



## Treatment of Young Permanent Tooth Literature Review

**Ahmed. N. AbdAlnabi,**

College Of Dentistry And Oral Surgery, Alasmara University, Zliten,Libya.

### Abstract

The management of young permanent teeth with immature roots is a significant challenge in pediatric dentistry, primarily due to their susceptibility to trauma and pulp necrosis. This paper explores advances in vital pulp therapy (VPT) and regenerative endodontic procedures (REP) as preferred methods for promoting continued root development and apical closure. A review of the literature highlights the efficacy of biomaterials, stem cell applications, and minimally invasive techniques in preserving pulp vitality and restoring structural integrity. Current trends favor regenerative approaches over traditional apexification, reflecting a shift toward biologically-driven methodologies that enhance long-term dental outcomes. This study synthesizes findings from systematic reviews, case reports, and meta-analyses to underscore the evolving understanding of therapeutic interventions for immature teeth. The findings advocate for evidence-based practices that prioritize tissue regeneration and functional restoration, paving the way for innovative solutions in pediatric dental care.

**Keywords:** Young permanent teeth, vital pulp therapy, regenerative endodontics, apexogenesis, stem cells, biomaterials.

### Introduction

The treatment of young permanent teeth, particularly those with immature roots, is a critical area of focus in pediatric dentistry, as these teeth are often subject to trauma and pulp necrosis. In the early work by 1, the authors highlight the importance of vital pulp therapy (VPT) as the preferred method for managing traumatic injuries to immature permanent teeth. Their case report illustrates how regenerative endodontic procedures can facilitate continued root development and apical closure, which are essential for strengthening the tooth structure[1]. This foundational understanding sets the stage for subsequent investigations into the efficacy and methodologies of regenerative treatments.

Building on this premise, 2 conducted a systematic review to synthesize findings related to endodontic regeneration therapies for immature necrotic permanent teeth[1]

[2]. They emphasize the importance of maintaining pulp vitality and the role of various treatment protocols, which include both human and animal studies. Their comprehensive analysis underscores the necessity of robust clinical guidelines and the potential of regenerative therapies to restore normal root development, a theme that resonates throughout the literature. In 2021, expanded the discussion by examining the broader implications of dental caries and trauma on young permanent teeth. They note the challenges pediatric dentists face when restoring extensively damaged teeth, advocating for conservative approaches when possible. Their review serves as a reminder that while regenerative techniques hold promise, the complexity of dental rehabilitation in young patients often necessitates a multifaceted approach, including the use of bonding agents and crown restorations[2] [3].

further contribute to the conversation by exploring the application of biomaterials and stem cells in dental tissue regeneration. They highlight the potential for using postnatal mesenchymal cells to indirectly generate dentin, emphasizing that while enamel damage is primarily addressed through remineralization, the regeneration of dentin and dental pulp remains a significant challenge. Their findings reinforce the need for innovative approaches in pediatric dentistry to address tooth loss due to caries. provide a systematic review and meta-analysis focused specifically on treatment protocols for pulpally involved young permanent teeth. They advocate for the preservation of noninflamed pulp tissue to promote apexogenesis and root development, reiterating the importance of maintaining pulp vitality[4] [5]. Their research reveals that newer regenerative techniques may outperform traditional apexification methods, aligning with the growing trend towards utilizing the regenerative capabilities of the pulp tissue. In the same year, present a narrative review that emphasizes the evolving understanding of VPT in the context of minimally invasive therapies. They discuss the advancements in bioceramic materials, which have improved the success rates of direct pulp capping procedures, particularly in young permanent teeth. Their insights suggest that a shift towards more conservative and tissue-preserving approaches could enhance long-term outcomes for these patients[6].

Finally, delve into the critical components necessary for successful regenerative therapies in endodontics, including stem cells, biomaterials, and growth factors. They identify existing challenges in achieving predictable clinical outcomes and the need for improved methodologies to enhance the regeneration of the pulp-dentin complex. Their work encapsulates the ongoing evolution of regenerative endodontics,

highlighting the importance of evidence-based practices that prioritize the vitality and functionality of young permanent teeth[7].

Through this literature review, the progression of knowledge regarding the treatment of young permanent teeth is evident, with a clear trajectory towards regenerative approaches that prioritize tooth vitality and structural integrity. Each article contributes to a comprehensive understanding of the complexities involved in managing these vulnerable teeth, ultimately guiding future research and clinical practice in pediatric dentistry[6] [7].

### **Literature review**

The article "Apexogenesis and revascularization treatment procedures for two traumatized immature permanent maxillary incisors: a case report"

This article provides valuable insights into the management of traumatic dental injuries in young patients, particularly focusing on immature permanent teeth. The authors emphasize the prevalence of dental trauma in children aged 7 to 10 years, which often results in pulpal and periapical diseases due to incomplete root development.

A critical evaluation of the article reveals that the authors effectively illustrate the importance of vital pulp therapy (VPT) as the preferred treatment for immature teeth with pulp exposure. By allowing the continuation of root development, VPT not only promotes apical closure but also enhances the structural integrity of the tooth. This is particularly significant in the context of young permanent teeth, where preserving pulp vitality is crucial for long-term success. The article also discusses the challenges faced when pulp vitality is compromised. The authors highlight various treatment modalities, including long-term calcium hydroxide apexification and one-visit apexification, which have traditionally been used in such scenarios. However, the authors advocate for regenerative endodontic procedures, which have gained traction in recent years. This method presents a notable advantage over apexification techniques, as it fosters the generation of vital tissue, thereby supporting root maturation.

The case report presented by the authors further substantiates their claims by comparing the outcomes of regenerative therapy with that of a contralateral tooth treated using VPT. This comparative analysis not only reinforces the efficacy of regenerative endodontics but also provides a practical framework for clinicians dealing with similar cases[1].

The article titled "Regenerative Endodontic Therapy in the Management of Immature Necrotic Permanent Dentition: A Systematic Review" by

provides a comprehensive examination of regenerative endodontic therapy (RET) as a treatment modality for immature permanent teeth with necrotic pulp. This systematic review synthesizes findings from various studies conducted between 2009 and 2019, focusing on both human and animal research, thereby offering a broad perspective on the efficacy and application of RET in clinical practice.

The authors meticulously outline their methodology, which involved extensive bibliographical searches in PubMed and Google Scholar, utilizing Mesh terms and Boolean operators to identify relevant studies. This systematic approach ensures a rigorous selection process, as studies included in the review were required to meet specific criteria, such as being original research articles published in English and directly addressing immature necrotic permanent teeth. The exclusion of studies that did not focus on root closure or development is particularly noteworthy, as it narrows the scope to those investigations that are most relevant to the treatment of the target population.

The review highlights critical variables such as the type of intracanal medication used, the scaffolds employed, and the maturation stage of the roots, which are essential for understanding the outcomes of RET. By extracting and analyzing data on these variables, the authors provide valuable insights into the factors that influence the success of regenerative treatments. Furthermore, the assessment of the risk of bias in included studies adds a layer of credibility to the findings, enabling readers to gauge the reliability of the evidence presented.

One of the key insights from this review is the potential of RET to promote root maturation and apical closure, which is crucial for the long-term prognosis of immature permanent teeth. The authors note that various techniques and materials have been explored, with varying degrees of success. This variability underscores the need for further research to standardize protocols and optimize treatment outcomes. Additionally, the review emphasizes the importance of follow-up duration in evaluating the efficacy of RET, as longer follow-up periods may yield more conclusive results regarding the success rates of different approaches[2].

The article "Posts in Primary Teeth–Past to Present: A Review of Literature" by provides a comprehensive overview of the challenges associated with treating dental caries and trauma in young permanent teeth, with a particular focus on primary teeth. The authors highlight that dental caries is the most prevalent chronic disease in childhood, often manifesting as early childhood caries (ECC), which predominantly affects maxillary central and lateral incisors. This condition is characterized by its

multifactorial etiology, including poor oral hygiene, cariogenic diets, and nighttime feeding practices.

A critical evaluation of the article reveals that the authors effectively synthesize existing literature to underscore the urgency of therapeutic intervention as outlined by the American Academy of Pediatric Dentistry (AAPD) guidelines. They argue that early intervention is crucial to prevent further destruction of the tooth structure, which is often neglected until the damage becomes severe. This point is particularly relevant as it draws attention to the common tendency of parents to seek dental care only when their children's teeth are significantly compromised. The authors suggest that this delay in treatment can complicate rehabilitation efforts, making it imperative for dental professionals to educate parents on the importance of early dental visits[3].

The article also discusses various treatment modalities for primary teeth, including conservative preparations and the application of dentin bonding agents, as well as the use of crowns when sufficient tooth structure remains. However, the authors acknowledge the limitations of primary anterior strip crowns, which are only applicable in cases where there is adequate enamel, thus presenting a clinical challenge in cases of extensive carious lesions. This limitation is significant, as it highlights the need for alternative restorative options in severely damaged primary incisors, where extraction has historically been the predominant treatment approach. Furthermore, the authors address the complexities involved in restoring severely mutilated incisors that may require pulpectomy and the use of intracanal posts. They emphasize the importance of evidence-based selection of intracanal posts, noting the challenges pediatric dentists face due to the variability in the available data. This aspect of the article is particularly valuable, as it points to a gap in knowledge that could benefit from further research and standardized guidelines[3].

The article titled "Application of Selected Biomaterials and Stem Cells in the Regeneration of Hard Dental Tissue in Paediatric Dentistry—Based on the Current Literature" by provides a comprehensive overview of the advancements in dental treatment, particularly focusing on the challenges and methodologies pertinent to the regeneration of hard dental tissues in young patients. The authors highlight the pressing issue of tooth loss due to carious lesions, which is notably prevalent among children and significantly impacts their oral health and overall well-being[4].

The article begins by contextualizing the problem of dental caries, which is identified as the most common disease globally and a leading cause of tooth loss in the pediatric population. The authors effectively emphasize the complexity of the tooth as an organ, comprising both hard tissues like enamel and dentin, as well as soft tissues such as

dental pulp. This complexity is crucial for understanding the regeneration processes that are discussed throughout the article[4].

A key point made by the authors is the distinction between the need for remineralization and regeneration in dental tissues. They assert that while early-stage enamel damage can be addressed through remineralization primarily facilitated by fluoride ions and amelogenins the regeneration of enamel is a more intricate challenge. The authors provide a critical evaluation of current methods for dentin regeneration, noting that the utilization of postnatal mesenchymal cells to promote odontoblast-like cell formation has shown promise. This insight into the biological mechanisms underlying dentin regeneration is particularly relevant for clinicians seeking to enhance treatment outcomes for young patients[4].

Furthermore, the article discusses various conservative approaches in treating carious lesions, emphasizing the shift towards methods that aim to restore lost biological tissues rather than solely relying on inorganic materials. The authors advocate for the integration of stem cell technology in pediatric dentistry, presenting it as a forward-looking approach with the potential to revolutionize how dental tissues are treated and regenerated. This perspective aligns with ongoing trends in regenerative medicine, where biological solutions are increasingly favored over traditional methods.

The authors' review of literature is thorough, and their critical analysis of existing treatments provides valuable insights into the future of pediatric dental care. However, the article could benefit from a more detailed exploration of the practical applications of these regenerative techniques in clinical settings, as well as potential barriers to their widespread adoption[4].

The systematic review and meta-analysis conducted by provides a comprehensive examination of the treatment protocols for managing pulpally involved young permanent teeth in children. The authors define young permanent teeth as those with incomplete root apex formation, which necessitates a treatment approach focused on preserving the noninflamed pulp tissue to facilitate apexogenesis and root dentin formation. This focus is particularly critical given that dental caries and traumatic injuries are prevalent causes of pulp necrosis in this demographic[5].

A significant contribution of the review is its emphasis on the primary aim of treatment: to maintain pulp vitality and promote continuous root development and apical closure (apexogenesis) in young permanent teeth. The discussion of apexification, particularly the formation of a calcific barrier at the open root apex of nonvital teeth, is well-articulated. The authors note the traditional use of calcium hydroxide for apexification, while also highlighting the shift towards biomimetic

materials such as Mineral Trioxide Aggregate (MTA) and Biodentin, which have shown promising results in recent studies[5].

Furthermore, the review introduces the concept of regenerative endodontic procedures (REPs), which represent a paradigm shift in the treatment of immature nonvital teeth. By advocating for the regeneration of pulp tissue, the authors underscore the importance of preserving the vitality of the apical papilla and its stem cells. This focus on revascularization and physiological root maturation is a critical advancement over conventional apexification methods, as it aims to restore the natural structures of the tooth[5].

The systematic review also aims to evaluate the clinical and radiographic success of various materials and treatment protocols in pediatric dentistry. This aspect is crucial, as it addresses the need for effective and evidence-based procedures tailored to the unique challenges presented by immature permanent teeth. The authors call for further research to identify substantial procedures that can enhance treatment outcomes for these vulnerable teeth[5].

The article "The Understanding of Vital Pulp Therapy in Permanent Teeth: A New Perspective" by provides a comprehensive review of the evolving landscape of vital pulp therapy (VPT) in the context of treating young permanent teeth. The authors emphasize the necessity of reevaluating traditional treatment approaches to pulpitis in light of contemporary trends favoring minimally invasive techniques and the preservation of dental pulp[6].

A critical evaluation of the material reveals that the authors effectively highlight the importance of treatment choice in promoting the restoration of remaining pulp tissue. They argue that the advent of bioceramic materials has significantly enhanced the treatment of pulpitis, particularly in young permanent teeth, where direct pulp capping has shown promising results even in cases of pulp exposure up to 2.5 mm. This finding underscores the relevance of VPT as a first-line treatment option, especially given the anatomical and biological characteristics of young permanent teeth, such as their loose pulp tissue and large apical foramina, which predispose them to infection[6].

The article further distinguishes between direct and indirect pulp capping, revealing that the success rate of indirect pulp capping is generally lower in young permanent teeth compared to direct pulp capping. This observation is crucial, as it suggests that conservative approaches may not always be effective in this demographic, thus reinforcing the need for a more aggressive treatment strategy when indicated. The authors also introduce a practical criterion for selecting between direct pulp capping and pulpotomy, emphasizing the significance of effective bleeding control within 10 minutes[6].

Moreover, the authors call for a shift away from the binary classification of pulpitis into reversible and irreversible categories, advocating for a more nuanced understanding of pulp states during treatment. This perspective aligns with the need for improved diagnostic methods and the potential expansion of bioceramic materials' applications to enhance treatment outcomes[6].

The article titled "The Four Pillars for Successful Regenerative Therapy in Endodontics: Stem Cells, Biomaterials, Growth Factors, and Their Synergistic Interactions" The article presents a comprehensive overview of the current state of regenerative therapies in the context of treating young permanent teeth. The authors emphasize the regenerative potential inherent within dental tissues and the biological processes crucial for effective pulp injury repair, particularly focusing on stem cell dynamics[7].

One of the central insights of the article is the identification of the key components necessary for successful regenerative outcomes: stem cells, biomaterials, growth factors, and their interactions. The authors note that while significant advancements have been made in producing reparative tissues, achieving a complete and functional restoration of the pulp-dentin complex remains a challenge. The presence of mineralizing cells, blood vessels, and organized extracellular matrix is acknowledged, yet the authors highlight the need for improved spatial and temporal control over tissue formation to ensure predictable clinical outcomes[7].

The article critically evaluates the limitations of current regenerative therapies, particularly the inadequacies in translating laboratory findings into clinical success. Despite promising results from clinical trials involving cell-based therapies and tissue transplants, the evidence supporting the regeneration of the pulp-dentin complex to its original histological architecture is limited. This discrepancy underscores the necessity for further research and development to enhance the predictability of regenerative treatments for young permanent teeth[7].

Moreover, the authors address the microbial challenges associated with treating immature infected teeth, emphasizing the role of disinfection strategies in regulating stem cell fate. They point out that residual bacterial antigens can significantly impact the differentiation of mesenchymal stem cells (MSCs), suggesting that future regenerative approaches must prioritize effective disinfection and detoxification methods. The regulation of hypoxia within the root canal is also highlighted as a critical factor in optimizing stem cell proliferation and integration, which is essential for replicating the native pulp-dentin architecture and function[7].



## Conclusion

The treatment of young permanent teeth, especially those with immature roots, has evolved significantly in recent years, focusing primarily on maintaining pulp vitality and promoting regenerative approaches by

emphasizes vital pulp therapy (VPT) as a critical intervention for managing traumatic injuries in immature permanent teeth, showcasing the potential of regenerative endodontic procedures to facilitate root development and apical closure.

This perspective is further supported by authors who conducted a systematic review highlighting the efficacy of regenerative therapies in restoring normal root development for necrotic permanent teeth.

The literature reflects a consensus on the importance of preserving pulp vitality, with underscoring the complexities faced by pediatric dentists when addressing dental caries and trauma. Their findings advocate for a conservative approach that includes the use of bonding agents and crowns, acknowledging the multifaceted nature of dental rehabilitation in young patients. Additionally, explore the application of biomaterials and stem cells in dental tissue regeneration, emphasizing the challenges of regenerating dentin and dental pulp while addressing enamel damage primarily through remineralization.

The systematic review by further reinforces the need for treatment protocols that prioritize the preservation of noninflamed pulp tissue to promote apexogenesis. Their findings suggest that newer regenerative techniques may outperform traditional apexification methods, aligning with the growing trend towards utilizing the regenerative capabilities of the pulp tissue.

In a similar vein, present advancements in bioceramic materials that enhance the success rates of direct pulp capping procedures, indicating a shift towards more conservative and tissue-preserving approaches.

Finally, highlight the critical components necessary for successful regenerative therapies, including stem cells, biomaterials, and growth factors. Their work encapsulates the ongoing evolution of regenerative endodontics, emphasizing the need for evidence-based practices that prioritize the vitality and functionality of young permanent teeth.

In conclusion, the literature collectively indicates a clear trajectory towards regenerative approaches in the management of young permanent teeth. The emphasis on maintaining pulp vitality and utilizing innovative treatment modalities reflects a significant advancement in pediatric dentistry, guiding future research and clinical practices in the field.

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## علاج الأسنان الدائمة غير مكتملة النمو

أحمد نصر عبدالنبي

كلية طب وجراحة الفم والأسنان، الجامعة الأسمرية الإسلامية، ليبيا

المستخلص:

إن علاج الأسنان الدائمة غير مكتملة النمو يعتبر تحدي كبير في طب أسنان الأطفال، لأنها أكثر عرضة للإصابة في الحوادث والتسوس وتعفن العصب فيما بعد.

في هذه الورقة نوضح العلاج المتقدم في علاج العصب الجزئي الذي يبقي العصب حي ويكتمل النمو للجذر (VPT) أو علاج عصب جزئي للإعادة تنشيط عملية النمو (REP) للجذر كما اهتمت سلطت بعض الأوراق البحثية السابقة على المواد الحيوية المستخدمة في علاج العصب والخلايا الجذعية والعلاجات التداخلية البسيطة التي تحافظ على حيوية العصب وهذه الطريقة تعتبر مجدية وفعالة حسب الدراسات الحديثة السابقة، وهذا أوضح الصورة في المستقبل للعلاجات الحيوية التي تعطي نتائج أفضل وديمومة أكثر.

لقد لخصنا النتائج من الدراسات السابقة لوضع قاعدة علمية لإجراء علاجات لهذه الأسنان واضعا حلا لأطباء أسنان الأطفال للتعامل مع الإصابات التي تتعرض لها هذه الأسنان.

**الكلمات المفتاحية:** الأسنان غير مكتملة النمو، علاج العصب الحي، علاج العصب التنشيطي، عملية اكتمال الجذور الحية، الخلايا الجذعية، المواد الحيوية.