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Failures Of Post And Core: A New Proposed Classification

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Abstract:
Introduction*: this paper outlines criteria which allow the clinician to identify endodontically treated teeth that can be restored with a high level of predictability. The intent of the article is not to preclude the restoration of teeth that do not meet these criteria; it is to provide a science-based approach for identifying those teeth with a high probability of long-term success upon restoration.*
Methods*: a comprehensive literature review was conducted on post core restoration in endodontics, utilizing pubmed to identify relevant articles published between january 1970 and august 2015. Keywords such as "failure of post and core" and "classification of failure of post and core," which generated a total of 818 titles. The analyzed articles presented a variety of classifications proposed by different researchers, highlighting the diverse perspectives on the topic.*
Results*: despite various classifications, none address the failure of post and core in endodontically treated teeth. Therefore, there is a need for a new classification system based on this aspect. Here we propose a new system for etiological classification of post and core failures.*
Discussion*: the three main causes identified as per our proposed system of classification are biological causes, bio-mechanical causes and technical causes. These are discussed in great depth along with their specific outcomes.*
Conclusion*: implementation of the proposed classification system has the potential to improve treatment outcomes and patient care by facilitating tailored interventions based on the underlying causes of post and core failure.*
Keyword*: post core; classification of post core failures; causes of failure of post core*

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I. Introduction

This paper outlines criteria which allow the clinician to identify endodontically treated teeth that can be restored with a high level of predictability. The intent of the article is not to preclude the restoration of teeth that do not meet these criteria; it is to provide a science-based approach for identifying those teeth with a high probability of long-term success upon restoration. A tooth requiring a post needs, in addition, enough root length to allow a 4 mm apical seal and a post length--apical to the crown margin, equal to the length of the crown. It is essential to assess the functional loads to which the restored tooth would be subjected. Teeth that are endodontically treated, or are likely to be in future, should be avoided as abutments supporting precision attachment RPDs, distal extension RPDs or cantilever FPDs. The performance of reinforcement and build-up systems of non-vital teeth is reported in many studies (Sorensen & Martinoff, 1984a)

Deutsch et al., 1985; Plasmans, Welle & Vrijhoef, 1988; Hunter, Feiglin & Williams, 1989). Ever since endodontic treatment of the root canal could be performed in a reliable way, the cast post and core has been an accepted method. Clinical studies on the success rate of the cast post and core restorations are scarce (Stokes, 1987). Several authors (Roberts, 1970; Sorensen & Martinoff, 1984b; Bergman et al., 1989) found that failures of the cast post and core are not an exception. Especially in the anterior region failures seemed to occur relatively frequently.

II. Methods

A comprehensive literature review was conducted on post core restoration in endodontics, utilizing PubMed to identify relevant articles published between January 1970 and August 2015. The initial search yielded 509 titles, but disappointingly, no documentation pertaining to the classification of post and core failure was discovered. In response, subsequent searches were conducted using keywords such as "failure of post and core" and "classification of failure of post and core," which generated a total of 818 titles. Following meticulous screening, 39 articles met the stringent selection criteria, with each excluded article undergoing careful assessment before finalizing the list of included studies. The analyzed articles presented a variety of classifications proposed by different researchers, highlighting the diverse perspectives on the topic. However, despite the thorough search efforts and the wealth of information gathered, no existing classification system specifically addressing post and core failure in endodontically treated teeth was identified. This notable absence underscores a significant gap in the literature and highlights the pressing need for further research in this area. The lack of a standardized classification system may pose challenges in clinical practice, hindering the identification and effective management of post and core failures. This review provides valuable insights into the current state of research on post and core failure classification, serving as a foundation for future studies aimed at developing a comprehensive and universally accepted classification system in endodontics.

III. Results

Esteves and Corressia's clinical protocol for diagnosing extensively damaged teeth evaluates various criteria including the Ferrule effect, the relationship between root and crown length, and the endodontic condition. The criteria are divided into three main categories: Ferrule effect (Criterion 1), crown-to-root length relationship (Criterion 2), and endodontic condition (Criterion 3). Endodontic damage is classified into Class I, Class II, and Class III, with further classifications based on the remaining tooth structure. These classifications range from Class I, which involves access preparation with all four axial cavity walls intact, to Class V, where no cavity wall remains (decoronated tooth).Additionally, teeth are classified based on the number of primary canals in endodontically treated teeth, divided into Class I (one canal), Class II (two canals), and Class III (three canals). Each class is further subdivided based on the percentage of remaining tooth structure: complete (C), partial (P), or no clinical crown (N). This assessment considers the percentage of coronal tooth height post-preparation and the horizontal cross-section measurement in the gingival half following root canal treatment and preparation.

Kurrer introduced a classification for pulpless teeth requiring post and core based on the amount and retentive capacity of the tooth structure. A tooth restorability index was formulated to assess retention and resistance, dividing the tooth into six sections for observation and scoring. Despite various classifications, none address the failure of post and core in endodontically treated teeth. Therefore, there is a need for a new classification system based on this aspect. Here we propose a new system for etiological classification of post and core failures.

IV. Discussion

The primary types of reported failures include tooth fracture, post loosening, and post fracture. This breakdown sheds light on the observed failures in post-retained restorations. In most endodontically treated teeth, there is missing tooth structure caused by caries or existing restorations, loss of structural integrity associated with the access preparation and during mechanical instrumentation of the root canal system, mechanical pressure during obturation, lack of cuspal protection can weaken the tooth that led to a higher occurrence of fractures in endodontically treated teeth compared with “vital” teeth (Williams et al., 2006). Although posts have been recommended to strengthen the teeth, several investigators have cautioned that posts with inadequate resistance to rotational forces can weaken the teeth 1) Indeed, posts contribute significantly to stress distribution within the tooth structure. Utilizing restorative materials with biomechanical properties similar to dentine facilitates a relatively uniform distribution of stress to the tooth and surrounding tissues. This uniform stress distribution provides a protective effect against root fracture, as highlighted by Cagidiaco et al. in 2008. By selecting restorative materials that mimic the biomechanical characteristics of dentine, clinicians can help enhance the longevity and stability of post-retained restorations, reducing the risk of root fractures and improving overall treatment outcomes. The success of an endodontic treatment can be evaluated in a few ways. One way is simply by determining if the tooth remains in the mouth (survival), or by assessing if there are any pathological signs or symptoms present (success), especially in cases of initial endodontic therapy. A common method involves examining whether periapical lesions are present or absent, or observing if they decrease in size on radiographs over time.

Moreover, the quality of the coronal restoration after endodontic treatment is crucial. Suboptimal restorations may lead to contamination of the root canals and adversely impact treatment outcomes. These restorations are typically performed using bonding systems. Interestingly, cases have been reported where root canal retreatment is necessary despite no apparent issues with the permanent coronal restorations, indicating the

complexities involved in ensuring long-term success of endodontic treatments. Post-treatment apical periodontitis is primarily a microbiological issue because infection is present in nearly all cases associated with this condition, even in teeth that have undergone what appears to be adequate root canal treatments. The infection typically resides within the root canal system (intraradicular infection), although in some instances, it may extend to the surrounding peri-radicular tissues (extraradicular infection). Depending on when bacteria entered the root canal, intraradicular infection can be categorized as persistent or secondary. Persistent infection stems from bacteria present during the initial treatment that were not effectively eliminated or controlled.

Persistent infection is the primary cause of persistent post-treatment apical periodontitis. Secondary infection, on the other hand, arises from bacteria not initially present in the canal but introduced during treatment due to breaches in aseptic conditions or failures in the coronal seal after treatment. While secondary infection is likely the main cause of emergent and recurrent disease, persistent infections can also contribute to recurrent cases. It is theorized that the loss of cementum and dentine structure due to periodontal disease might increase root permeability to components of the periodontal space. This increased permeability could potentially compromise the bond strength of luting agents used to bond posts to root canal dentin.

Various restoration techniques have been proposed, each with its own criteria for success based on factors such as tooth length, diameter, shape, surface configuration, dentinal structure quantity, and the materials and techniques employed in the reconstruction process. For teeth with minimal to moderate damage, conservative approaches involving bonded direct composite restorations are often suitable. However, in cases where a significant portion of the coronal structure is lost, a common approach involves the use of a post to support a full crown.

The post serves primarily to enhance restoration retention and protect the tooth by distributing or dissipating forces along its structure. Choosing the most appropriate restoration technique depends on careful assessment of the extent of damage and consideration of long-term stability and functionality.

Failures resulting in the loss of retention are typically more manageable, while tooth fractures often necessitate nonrestorable outcomes, such as tooth extraction. There's a possibility that practitioners were more likely to recall submitting a questionnaire when a significant tooth fracture occurred, compared to instances where a post simply lost retention and needed recementation. This scenario could lead to an underestimation of the prevalence of loosened posts. The most frequently reported type of failure in post-retained restorations was tooth fracture, followed by loosening of the post and fracture of the post itself. Tapered posts were associated with a higher risk of tooth fracture compared to post loosening or fracture. Additionally, the relative risk of tooth fracture increased with the duration of functioning until failure. failures resulting in the loss of retention are typically easier to address, while tooth fractures often lead to irreversible consequences, such as the need for tooth extraction.

There's a chance that practitioners may be more likely to remember and report cases involving severe tooth fractures compared to instances where a post simply becomes loose and requires recementation. This bias might lead to an underestimation of the frequency of loosened posts. Alternatively, it's possible that the distribution of failure types has genuinely changed over time, reflecting a decrease in the use of smooth and tapered posts. This shift could be influenced by factors like advancements in materials, changes in treatment approaches, or evolving preferences in clinical practice. Thus, it's important to consider these potential factors when interpreting the observed patterns of failure in post-retained restorations,

Moreover, fracture of the post was more prevalent among male patients compared to female patients. These observations suggest gender-related differences in the types of failures experienced in post-retained restorations, emphasizing the importance of considering patient-specific factors when planning and performing such treatments. Taking various factors into account a classification has been proposed based on the various etiological origin of these failures and has been proposed in Figure 1.

V. Conclusion

- Esteves and Corressia's clinical protocol assesses extensively damaged teeth based on the Ferrule effect, crown-to-root length relationship, and endodontic condition, categorized into Class I, Class II, and Class III, with further subdivisions.
- Teeth in endodontic treatment are classified by the number of primary canals (Class I, II, III), considering the percentage of remaining tooth structure.
- Kurrer's classification for pulpless teeth needing post and core evaluates retention and resistance, dividing the tooth into six sections.
- Despite existing classifications, none directly address post and core failure in endodontically treated teeth.
- A new classification system is proposed to address this gap, focusing on etiological factors contributing to post and core failure.
- The proposed system aims to enhance understanding and management of post and core failures, providing a framework for more targeted treatment approaches.

- By considering specific etiological factors, such as post and core integrity, this new classification system can assist clinicians in identifying and addressing potential causes of failure more effectively.
- Implementation of the proposed classification system has the potential to improve treatment outcomes and patient care by facilitating tailored interventions based on the underlying causes of post and core failure.

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