

Integrated Periodontal, Endodontic, and Prosthodontic Rehabilitation of Compromised Teeth: A Multidisciplinary Case Report

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ABSTRACT

The preservation of structurally compromised teeth remains one of the most challenging objectives in contemporary dentistry. Advances in periodontal regeneration, endodontic surgery, biomaterials, and prosthodontic rehabilitation have significantly expanded the possibilities for retaining teeth that were previously considered hopeless. The present article examines the role of integrated periodontal, endodontic, and prosthodontic rehabilitation in the management of compromised teeth through a multidisciplinary framework supported by available evidence and a representative clinical case model. The study synthesizes current knowledge regarding periodontal regeneration, furcation management, hemisection procedures, apical surgery, regenerative biomaterials, and restorative rehabilitation strategies. A comprehensive review of the literature demonstrates that successful outcomes depend on accurate diagnosis, interdisciplinary treatment planning, biological preservation, and long-term maintenance. The proposed case-based analysis illustrates how coordinated management can restore function, aesthetics, and periodontal stability while avoiding premature extraction. Findings indicate that multidisciplinary rehabilitation provides predictable clinical outcomes when biological, mechanical, and restorative principles are integrated. The study highlights the importance of individualized treatment planning, regenerative technologies, and collaborative decision-making in extending tooth longevity. The article contributes to the growing evidence supporting conservative tooth preservation as a viable alternative to extraction and replacement therapy.

Keywords: Periodontal rehabilitation, Endodontic therapy, Prosthodontic rehabilitation, Multidisciplinary dentistry, Tooth preservation, Periodontal regeneration, Hemisection, Apical surgery, Regenerative biomaterials.

1. INTRODUCTION

1.1 Background

The management of severely compromised teeth represents a complex clinical challenge requiring the integration of multiple dental specialties. Periodontal destruction, pulpal pathology, furcation involvement, extensive coronal damage, and biomechanical instability frequently coexist in advanced dental disease. Historically, such teeth were often considered hopeless and extracted. However, advances in regenerative periodontology, endodontic microsurgery, and prosthodontic rehabilitation have transformed treatment philosophies toward conservation and functional preservation (Mehta et al., 2016).

Periodontal disease remains one of the principal causes of tooth loss worldwide. The pathogenesis of periodontitis involves a polymicrobial disruption of host homeostasis

that results in progressive destruction of supporting periodontal tissues (Darvean, 2010). The resulting attachment loss, alveolar bone resorption, and furcation involvement significantly compromise tooth prognosis. Nevertheless, modern regenerative procedures have improved clinicians' ability to reconstruct lost periodontal structures and maintain natural dentition.

The evolution of regenerative medicine has introduced novel therapeutic options including stem-cell-based therapies, biomaterial scaffolds, bone graft substitutes, and cell sheet technologies. These approaches have demonstrated substantial potential for periodontal tissue regeneration and biological restoration (Wang et al., 2014; Hernandez-Manjaraz et al., 2018). Simultaneously, advances in endodontic diagnosis and microsurgical intervention have enhanced the predictability of treatment for teeth exhibiting persistent periapical pathology (Abramovitz et al., 2002; von Arx, 2011).

The prosthodontic component is equally important because

periodontal and endodontic success must ultimately translate into long-term functional rehabilitation. Restorative strategies are required to redistribute occlusal forces, preserve structural integrity, and maintain aesthetic outcomes. Consequently, successful rehabilitation increasingly depends on multidisciplinary coordination rather than isolated specialty interventions.

Problem Statement

Despite considerable advances in dental treatment modalities, the management of teeth presenting with combined periodontal, endodontic, and restorative challenges remains controversial. Many clinicians continue to favor extraction when confronted with extensive attachment loss, furcation involvement, and endodontic complications. Such decisions may overlook the potential benefits of integrated treatment approaches that preserve natural dentition.

Research Relevance

Natural teeth possess biological, functional, and proprioceptive advantages that artificial replacements cannot fully replicate. Therefore, evidence-based strategies for retaining compromised teeth are of considerable clinical significance. The increasing availability of regenerative materials, microsurgical techniques, and interdisciplinary treatment protocols necessitates a comprehensive evaluation of their collective application.

Objectives

The objectives of this article are:

1. To evaluate the theoretical basis of multidisciplinary rehabilitation of compromised teeth.
2. To review current evidence regarding periodontal, endodontic, and prosthodontic interventions.
3. To present a case-based framework for integrated treatment planning.
4. To assess the clinical implications of tooth preservation strategies.
5. To identify limitations and future directions in multidisciplinary dental rehabilitation.

Scope and Significance

This article focuses on the interdisciplinary management of compromised teeth requiring periodontal, endodontic, and prosthodontic intervention. By integrating evidence from regenerative periodontology, endodontic surgery,

and restorative dentistry, the study aims to establish a comprehensive framework for conservative treatment and long-term tooth preservation.

2. LITERATURE REVIEW

The contemporary concept of multidisciplinary dental rehabilitation is rooted in the recognition that oral diseases rarely exist in isolation. Periodontal, pulpal, and restorative pathologies frequently interact, requiring integrated management strategies. The reviewed literature provides substantial evidence supporting conservative treatment approaches for preserving compromised teeth.

Darvean (2010) described periodontitis as a polymicrobial disease characterized by disruption of host homeostasis and chronic inflammatory destruction of supporting tissues. This conceptual framework emphasizes that successful treatment requires both microbial control and biological regeneration. The study established the biological foundation for modern periodontal therapy and highlighted the necessity of restoring periodontal stability before definitive restorative procedures.

The classification of periodontal defects remains critical for treatment planning. Cairo et al. (2011) developed a clinically relevant framework for assessing interproximal attachment loss and predicting root coverage outcomes. Their findings demonstrated that attachment level measurements provide valuable prognostic information regarding regenerative potential and treatment predictability. Because attachment loss significantly influences both periodontal and restorative prognosis, the Cairo classification continues to serve as a critical diagnostic tool in multidisciplinary rehabilitation. Furthermore, Cairo et al. (2011) emphasized that accurate assessment of attachment levels improves treatment planning and facilitates outcome prediction across diverse clinical scenarios.

Recent advancements in regenerative periodontology have significantly expanded therapeutic possibilities. Goldar et al. (2021) reviewed emerging periodontal regenerative materials and highlighted the growing role of biomimetic scaffolds, graft materials, and biologically active compounds. Their findings suggest that contemporary regenerative approaches can enhance tissue reconstruction while improving long-term clinical outcomes.

Similarly, Li Shue et al. (2012) analyzed biomaterials utilized in periodontal regeneration and identified ceramics and polymer-based scaffolds as important components of regenerative therapy. The authors emphasized the importance of material biocompatibility, structural stability, and osteoconductive properties in facilitating tissue repair. These findings support the integration of advanced biomaterials into multidisciplinary treatment protocols.

The emergence of regenerative medicine has introduced stem-cell-based therapies as potential alternatives to conventional

approaches. Hernandez-Manjaraz et al. (2018) reviewed the application of dental-derived mesenchymal stem cells in periodontal regeneration and concluded that these cells possess substantial regenerative capacity. Their work highlights future possibilities for biological reconstruction of periodontal defects that were previously considered irreversible.

An important development in regenerative dentistry is cell sheet technology. Wang et al. (2014) demonstrated that engineered cell sheets can promote periodontal regeneration through enhanced cellular organization and tissue integration. The technology offers potential advantages over traditional regenerative methods by facilitating coordinated tissue development and improved healing responses.

Bone grafting remains a cornerstone of periodontal regeneration. Kumar et al. (2019) provided a chronological review of bone graft materials used in periodontal therapy and documented the evolution from autogenous grafts to advanced synthetic and biologically engineered alternatives. Their analysis revealed increasing emphasis on regenerative predictability and tissue compatibility.

Furcation involvement continues to represent a major challenge in periodontal treatment. Newell (1998) discussed diagnostic and therapeutic considerations associated with molar furcation invasions and emphasized the importance of individualized treatment planning. The study highlighted the need for conservative interventions capable of maintaining strategic teeth despite advanced periodontal compromise.

One such conservative intervention is hemisection. Mishra et al. (2016) presented hemisection as an effective method of preserving multirooted teeth affected by localized pathology. The procedure allows removal of compromised root structures while retaining functional tooth segments capable of supporting restorative rehabilitation. The study reinforced the concept that extraction is not always the most appropriate treatment option.

Endodontic management constitutes another essential component of multidisciplinary rehabilitation. Abramovitz et al. (2002) evaluated factors influencing apical surgery outcomes and demonstrated the importance of careful case selection. Their findings suggest that successful surgical intervention depends upon accurate diagnosis, lesion characteristics, and restorative considerations.

Further advancements in endodontic microsurgery were reviewed by von Arx (2011), who documented improvements in surgical techniques, magnification systems, and biomaterials. These innovations have

substantially enhanced treatment predictability and expanded indications for tooth preservation.

A particularly relevant contribution was provided by Mehta et al. (2016), who introduced the concept of preserving the "hopeless tooth." Their work challenged traditional extraction-oriented philosophies and demonstrated that interdisciplinary treatment can successfully rehabilitate teeth previously considered unsalvageable. The study supports contemporary trends toward biological conservation and comprehensive rehabilitation.

Comparative analysis of the literature reveals a consistent shift from replacement-oriented treatment toward preservation-based strategies. While earlier approaches emphasized extraction and prosthetic replacement, contemporary evidence increasingly supports regenerative and multidisciplinary interventions. Nevertheless, significant challenges remain. Long-term evidence regarding stem-cell therapies and advanced regenerative technologies is limited. Variability in patient factors, defect morphology, and maintenance compliance also influences treatment outcomes.

The reviewed studies collectively establish the theoretical foundation for multidisciplinary rehabilitation. They indicate that successful management requires integration of periodontal regeneration, endodontic stabilization, and prosthodontic reconstruction. Furthermore, the literature demonstrates that attachment-level assessment remains a critical determinant of prognosis and treatment planning, reinforcing the continued relevance of the framework proposed by Cairo et al. (2011). The existing evidence therefore supports the development of structured multidisciplinary protocols aimed at maximizing tooth retention and long-term functional success.

3. METHODOLOGY

Study Design

This article adopts a research-review and case-based analytical methodology to examine the multidisciplinary rehabilitation of compromised teeth. The methodology integrates evidence obtained exclusively from the selected literature with a hypothetical clinical framework representing a tooth affected by advanced periodontal destruction, secondary endodontic involvement, and significant restorative compromise. The objective is not to evaluate a single treatment procedure but rather to analyze how coordinated periodontal, endodontic, and prosthodontic interventions collectively influence prognosis and long-term survival.

The methodological framework is based on the principle that successful tooth preservation requires sequential biological stabilization, structural rehabilitation, and functional restoration. Therefore, the treatment model is organized into three interconnected phases: periodontal management, endodontic intervention, and prosthodontic reconstruction.

Diagnostic Framework

Accurate diagnosis represents the foundation of multidisciplinary treatment planning. Clinical examination should include assessment of periodontal attachment loss, probing depth, furcation involvement, mobility, occlusal relationships, pulpal status, and restorative condition.

The attachment-level classification proposed by Cairo et al. (2011) provides an important diagnostic tool for evaluating periodontal prognosis and regenerative potential. Assessment of interproximal attachment levels allows clinicians to estimate the predictability of root coverage and regenerative outcomes. In multidisciplinary rehabilitation, such classification assists in determining whether preservation remains biologically feasible.

Radiographic evaluation is equally essential. Periapical radiographs and advanced imaging modalities facilitate assessment of bone loss patterns, periapical pathology, root morphology, and structural integrity. The combination of clinical and radiographic findings enables comprehensive treatment planning and risk assessment.

Phase I: Periodontal Stabilization

Control of Disease Activity

The initial treatment objective is elimination of active periodontal disease. According to Darvean (2010), periodontitis results from microbial dysbiosis that disrupts host homeostasis and promotes chronic inflammation. Consequently, disease control requires reduction of bacterial burden and restoration of periodontal health.

Scaling and root planing serve as the first stage of therapy. Mechanical debridement removes biofilm and calculus deposits, reducing inflammatory activity and improving tissue response. Oral hygiene reinforcement is simultaneously implemented to ensure long-term plaque control.

Regenerative Periodontal Therapy

Following disease stabilization, regenerative procedures may be considered for residual periodontal defects. The selection of regenerative materials depends on defect morphology, attachment loss severity, and patient-specific factors.

Goldar et al. (2021) emphasized that modern regenerative materials provide enhanced opportunities for reconstruction of lost periodontal tissues. These materials function by promoting cellular migration, tissue organization, and bone formation.

Similarly, Li Shue et al. (2012) demonstrated that ceramic and polymer-based biomaterials possess favorable regenerative characteristics. Their application contributes to improved structural support and biological integration within periodontal defects.

Bone grafting remains a central component of regenerative treatment. Kumar et al. (2019) described the evolution of graft materials from traditional autogenous grafts to advanced synthetic substitutes capable of supporting tissue regeneration. In the proposed rehabilitation model, bone grafting may be employed in vertical defects and furcation areas to improve attachment gain and support long-term stability.

Advanced Regenerative Approaches

Emerging regenerative strategies have introduced stem-cell and cell-sheet technologies into periodontal therapy.

Hernandez-Manjaraz et al. (2018) reported that dental-derived mesenchymal stem cells possess substantial regenerative potential. These cells contribute to tissue repair through differentiation and secretion of bioactive mediators that enhance healing.

Wang et al. (2014) further demonstrated that cell sheet technology offers an innovative platform for coordinated periodontal regeneration. Cell sheets preserve extracellular matrix components and cellular interactions, thereby facilitating organized tissue development. Although still developing clinically, these technologies represent promising future directions for management of severe periodontal defects.

Phase II: Endodontic Rehabilitation

Endodontic Diagnosis

Following periodontal stabilization, pulpal evaluation becomes essential. Teeth exhibiting pulpal necrosis, chronic apical periodontitis, or persistent infection require endodontic treatment to eliminate microbial reservoirs and prevent reinfection.

Accurate diagnosis is particularly important because periodontal and endodontic lesions frequently present with overlapping clinical manifestations. Failure to distinguish between primary periodontal and primary endodontic pathology may result in inappropriate treatment planning.

Conventional Endodontic Therapy

Root canal treatment aims to remove infected tissue, disinfect the canal system, and establish a hermetic seal. Successful treatment eliminates microbial contamination and supports periapical healing.

Within the multidisciplinary framework, endodontic treatment provides biological stability necessary for subsequent restorative rehabilitation. It also prevents continued periapical inflammation that could compromise periodontal regenerative outcomes.

Apical Surgery

Certain cases require surgical intervention due to persistent periapical pathology or anatomical limitations.

Abramovitz et al. (2002) emphasized that case selection significantly influences the success of apical surgery. Factors such as lesion size, root morphology, and restorative condition determine treatment predictability.

Von Arx (2011) documented substantial improvements in microsurgical techniques, including enhanced visualization, refined instrumentation, and superior retrograde filling materials. These developments have increased success rates and expanded indications for tooth preservation.

In the proposed framework, apical surgery serves as a supplementary procedure when conventional endodontic treatment alone is insufficient to achieve healing.

Phase III: Conservative Surgical Preservation

Furcation Management

Furcation involvement remains one of the most challenging periodontal conditions affecting multirooted teeth.

According to Newell (1998), successful furcation management depends upon precise diagnosis, accessibility, maintenance capability, and restorative considerations. Teeth exhibiting moderate furcation involvement may respond favorably to regenerative procedures and supportive periodontal therapy.

The multidisciplinary model prioritizes preservation whenever biologically feasible because strategic molars contribute significantly to occlusal stability and masticatory function.

Hemisection as a Preservation Strategy

When one root of a multirooted tooth is severely compromised while the remaining structure remains maintainable, hemisection may be indicated.

Mishra et al. (2016) described hemisection as a conservative alternative to extraction. The procedure removes the diseased root and associated crown segment while preserving healthy structures.

The principal advantages include:

- Retention of natural dentition.
- Preservation of alveolar bone.
- Maintenance of proprioception.
- Reduced need for extensive prosthetic replacement.

Within multidisciplinary rehabilitation, hemisection serves as an intermediate treatment option between complete extraction and full tooth preservation.

Phase IV: Prosthodontic Rehabilitation

Structural Reconstruction

After biological stabilization, restorative rehabilitation focuses on structural integrity and functional restoration.

Compromised teeth frequently exhibit extensive loss of tooth structure resulting from caries, trauma, endodontic access preparation, or periodontal destruction. Therefore, appropriate restorative design is essential for long-term survival.

The prosthodontic phase includes:

- Core build-up procedures.
- Full-coverage restorations when indicated.
- Occlusal adjustment.
- Splinting of mobile teeth where necessary.

Biomechanical Considerations

Successful prosthodontic rehabilitation requires careful distribution of occlusal forces.

Excessive loading may contribute to attachment loss, restorative failure, and root fracture. Consequently, prosthetic design must account for:

- Crown-to-root ratio.
- Remaining periodontal support.
- Occlusal scheme.
- Functional demands.

The multidisciplinary framework emphasizes that prosthodontic treatment should complement periodontal and endodontic objectives rather than compromise them.

Maintenance Protocol

Long-term maintenance is indispensable for treatment success.

Supportive periodontal therapy includes:

- Regular periodontal monitoring.
- Reinforcement of oral hygiene.
- Occlusal evaluation.
- Radiographic assessment.
- Early intervention for recurrent disease.

The importance of maintenance is supported by Cairo et al. (2011), whose work demonstrated that attachment stability remains a major determinant of long-term outcomes. Continuous evaluation of attachment levels enables clinicians to identify disease recurrence before significant tissue destruction occurs.

Proposed Clinical Workflow

The multidisciplinary treatment pathway may be summarized as:

Diagnosis → Periodontal Stabilization → Regenerative Therapy → Endodontic Treatment → Surgical Preservation (if required) → Prosthodontic Rehabilitation → Maintenance

This sequence ensures that biological health is established before definitive restorative procedures are performed. The framework also facilitates coordinated decision-making among specialists and promotes predictable long-term outcomes.

4. RESULTS

The analysis indicates that multidisciplinary rehabilitation significantly improves the prognosis of teeth traditionally classified as questionable or hopeless. Integration of periodontal regeneration, endodontic stabilization, and prosthodontic reconstruction creates a biologically favorable environment that supports long-term tooth retention.

The reviewed literature consistently demonstrates that periodontal regeneration has progressed beyond simple defect repair toward true tissue reconstruction. Studies involving regenerative biomaterials, stem-cell therapies, and cell-sheet technology suggest substantial improvements in attachment gain and periodontal healing (Goldar et al., 2021; Hernandez-Manjaraz et al., 2018; Wang et al., 2014). These developments increase the number of teeth considered suitable for preservation.

Endodontic advances similarly contribute to treatment success. Evidence from apical surgery studies indicates improved outcomes through refined microsurgical techniques and appropriate case selection (Abramovitz et al., 2002; von Arx, 2011). Elimination of periapical infection enhances the stability of periodontal and restorative treatment.

Conservative surgical procedures such as hemisection provide additional opportunities for tooth retention. Rather than extraction, selective removal of compromised root segments preserves function and alveolar bone while maintaining restorative options (Mishra et al., 2016).

The literature also highlights the prognostic significance of periodontal attachment assessment. The classification framework proposed by Cairo et al. (2011) remains valuable for evaluating regenerative potential, predicting treatment outcomes, and guiding multidisciplinary planning.

Overall, the findings support a treatment philosophy centered on preservation rather than replacement. Successful outcomes depend on accurate diagnosis, interdisciplinary coordination, regenerative capability, and patient compliance with maintenance protocols.

5. DISCUSSION

The findings of this review demonstrate that the rehabilitation of compromised teeth has evolved from a discipline-specific approach to a biologically integrated treatment model. Historically, extensive periodontal destruction, furcation involvement, and endodontic pathology were considered strong indications for extraction. However, contemporary evidence suggests that many of these teeth can be retained successfully when treatment planning incorporates periodontal, endodontic, and prosthodontic principles simultaneously. The concept of preserving the “hopeless tooth,” as discussed by Mehta et al. (2016), reflects a significant paradigm shift toward conservation-based dentistry.

One of the most important observations emerging from the literature is the central role of periodontal stability in determining long-term prognosis. Periodontitis initiates a cascade of inflammatory destruction affecting attachment apparatus and supporting bone (Darvean, 2010). Consequently, periodontal stabilization must precede definitive restorative procedures. The attachment-level classification developed by Cairo et al. (2011) provides an important prognostic framework because it allows clinicians to evaluate regenerative potential and predict treatment outcomes. The repeated relevance of attachment assessment throughout diagnosis, treatment planning, and maintenance highlights its value within multidisciplinary rehabilitation. Furthermore, Cairo et al. (2011) demonstrated that attachment measurements provide objective criteria for monitoring healing and identifying disease recurrence, making them indispensable for long-term evaluation.

The literature further indicates that regenerative technologies have transformed treatment possibilities. Traditional periodontal therapy primarily focused on arresting disease progression, whereas contemporary regenerative approaches aim to reconstruct lost tissues. Biomaterial-based regeneration, bone grafting, stem-cell applications, and cell-sheet technology collectively represent a major advancement in periodontal science (Goldar et al., 2021; Kumar et al., 2019; Wang et al., 2014). These innovations increase the likelihood of preserving teeth that previously exhibited poor prognoses. Nevertheless, while experimental and early clinical outcomes are encouraging, long-term evidence remains limited for certain advanced regenerative modalities, particularly stem-cell-based therapies.

The endodontic component of rehabilitation also plays a critical role in treatment success. Persistent infection within the root canal system can undermine periodontal healing and compromise restorative outcomes. Studies by Abramovitz et al. (2002) and von Arx (2011) suggest that improvements in microsurgical techniques and case selection have significantly enhanced the predictability of endodontic surgery. These findings reinforce the necessity of eliminating pulpal and periapical pathology before definitive prosthodontic reconstruction.

Another important theme identified in the literature is the value of conservative surgical procedures. Hemisection and furcation management strategies provide alternatives to extraction in carefully selected cases (Mishra et al., 2016; Newell, 1998). Such interventions preserve natural tooth structure, maintain alveolar bone, and support functional rehabilitation. Their success, however, depends upon strict maintenance protocols and appropriate prosthodontic design.

Despite these advantages, several limitations must be acknowledged. Multidisciplinary treatment frequently requires extended treatment duration, higher costs, and collaboration among multiple specialists. Patient compliance is another significant determinant of success. Inadequate oral hygiene, irregular maintenance visits, or unfavorable systemic factors may compromise outcomes regardless of treatment quality. Additionally, some severely compromised teeth may remain unsuitable for preservation despite advances in regenerative and surgical techniques.

From a practical perspective, the evidence supports individualized treatment planning rather than reliance on generalized prognostic categories. Teeth traditionally labeled as hopeless may still possess strategic value and biological potential when managed through an integrated framework. The decision-making process should therefore balance biological feasibility, patient expectations, functional requirements, and long-term

maintenance considerations. Ultimately, multidisciplinary rehabilitation represents a scientifically supported approach that aligns with contemporary principles of minimally invasive and preservation-oriented dentistry.

6. CONCLUSION

The management of compromised teeth requires a comprehensive understanding of periodontal, endodontic, and prosthodontic interactions. The present review demonstrates that successful rehabilitation is achievable when these disciplines function within a coordinated treatment framework. Contemporary evidence indicates that advances in regenerative biomaterials, stem-cell research, cell-sheet technology, endodontic microsurgery, and conservative surgical procedures have significantly expanded opportunities for tooth preservation.

Periodontal stabilization remains the biological foundation of treatment, while endodontic therapy eliminates infection and prosthodontic rehabilitation restores structural and functional integrity. The attachment-level classification proposed by Cairo et al. (2011) continues to provide valuable prognostic guidance throughout diagnosis, treatment planning, and maintenance. Furthermore, procedures such as hemisection and regenerative periodontal therapy offer viable alternatives to extraction in appropriately selected cases.

The principal contribution of this article is the presentation of a multidisciplinary framework that prioritizes preservation of natural dentition whenever biologically feasible. The findings suggest that teeth previously regarded as hopeless may achieve favorable long-term outcomes when managed through integrated treatment protocols. Future research should focus on long-term clinical evaluation of regenerative technologies, particularly stem-cell-based therapies and advanced tissue-engineering approaches, to further enhance the predictability of multidisciplinary rehabilitation.

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