out, the structural integrity of the tooth is significantly compromised, resulting in increased flexural deformation. In such situations, the use of bonded partial restorations should be preferred, as they not only preserve enamel and dentin but also reduce biomechanical disruption and help maintain the functional integrity of the restored tooth.

Both direct and indirect adhesive restorations have been advocated for cuspal coverage, allowing clinicians to avoid traditional axial wall reduction required for full-crown retention. Composite materials, in particular, have furthered the shift away from mechanical retention toward adhesive retention, enabling minimally invasive restorations even in structurally compromised teeth. This trend toward preservation aligns with contemporary biomimetic principles and is increasingly accepted in clinical practice.

Despite the growing popularity of partial adhesive restorations, the current literature lacks direct comparative studies between direct composite restorations and adhesive indirect restorations such as ceramic onlays or crowns. As such, further clinical trials are warranted to evaluate whether extensive preparation for full-crown restorations is justified in cases where indirect adhesive techniques may provide equivalent or superior outcomes with less biological cost.

The Role of the Ferrule in the Survival of Full-Coverage Crowns in ETT. The restoration of endodontically treated teeth (ETT) often poses a biomechanical challenge due to substantial loss of coronal structure resulting from endodontic access, extensive caries, restorative interventions, or trauma. This reduction in remaining tooth structure has been consistently correlated with decreased long-term survival of restored ETT [35].

The ferrule concept—defined as a circumferential band of sound tooth structure surrounding the core, located apically to the crown margin—has been extensively investigated and is widely recognized as a critical factor for improving the biomechanical performance of full-coverage restorations. Multiple clin-

ical and experimental studies have confirmed that the presence of a ferrule significantly enhances fracture resistance and overall longevity of restorations. For instance, a prospective study by Creugers et al. demonstrated that porcelain-fused-to-metal crowns placed on teeth with less than 50% of residual coronal structure exhibited nearly double the failure risk compared with those having more than half of the coronal structure preserved.

A systematic review by Sorensen et al. [12], incorporating data from laboratory studies, finite element analyses, and clinical trials, concluded that a ferrule height of 1.5–2 mm consistently contributes to improved fracture resistance. Moreover, an adequate ferrule can minimize the influence of other factors such as post-and-core material, type of luting cement, and restoration design. Conversely, a recent meta-analysis restricted to clinical studies reported no statistically significant difference in failure rates between restorations with and without a ferrule when using glass-fiber post-and-core systems. However, the limited number of clinical trials (only two meeting inclusion criteria) weakens the strength of these findings and underscores the need for further high-quality research to establish definitive clinical guidelines.

Taken together, the available evidence suggests that while the ferrule remains a biomechanically beneficial feature, particularly in full-coverage restorations, its absence may be partially compensated for by advanced adhesive strategies and material properties. Nevertheless, the clinical implementation of a ferrule, when feasible, continues to be considered a best practice to optimize long-term outcomes.

Several adjunctive techniques have been proposed to further optimize the adhesion and performance of postless restorations. Immediate dentin sealing (IDS), for example, has shown promise in improving bond strength at the adhesive interface. Indirect composite restorations have also been suggested for enhancing mechanical properties and stress distribution in structurally compromised teeth. These contemporary strategies work synergistically to create a cohesive restorative complex that more closely emulates the biomechanical behavior of the dentin–enamel junction.

Recent studies evaluating both anterior and posterior ETT with sufficient ferrule height have demonstrated favorable outcomes using postless restorative techniques. In such cases, crown retention is primarily achieved through adhesive bonding to the ferrule-retained composite build-up rather than through frictional retention of a post within the root canal. This strategy not only simplifies the clinical procedure but also reduces the risk of root perforation and stress concentration commonly associated with post placement.

Given that the presence of an adequate ferrule is already well-established as a critical determinant in the longevity and fracture resistance of ETT, preserving sound tooth structure becomes a central priority. By adopting minimally invasive, precision-based techniques—including the use of magnification, controlled instrumentation, and conservative adhesive restorations—clinicians can maintain the integrity of the ferrule. This, in turn, helps interrupt the so-called "restorative cycle of death," thereby enhancing the prognosis of ETT over the long term.

Preserving Tooth Structure through Precision and Minimally Invasive Treatment in ETT. Precision is a cornerstone of minimally invasive dentistry, particularly in the restoration of endodontically treated teeth (ETT), where preservation of remaining tooth structure is essential for long-term success. High levels of visual and tactile control—achievable through the use of magnification and advanced instrumentation—allow clinicians to selectively remove only infected or structurally compromised tissue, thereby minimizing unnecessary loss of sound dentin and enamel.

One of the critical technological advancements in this regard is the shift from high-speed air-driven turbines to electric handpieces with low-speed and high-torque functionality. Unlike air turbines, electric handpieces provide enhanced tactile feedback and greater control during caries excavation and cavity preparation. This is particularly relevant in ETT, where even minor structural loss can significantly affect fracture resistance and survival.

Numerous studies have demonstrated a direct correlation between the quantity of residual coronal structure and the survival rate of ETT. As such, preserving the coronal dentin and enamel during restorative procedures becomes paramount. The use of electric handpieces facilitates more controlled and conservative tooth preparation, especially in compromised teeth with weakened structural integrity. Modern restorative principles advocate for cavity designs that respect the three-dimensional architecture of the lesion rather than adhere to traditional geometric outlines. This tailored approach enables more precise and tissue-conserving preparations. A wider cavity, particularly involving the marginal ridges and occlusal isthmus, is strongly associated with reduced fracture strength and increased susceptibility to structural failure. Therefore, limiting cavity width and avoiding aggressive tooth reduction are crucial to maintaining the biomechanical integrity of ETT.

Biomimetic restorative strategies emphasize the reinforcement of the remaining tooth structure through adhesive bonding of partial restorations. These techniques aim not only to restore function and aesthetics but also to mimic the biomechanical behavior of natural dentin-enamel complexes by creating a unified, resilient structure. Visual accuracy further

enhances precision in restorative dentistry. The integration of magnification devices—such as dental loupes and operating microscopes—alongside enhanced illumination systems has been shown to significantly improve the detection of carious tissue, the evaluation of preparation margins, and the adaptation of restorations.

In summary, the integration of magnification, advanced rotary instrumentation, and adhesive protocols enables a precision-driven, minimally invasive approach that maximizes tooth structure preservation. This strategy is especially critical in endodontically treated teeth, where the remaining coronal architecture plays a decisive role in determining long-term outcomes.

Adhesive Micromechanical Retention versus Macromechanical Retention and Catastrophic Failure in ETT. Traditionally, the restoration of endodontically treated teeth (ETT) with extensive coronal tissue loss has relied on the use of post-and-core systems to retain full-coverage restorations. In cases where less than 2 mm of coronal tooth height remains—insufficient to achieve a ferrule effect—cast post-and-core techniques have historically been indicated to provide mechanical retention. However, such approaches are not without drawbacks. They are time-intensive, incur higher laboratory and material costs, and, most critically, are associated with unfavorable failure modes due to their biomechanical mismatch with dentin.

Posts fabricated from metal alloys possess a significantly higher elastic modulus than natural dentin, resulting in stress concentration within the root canal system. These concentrated stresses may propagate apically and increase the risk of vertical root fractures, which are typically classified as catastrophic failures. Such failures often necessitate tooth extraction, thereby undermining the ultimate goal of restorative treatment: tooth preservation and maintainability

In summary, the choice of post-and-core technique must consider not only mechanical strength but also the long-term re-treatability and preservation of the tooth. The growing body of evidence favors adhesively bonded, fiber-reinforced posts for their capacity to reduce catastrophic outcomes and preserve tooth structure in the event of failure.

Endocrowns. The use of intraradicular posts in the restoration of endodontically treated teeth (ETT) has been associated with an increased risk of catastrophic root fracture, regardless of the post material employed. This risk, combined with the need for additional removal of healthy tooth structure during post space preparation, has led researchers to explore postless restorative alternatives. One such alternative is the endocrown—a monolithic restoration that utilizes the pulp chamber for macromechanical retention and simultaneously serves as both the crown and core structure. Endocrowns require a more conservative tooth preparation compared to traditional post-and-core restorations, as they preserve more of the remaining dental structure and simplify the clinical workflow. This conservative approach results in reduced chairside time and overall treatment cost. Furthermore, the advent of chairside computer-aided design/computer-aided manufacturing (CAD/CAM) systems has facilitated the fabrication of endocrowns in a single visit, further improving patient convenience and procedural efficiency.

As their popularity has grown, numerous clinical reports have demonstrated the successful use of endocrowns, detailing standardized protocols for their fabrication and cementation. Finite element analyses have supported their biomechanical performance, shown favorable stress distribution and indicating that endocrowns can be a predictable and conservative solution for restoring endodontically treated posterior teeth—particularly maxillary premolars. Clinical data suggest a high short-term survival rate for endocrowns in posterior applications, ranging from 90% to 95%.

This approach is particularly advantageous for posterior non-vital teeth with extensive coronal destruction, offering a durable and minimally invasive solution that promotes long-term biomechanical stability and esthetic restoration.

Conversely, there is limited evidence regarding the application of endocrowns in the anterior region. Only a few finite element studies and a single in vitro investigation have evaluated their performance in anterior teeth. In one study, Ramírez-Sebastià et al. reported that anterior endocrowns fabricated with adhesive materials provided adequate retention and stress distribution, particularly when a 2 mm ferrule was present. However, no clinical trials have yet assessed their use in anterior dentition.

Final Considerations. The long-term survival of endodontically treated teeth (ETT) is fundamentally dependent on the quantity and quality of the remaining tooth structure following endodontic access and caries excavation. Consequently, the preservation of enamel, dentin, and the dentinoenamel junction (DEJ) becomes paramount when planning the restorative phase. Current evidence supports the preference for bonded partial restorations over traditional full-coverage crowns, as they allow for more conservative tissue preservation and superior biomechanical integration.

Modern restorative strategies emphasize the paradigm shift from “extension for prevention” to “prevention of extension”. This shift advocates for minimally invasive protocols, which prioritize structural conservation and functional rehabilitation through adhesive techniques. The use of magnification (e.g., dental microscopes or loupes) and electric handpieces enhances the precision of operative pro-

cedures, enabling more controlled tooth preparation. Simultaneously, advancements in adhesive dentistry—particularly the implementation of proper isolation protocols and immediate dentin sealing (IDS)—have significantly improved bonding efficacy and longevity in restorative outcomes.

Given that the amount of residual tooth structure is a critical determinant of success, the traditional concept of extensive preparation for mechanical retention is increasingly viewed as obsolete. In cases where a ferrule effect is present, both in vitro and clinical studies have consistently shown that the use of intraradicular posts is not necessary for the successful restoration of ETT. In fact, these studies indicate that posts neither enhance retention of crowns or endocrowns nor improve clinical outcomes—and may even increase the risk of catastrophic failure, particularly in posterior teeth.

However, it is important to acknowledge that in specific clinical scenarios—particularly in restorations involving porcelain-fused-to-metal (PFM) crowns—some evidence suggests that the use of posts may contribute to increased survival rates of ETT. These findings highlight the need for a case-by-case assessment of biomechanical demands and restorative materials.

To refine clinical protocols and further validate postless, biomimetic approaches, additional high-quality clinical trials are required. These should compare adhesive crowns bonded to restorations with and without posts, thereby contributing to a deeper understanding of the interplay between tooth structure preservation, material selection, and long-term clinical success in restorative dentistry.

Literature:

1. Dietschi D, Duc O, Krejci I, Sadan A. Biomechanical considerations for the restoration of endodontically treated teeth: a systematic review of the literature. Part II. Evaluation of fatigue behavior, interfaces, and in vivo studies. Quintessence Int. 2008 Feb;39(2):117-29.
2. Dietschi D, Duc O, Krejci I, Sadan A. Biomechanical considerations for the restoration of endodontically treated teeth: a systematic review of the literature. Part 1. Composition and micro- and macrostructure alterations. Quintessence Int. 2007 Oct;38(9):733-43.
3. Magne P, Carvalho AO, Bruzi G, Anderson RE, Maia HP, Giannini M. Influence of no-ferrule and no-post buildup design on the fatigue resistance of endodontically treated molars restored with resin nanoceramic CAD/ CAM crowns. Oper Dent. 2014 Nov-Dec;39(6):595-602. https://doi.org/10.2341/13-004-L
4. Taha NA, Palamara JE, Messer HH. Cuspal deflection, strain and microleakage of endodontically treated premolar teeth restored with direct resin composites. J Dent. 2009 Sep;37(9):724-30. https://doi.org/10.1016/j.jdent.2009.05.027.
5. Zicari F, Van Meerbeek B, Scotti R, Naert I. Effect of ferrule and post placement on fracture resistance of endodontically treated teeth after fatigue loading. J Dent. Elsevier Ltd; 2013 Mar; 41(3):207-15. https://doi.org/10.1016/j.jdent.2012.10.004
6. Santos-Filho PC, Veríssimo C, Soares PV, Saltarelo RC, Soares CJ, Marcondes Martins LR. Influence of ferrule, post system, and length on biomechanical behavior of endodontically treated anterior teeth. J Endod. 2014 Jan;40(1):119-23. https://doi.org/10.1016/j.joen.2013.09.034
7. Magne P, Lazari PC, Carvalho MA, Johnson T, Del Bel Cury AA. Ferrule-effect dominates over use of a fiber post when restoring endodontically treated incisors: an in vitro study. Oper Dent. 2017 Jul/Aug;42(4):396-406. https://doi.org/10.2341/16-243-L
8. Lazari PC, Carvalho MA, Del Bel Cury AA, Magne P. Survival of extensively damaged endodontically treated incisors restored with different types of posts-and-core foundation restoration material. J Prosthet Dent. 2018 May;119(5):769-76. https://doi.org/10.1016/j.prosdent.2017.05.012
9. Kubaev A. S. et al. Patients associated injuries with fractures of the maxillofacial region: 118 Patients review //Достижения науки и образования. – 2022. – №. 1 (81). – С. 90-94.
10. Opdam NJ, Bronkhorst EM, Loomans BA, Huysmans MC. 12-year survival of composite vs. amalgam restorations. J Dent Res. 2010 Oct;89(10):1063-7. https://doi.org/10.1177/0022034510376071
11. Schwartz RS, Robbins JW. Post placement and restoration of endodontically treated teeth: a literature review. J Endod. 2004 May;30(5):289-301. https://doi.org/10.1097/00004770-200405000-00001
12. Magne P, Goldberg J, Edelhoff D, Güth JF. Composite resin core buildups with and without post for the restoration of endodontically treated molars without ferrule. Oper Dent. 2016 Jan-Feb;41(1):64-75. https://doi.org/10.2341/14-258-L
13. Opdam N, Frankenberger R, Magne P. From "direct versus indirect" toward an integrated restorative concept in the posterior dentition. Oper Dent. 2016 Sep;41 S7:S27-34. https://doi.org/10.2341/15-126-LIT
14. Yuan K, Niu C, Xie Q, Jiang W, Gao L, Huang Z et al. Comparative evaluation of the impact of minimally invasive preparation vs. conventional straight-line preparation on tooth biomechanics: a finite element analysis. Eur J Oral Sci. 2016 Dec;124(6):591-6. https://doi.org/10.1111/eos.12303
15. Rizaev J. A. et al. Immunological and Clinical Aspects of Oral Inflammatory Diseases in the Development of Postpartum Septic Complications //International Journal of Integrative and Modern Medicine. – 2024. – Т. 2. – №. 12. – С. 253-257.

16.Rizaev J. A. et al. The need of patients with systemic vasculitis and coronavirus infection in the treatment of periodontal diseases //Applied Information Aspects of Medicine (Prikladnye informacionnye aspekty mediciny). – 2022. – T. 25. – №. 4. – C. 40-45.
17.Rizaev J. A. et al. The use of tenoten for outpatient oral surgery in children //Journal of Modern Educational Achievements. – 2023. – T. 3. – №. 3. – C. 10-19.
18.Rizaev J. A. et al. Morphological Changes in the Oral Mucous Membrane in Patients with COVID-19 //American Journal of Medicine and Medical Sciences. – 2022. – T. 12. – №. 5. – C. 466-470.
19.Silva NR, Raposo LH, Versluis A, Fernandes-Neto AJ, Soares CJ. The effect of post, core, crown type, and ferrule presence on the biomechanical behavior of endodontically treated bovine anterior teeth. J Prosthet Dent. 2010 Nov;104(5):306- 17. https://doi.org/10.1016/S0022-3913(10)60146-1
20.Fennis WM, Kuijs RH, Kreulen CM, Verdonschot N, Creugers NH. Fatigue resistance of teeth restored with cuspal-coverage composite restorations. Int J Prosthodont. 2004 May- Jun;17(3):313-7.
21.Skupien JA, Cenci MS, Opdam NJ, Kreulen CM, Huysmans MC, Pereira-Cenci T. Crown vs. composite for post-retained restorations: a randomized clinical trial. J Dent. 2016;48:34- 9. https://doi.org/10.1016/j.jdent.2016.03.007
22.Fedorowicz Z, Carter B, Souza RF, Chaves CAL, Nasser M, Sequeira-Byron P. Single crowns versus conventional fillings for the restoration of root filled teeth. Cochrane Database Syst Rev. 2012 May;(5): CD009109
https://doi.org/10.1002/14651858.CD009109.pub2
23.Murphy F, McDonald A, Petrie A, Palmer G, Setchell D. Coronal tooth structure in root-treated teeth prepared for complete and partial coverage restorations. J Oral Rehabil. 2009 Jun;36(6):451-61. https://doi.org/10.1111/j.1365-2842.2009.01952.x
24.Suksaphar W, Banomyong D, Jirathanyanatt T, Ngoenwiwatkul Y. Survival rates against fracture of endodontically treated posterior teeth restored with fullcoverage crowns or resin composite restorations: a systematic review. Restor Dent Endod. 2017 Aug;42(3):157-67.
https://doi.org/10.5395/rde.2017.42.3.157
25.Kosimov, A. A., and B. N. Khabilov. "Оценка эффективности применения цифровых технологий при ортопедическом лечении съемными конструкциями." Integrative dentistry and maxillofacial surgery 4.2 (10) (2025): 70-76.

СОВРЕМЕННЫЕ ПОДХОДЫ К ВОССТАНОВЛЕНИЮ ЭНДОДОНТИЧЕСКИ ЛЕЧЕННЫХ ЗУБОВ С ИСПОЛЬЗОВАНИЕМ АДГЕЗИВНЫХ ТЕХНОЛОГИЙ

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Резюме. *Достижения в области адгезивной стоматологии существенно изменили стратегии реставрации эндодонтически леченных зубов (ЭЛЗ). Традиционная ориентация на литые системы штифтов и культевых вкладок постепенно уступила место штифтам, армированным волокнами, что отражает смену парадигмы не только в материалах, но и в философии реставрации. В то время как в более ранних подходах приоритет отдавался механической прочности, в настоящее время внимание все больше уделяется моделям разрушения, в частности риску катастрофических, не подлежащих восстановлению переломов — даже при использовании систем с волоконными штифтами. В ответ на это появились концепции безштифтового восстановления, направленные на повышение репаративности и долгосрочного прогноза ЭЛЗ. В этом литературном обзоре обобщены современные данные о стратегиях адгезивного восстановления при ЭЛЗ, с особым акцентом на случаях с различной степенью потери коронковой части зуба. Ключевые темы, которые будут рассмотрены, включают в себя сравнение частичных и полных реставраций, значение эффекта феррула, влияние типа штифта на характер разрушения и эффективность безштифтовых альтернатив, таких как эндокоронки и прямые адгезивные наращивания. Несмотря на общее мнение о том, что количество и качество оставшейся ткани зуба играют ключевую роль в клиническом успехе ЭЛЗ, сохраняются противоречивые данные о роли штифтовых систем в предотвращении переломов корня и относительных преимуществах полного отказа от установки штифта. Учитывая эту неопределенность, необходимы дальнейшие долгосрочные клинические исследования для подтверждения эффективности и надежности современных безштифтовых адгезивных методов по сравнению с традиционными методами с использованием штифтов.*

Ключевые слова*: зуб, невитальный, стоматологические материалы, коронки, несостоятельность реставраций зубов, фиксация зубов.*