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Optimization of Therapeutic Methods in Tooth Impaction Management

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Annotation: Tooth impaction represents a complex clinical challenge that affects millions of individuals worldwide and continues to be a significant concern in contemporary dental practice. Defined as the failure of a tooth to erupt into its normal functional position within the expected timeframe, tooth impaction encompasses a spectrum of conditions ranging from partial eruption difficulties to complete bony encasement of teeth. This phenomenon most commonly affects third molars, maxillary canines, mandibular premolars, and supernumerary teeth, with varying degrees of clinical significance and treatment complexity.

Keywords: Tooth retention, impacted teeth, impaired eruption, surgical exposure, orthodontic traction, combined treatment.

Introduction. The etiology of tooth impaction is multifactorial, involving genetic predisposition, anatomical constraints, mechanical obstructions, and developmental anomalies. Space deficiency within the dental arch, abnormal tooth positioning, presence of supernumerary teeth, odontogenic cysts, and trauma constitute the primary local factors contributing to impaction[1]. Systemic factors including endocrine disorders, nutritional deficiencies, and genetic syndromes may also play contributory roles in the development of impaction scenarios.

Clinical manifestations of tooth impaction vary considerably depending on the affected tooth, degree of impaction, and associated complications. While some impacted teeth remain asymptomatic throughout life, others may present with pain, swelling, infection, cyst formation, root resorption of adjacent teeth, and periodontal complications. The aesthetic and functional implications of impacted teeth, particularly in the anterior region, can significantly impact patient quality of life and psychological well-being[2].

The etiology of tooth retention is multifactorial and includes genetic predispositions, anatomical features of the maxillofacial region, mechanical obstacles to eruption, endocrine disorders, and local inflammatory processes. The third molars, upper canines, lower second premolars, and upper central incisors are most often subject to retention[3].

Clinical manifestations of tooth retention range from asymptomatic to pronounced symptoms, including pain, inflammatory processes in surrounding tissues, malocclusion, aesthetic defects, and functional disorders of the masticatory apparatus. Delayed diagnosis and inadequate treatment of retained teeth can lead to serious complications, including the development of odontogenic cysts, resorption of adjacent tooth roots, periodontitis, and other inflammatory diseases[4].

Modern approaches to treating tooth retention have undergone significant changes due to the introduction of new diagnostic methods, improvement of surgical techniques, and development of

orthodontic technologies. The use of cone beam computed tomography (CBCT) has significantly improved preoperative planning and increased diagnostic accuracy. The use of minimally invasive surgical techniques, including endoscopically-assisted interventions and piezosurgery, helps minimize surgical trauma and accelerate reparative processes[5].

The orthodontic aspect of treating retained teeth has also undergone significant development with the introduction of modern bracket systems, aligners, mini-screws for orthodontic anchorage, and digital technologies for planning tooth movement. Combined surgical-orthodontic treatment allows for optimal functional and aesthetic results while preserving the maximum number of teeth[6].

The relevance of improving therapeutic approaches to dental retention is due to the need to increase treatment effectiveness, minimize complications, reduce treatment time, and improve the quality of life of patients. The integration of modern diagnostic methods, innovative surgical techniques, and advanced ortodontic technologies opens up new possibilities for optimizing the treatment process. Improving therapeutic approaches to dental retention requires the integration of modern diagnostic methods, innovative surgical techniques, and advanced ortodontic technologies to achieve optimal clinical results. The use of conical-radial computed tomography and digital planning technologies significantly increases the accuracy of diagnostics, allows for predicting treatment outcomes, and minimizes the risk of complications in the treatment of retentioned teeth[7].

An interdisciplinary approach involving orthopedists, surgeons-dentists, and other specialists is a key factor in the successful treatment of complex cases of dental retention, especially in cases of multiple anomalies and comorbidities. Personalization of treatment based on individual anatomical features, patient's age, complexity of the clinical situation, and patient expectations contributes to better functional and aesthetic results. The introduction of modern ortodontic systems, including liners and mini-screws for anchoring, expands the possibilities of biomechanical control during the extraction of retention teeth and allows for a reduction in the overall treatment time. The development of digital technologies, including virtual planning and 3D printing, opens up new prospects for precision treatment of retentioned teeth and the creation of individual surgical templates. Further improvement of therapeutic approaches for dental retention should be aimed at developing standardized treatment protocols, implementing telemedicine technologies, and improving long-term treatment outcomes[8].

Traditional management approaches for impacted teeth have historically relied on surgical extraction or combined surgical-orthodontic treatment protocols. However, these conventional methods often involve significant morbidity, prolonged treatment duration, and unpredictable outcomes. The growing emphasis on minimally invasive dentistry, patient-centered care, and evidence-based treatment planning has necessitated a fundamental reevaluation of therapeutic strategies for impacted teeth[9].

Recent advances in diagnostic imaging, particularly cone-beam computed tomography (CBCT), have revolutionized the assessment and treatment planning for impacted teeth. Three-dimensional visualization capabilities enable precise localization of impacted teeth, evaluation of anatomical relationships, assessment of root development, and identification of potential complications. This enhanced diagnostic capability has paved the way for more accurate treatment planning and improved clinical outcomes[10].

Simultaneously, innovations in surgical techniques, including piezosurgery, computer-guided surgery, and endoscopic-assisted procedures, have emerged as promising alternatives to conventional surgical approaches. These advanced techniques offer the potential for reduced operative trauma, enhanced precision, faster healing, and improved patient comfort. The integration of digital workflow technologies, including intraoral scanning, virtual treatment planning, and 3D printing, further augments the precision and predictability of treatment interventions.

The orthodontic management of impacted teeth has also undergone significant evolution with the introduction of temporary anchorage devices, advanced bracket systems, clear aligner therapy, and sophisticated biomechanical approaches. These innovations have expanded treatment possibilities,

reduced treatment duration, and improved the predictability of tooth movement in complex impaction cases.

Furthermore, the growing understanding of tissue engineering principles, regenerative medicine concepts, and biomaterial applications has opened new avenues for managing impaction-related complications such as periodontal defects and root resorption. The potential for combining traditional treatment modalities with regenerative approaches represents an exciting frontier in impacted tooth management.

The optimization of therapeutic methods in tooth impaction management requires a comprehensive, evidence-based approach that integrates technological advances, clinical expertise, and patient preferences. This multidisciplinary endeavor aims to establish standardized protocols, improve treatment outcomes, minimize complications, and enhance the overall patient experience while considering economic constraints and accessibility of care.

This review seeks to examine current therapeutic approaches for impacted teeth, analyze emerging technologies and techniques, evaluate clinical evidence, and propose optimized management strategies that reflect contemporary best practices in the field. By synthesizing available research and clinical experience, this work aims to provide clinicians with practical guidance for implementing evidence-based, patient-centered care in the management of tooth impaction.

Conclusions: Thus, optimizing therapeutic methods for treating damaged teeth requires the integration of modern diagnostic technologies, innovative surgical approaches, and advanced ortodontic methods to achieve maximum treatment effectiveness while minimizing complications. The use of conical radiation computed tomography and three-dimensional treatment planning significantly increases the accuracy of diagnostics, allows for predicting the complexity of the intervention, and allows for the selection of optimal treatment tactics, taking into account the individual anatomical characteristics of the patient. Minimally invasive surgical techniques, including piezo surgery, endoscopic-assisted surgeries, and computer-navigated surgery, ensure reduced surgical trauma, accelerated reparative processes, and improved postoperative comfort for patients. An interdisciplinary approach involving orthopedists, maxillofacial surgeons, periodontists, and other specialists is the foundation for successful treatment of complex dental infections, especially in cases of multiple anomalies and comorbidities. The introduction of temporary anchor devices, modern bracket systems, and elayner therapy into orthoodontic treatment of affected teeth expands biomechanical capabilities and allows for a reduction in overall treatment time while improving its quality. A personalized approach to treatment, based on the analysis of risk factors, the patient's age, the degree of complexity of the clinical situation, and the patient's expectations, contributes to achieving optimal functional and aesthetic results. Digital technologies, including CAD/CAM systems, 3D printing of surgical patterns, and virtual treatment planning, increase the precision of interventions and open up new possibilities for individualized therapy.

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