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CHALLENGES IN THE MANAGEMENT OF TEETH WITH EXTENSIVE STRUCTURAL LOSS AFTER ENDODONTIC TREATMENT

DESAFIOS NO MANEJO DE DENTES COM GRANDE PERDA ESTRUTURAL APÓS ENDODONTIA

DESAFÍOS EN EL MANEJO DE DIENTES CON GRAN PÉRDIDA ESTRUCTURAL DESPUÉS DE LA ENDODONCIA

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Eduardo Loures Filho[1], Hellen Karina Silva de Mendonça[2], Maria Luisa Silva de Melo[3], Fabiana Oliveira Carvalho[4], Rafaela Mariana Fontes de Bragança[5], Amanda Cypriano Alves[6], Giulia Dias Ribeiro[7]

ABSTRACT

Endodontically treated teeth present increased susceptibility to fracture, mainly due to the loss of dental structure and associated biomechanical changes. The restorative management of these teeth, especially when there is extensive structural compromise, represents a significant clinical challenge and requires an evidence-based approach. The present study aimed to analyze, through a narrative literature review, the main restorative strategies and biomechanical factors involved in the rehabilitation of teeth with severe structural loss after endodontic treatment. The databases PubMed, Scopus, and Web of Science were consulted, including studies published between 2021 and 2025, such as clinical trials, systematic reviews, and laboratory studies. The findings indicate that the amount of remaining dental structure is the primary determinant of restorative success. The presence of a ferrule is associated with greater fracture resistance, while intraradicular posts play a fundamental role in core retention without providing significant structural reinforcement. Fiber glass posts exhibit more favorable biomechanical behavior, with better stress distribution and a lower incidence of irreparable fractures. Additionally, endocrowns have shown to be a conservative and effective alternative, with performance comparable to conventional restorations in selected cases. It is concluded that the success of restorative treatment depends on individualized planning, maximum preservation of dental structure, and appropriate selection of technique and materials, favoring minimally invasive approaches and greater clinical longevity.

Keywords: Endodontically Treated Teeth. Intraradicular Posts. Fiber Glass Posts. Endocrowns. Structural Loss.

[1] Graduated in Dentistry. Universidade Paulista (UNIP).
[2] Master's student in Dental Clinics. Faculdade Paulo Picanço (FACPP).
[3] Specialist in Endodontics. Faculdade de Odontologia do Recife (FOR).
[4] Dental Student. Faculdade de Excelência de Jequié (UNEX).
[5] Dr. in Dentistry. Universidade Federal de Sergipe (UFS).
[6] Professor in Operative Dentistry. Universidade Federal Fluminense (UFF).
[7] Master's student in Clinical Dentistry. Universidade do Grande Rio (UNIGRANRIO).

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RESUMO

Dentes tratados endodonticamente apresentam maior suscetibilidade à fratura, principalmente em decorrência da perda de estrutura dentária e das alterações biomecânicas associadas. O manejo restaurador desses dentes, especialmente quando há grande comprometimento estrutural, representa um desafio clínico relevante e exige uma abordagem baseada em evidências. O presente estudo teve como objetivo analisar, por meio de uma revisão narrativa da literatura, as principais estratégias restauradoras e os fatores biomecânicos envolvidos na reabilitação de dentes com perda estrutural severa após tratamento endodôntico. Foram consultadas as bases de dados PubMed, Scopus e Web of Science, incluindo estudos publicados entre 2021 e 2025, como ensaios clínicos, revisões sistemáticas e estudos laboratoriais. Os achados indicam que a quantidade de estrutura dentária remanescente é o principal determinante do sucesso restaurador. A presença de férula está associada a maior resistência à fratura, enquanto pinos intrarradiculares desempenham papel fundamental na retenção do núcleo, sem promover reforço estrutural significativo. Pinos de fibra de vidro apresentam comportamento biomecânico mais favorável, com melhor distribuição de tensões e menor incidência de fraturas irreparáveis. Além disso, as endocrowns têm se mostrado uma alternativa conservadora e eficaz, com desempenho comparável às restaurações convencionais em casos selecionados. Conclui-se que o sucesso do tratamento restaurador depende de planejamento individualizado, preservação máxima da estrutura dentária e seleção adequada da técnica e dos materiais, favorecendo abordagens minimamente invasivas e maior longevidade clínica.

Palavras-chave: Dentes Tratados Endodonticamente. Pinos Intrarradiculares. Pinos de Fibra de Vidro. Endocrowns. Perda Estrutural.

RESUMEN

Los dientes tratados endodónticamente presentan una mayor susceptibilidad a la fractura, principalmente debido a la pérdida de estructura dentaria y a los cambios biomecánicos asociados. El manejo restaurador de estos dientes, especialmente cuando existe un gran compromiso estructural, representa un desafío clínico relevante y requiere un enfoque basado en la evidencia. El presente estudio tuvo como objetivo analizar, mediante una revisión narrativa de la literatura, las principales estrategias restauradoras y los factores biomecánicos involucrados en la rehabilitación de dientes con pérdida estructural severa después del tratamiento endodóntico. Se consultaron las bases de datos PubMed, Scopus y Web of Science, incluyendo estudios publicados entre 2021 y 2025, tales como ensayos clínicos, revisiones sistemáticas y estudios de laboratorio. Los hallazgos indican que la cantidad de estructura dentaria remanente es el principal determinante del éxito restaurador. La presencia de férula se asocia con una mayor resistencia a la fractura, mientras que los postes intrarradiculares desempeñan un papel fundamental en la retención del muñón sin proporcionar un refuerzo estructural significativo. Los postes de fibra de vidrio presentan un comportamiento biomecánico más favorable, con mejor distribución de tensiones y menor incidencia de fracturas irreparables. Además, las endocrowns han demostrado ser una alternativa conservadora y eficaz, con un desempeño comparable al de las restauraciones convencionales en casos seleccionados. Se concluye que el éxito del tratamiento restaurador depende de una planificación individualizada, la máxima preservación de la estructura dentaria y la selección adecuada de la técnica y los materiales, favoreciendo enfoques mínimamente invasivos y una mayor longevidad clínica.

Palabras clave: Dientes Tratados Endodónticamente. Postes Intrarradiculares. Postes de Fibra de Vidrio. Endocrowns. Pérdida Estructural.

1 INTRODUCTION

Endodontically treated teeth (ETD) have a significantly higher risk of fracture compared to vital teeth, a phenomenon mainly attributed to the substantial loss of tooth structure due to extensive caries, previous restorations, and the preparation of the access cavity (Alenezi et al., 2024; Spicciarelli et al., 2021). The biomechanics of these teeth are altered, resulting in a reduction in structural stiffness that compromises long-term prognosis (Popescu et al., 2022). Historically, fragility was believed to be caused by dentin dehydration or loss of vitality, but current evidence confirms that the integrity of the remaining dentin walls is the determining factor for fracture strength (Spicciarelli et al., 2021).

The management of teeth with large structural loss requires a critical decision between the use of intraradicular retainers (pins), total crowns, endocrowns (endocrowns) or more conservative approaches, such as the use of fiber reinforcement and/or cusp lowering (Mously et al., 2025; Alenezi et al., 2024; Vartak et al., 2025; Yüksek et al., 2025). The primary objective of post-endodontic rehabilitation should be to protect the remaining structure, restore function, and ensure aesthetics when necessary by minimizing stresses at the interface between the restorative material and the dentin (Popescu et al., 2022; Shereef et al., 2021). This study reviews contemporary evidence on restorative strategies and the biomechanical challenges involved in preserving these elements.

2 METHODOLOGY

The present study is characterized as a literature review of a narrative nature, focused on synthesizing scientific evidence on the clinical and biomechanical management of teeth with severe structural loss after endodontic treatment. Data collection was carried out in the PubMed, Scopus, and Web of Science databases, using the descriptors "Endodontically treated teeth", "significant structural loss", "post", "endocrown", and "fiber" articulated according to the MeSH terminology. The sample included high-impact articles published between 2021 and 2025, including clinical trials, systematic reviews with meta-analysis, and finite element analysis studies. Studies focused exclusively on deciduous teeth or purely endodontic techniques without a restorative focus were excluded. The curation process involved critical analysis of the

texts to extract data on fracture strength, fracture type, stress distribution, and survival rates. The information was organized in a descriptive way.

3 RESULTS

The literature establishes that the amount of remaining dentin tissue is the single most important predictor of restorative success. Results of biomechanical studies indicate that the removal of the mesial and distal walls (loss of marginal ridges) drastically reduces fracture resistance, and the presence of a *ferrule effect* of at least 1.5 to 2 mm in height is indispensable for the stability of the restoration (Spicciarelli et al., 2021; Mously et al., 2025).

Regarding intraradicular retainers, the evidence points to:

- **Fiberglass Pins (PFV):** They have a modulus of elasticity similar to that of dentin, which allows for a more uniform distribution of stresses along the root. Finite element analyses demonstrate that PFV reduces the risk of catastrophic root fractures compared to metal or zirconia pins (Popescu et al., 2022; Shereef et al., 2021).
- **Clinical Survival:** Recent meta-analyses suggest that pin placement does not necessarily increase the survival rate of DTE if there is sufficient coronary structure (2 walls or more). However, in teeth with severe structural loss (0-1 wall), the use of pins significantly improves core retention and crown stability (Alenezi et al., 2024).

As an alternative to traditional crowns on pins, endocrowns have gained prominence. In anterior and posterior teeth with severe coronary loss, endocrowns have demonstrated fracture resistance comparable to or superior to conventional crowns with a pin and core, with the advantage of being more conservative and requiring less root wear (Mously et al., 2025). In addition, the cementing system plays a vital role; the use of dual-cure resin cements (DCRC) plus PFV has shown superior results in terms of fracture strength compared to resin-modified ionomeric cements (Shereef et al., 2021).

4 DISCUSSION

The discussion about the management of teeth with large structural loss reveals a paradigm shift: from aggressive mechanical retention to biomimetic adhesion. Fracture resistance is a "fight" against the concentration of stresses. As demonstrated by Popescu

et al. (2022), the use of pins in endodontically treated canines helps to dissipate lateral forces, but excess wear to accommodate the post can dangerously weaken the cervical third of the root.

The debate about "pin or no pin" is mediated by the number of remaining walls. Alenezi et al. (2024) reinforce that the pin should be seen as a tool for retaining the restorative nucleus, and not as a structural reinforcement of the root. In cases of almost total coronary destruction, the endocrown discussed by Mously et al. (2025) emerges as a promising solution, as it uses the pulp chamber for macro-mechanical and micro-adhesive retention, avoiding manipulation of the root canal and preserving apical integrity.

Another critical point is the type of failure. Teeth restored with fiber pins tend to have "favorable" fractures (above the alveolar bone), allowing for retreatment, while teeth with high-rigidity pins (such as zirconia or metal) often suffer longitudinal root fractures (Shereef et al., 2021). It is concluded that restorative planning should be individualized, prioritizing the maintenance of the dentin ferula, the use of materials with biomechanical properties similar to dentin, and the adoption of rigorous adhesive techniques to ensure functional longevity (Spicciarelli et al., 2021; Alenezi et al., 2024).

5 CONCLUSION

The success of the restorative management of endodontically treated teeth (DTE) is directly related to the analysis of the remaining structure and individualized planning.

The longevity of the treatment depends mainly on the preservation of the tooth structure, the maintenance of the splint and the appropriate choice of the restorative method. The use of pins should be evaluated with criteria, and their main function is the retention of the restorative core in cases of great tissue loss, and not the structural reinforcement of the root, since they do not increase the strength of the tooth (Spicciarelli et al., 2021).

Fiberglass (PFV) pins stand out for having a modulus of elasticity similar to that of dentin, which favors a more homogeneous distribution of stresses along the root structure and reduces the risk of irreparable root fractures. In contrast, more rigid materials, such as zirconia, concentrate forces and can lead to unfavorable failure patterns. It is crucial to consider that fracture strength is related not only to the type of restorative material, but also to the quantity of remaining walls and the quality of adhesion, factors that influence stress distribution and failure pattern (Spicciarelli et al., 2021; Alenezi et al., 2024).

Regarding coronary restoration, crowns with cuspal coverage offer long-term predictability, but conservative solutions, such as *endocrowns*, can perform similarly when there is sufficient tooth structure.

Therefore, long-term clinical predictability is achieved through planning based on the analysis of the remaining structure, the selection of biomimetic materials, and the execution of rigorous adhesive techniques.

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