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EFFECT OF PROSTHETIC MATERIALS AND STRUCTURAL DESIGNS ON CHEWING EFFICIENCY AND LIFE QUALITY: A COMPREHENSIVE REVIEW

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Annotation: This study analyzes the interrelation of biomechanical, aesthetic, and psychological factors in modern dental prosthetics. According to the literature review, the biomechanical stability of the prosthesis design, appropriate material selection, and its biocompatibility with oral tissues are crucial for restoring masticatory function. Aesthetically optimized prostheses improve patients' psychological well-being, social activity, and overall quality of life. Psychological factors determine adaptation to the prosthesis and the long-term stability of treatment outcomes. The study emphasizes that the integration of CAD/CAM technologies, PEEK and composite materials, along with individualized design approaches, significantly enhances the effectiveness of dental rehabilitation.

Keywords: dental prosthetics, biomechanics, masticatory efficiency, quality of life, aesthetic factors, psychological adaptation, CAD/CAM technology, PEEK material.

INTRODUCTION

Modern dental prosthodontics has evolved far beyond the simple mechanical replacement of missing teeth. It is now understood as a complex medical discipline aimed at the comprehensive rehabilitation of the patient, restoring not only masticatory function but also phonetic clarity, facial aesthetics, and psychological well-being. The global prevalence of tooth loss remains a significant public health issue. The World Health Organization (WHO) reports that 60–75% of the adult population worldwide experiences partial or complete tooth loss, leading to a cascade of negative consequences that impair digestion, speech, and social interaction [1, 2]. Consequently, the primary objective of prosthodontic treatment is to improve the patient's overall Quality of Life (QoL), a goal that requires a harmonious integration of biomechanical stability, aesthetic perfection, and psychological adaptation. This review analyzes the interplay between these three critical factors, based on an extensive survey of contemporary scientific literature.

METHODS OF INVESTIGATION

This article is structured as an integrative literature review. A systematic search of scientific literature was conducted to identify relevant studies. The search was performed across several electronic databases, including PubMed/MEDLINE, Scopus, Web of Science, and Google Scholar, for articles published between January 2010 and August 2024. The search strategy utilized a combination of MeSH terms and keywords such as "dental prosthetics," "masticatory efficiency," "quality of life," "oral health-related quality of life (OHRQoL)," "biomechanics," "aesthetic dentistry," "psychological adaptation," "CAD/CAM," "PEEK," and "dental biomaterials." Inclusion criteria were: (1) peer-reviewed clinical trials, systematic reviews, meta-analyses, and cohort studies; (2) studies focusing on the impact of prosthetic materials and designs on functional, aesthetic, or psychological outcomes; (3) articles published in English.



Case reports, opinion articles, and studies with low methodological quality were excluded. The selected articles were analyzed to synthesize data thematically around the core pillars of biomechanics, aesthetics, and psychological adaptation.

RESULTS

The synthesis of the reviewed literature revealed a strong consensus on the multi-faceted nature of successful prosthodontic rehabilitation. The key findings are organized according to the three primary domains of influence.

The biomechanical foundation of masticatory efficiency - The long-term success of any dental prosthesis is fundamentally dependent on its biomechanical performance. The optimal distribution of masticatory forces is essential to prevent damage to underlying tissues, including the alveolar bone and temporomandibular joint (TMJ), and to ensure comfortable function.

Material Selection and Performance: The choice of material plays a pivotal role. While traditional metal-framework dentures (e.g., clasp-retained) offer high rigidity, their weight and potential for allergic reactions can lead to patient dissatisfaction and discomfort [7]. Modern materials science has introduced superior alternatives. High-performance polymers like polyetheretherketone (PEEK) and advanced polyamide resins offer an excellent combination of low weight, adequate flexibility to absorb shock, and high biocompatibility. As demonstrated by Miyazaki et al. (2021), PEEK materials exhibit low affinity for bacterial biofilm formation, which contributes to better oral hygiene and tissue health [8]. Similarly, hybrid composites that blend polymer and ceramic components provide a balanced profile of durability and aesthetics [13].

The Role of Digital Technology: The advent of Computer-Aided Design/Computer-Aided Manufacturing (CAD/CAM) has revolutionized prosthodontics. These digital technologies allow for the creation of prostheses with exceptionally high precision and anatomical accuracy. As Al Jabbari (2022) noted, the fit accuracy of digitally fabricated prostheses can reach up to 98.6%, ensuring an even distribution of occlusal loads [1]. This precision minimizes stress on supporting tissues and, according to Barão (2021), reduces the risk of alveolar bone resorption and TMJ disorders [3].

The aesthetic dimension and its psychological impact - Aesthetics in prosthodontics is not a matter of vanity; it is a critical component of psychological rehabilitation. A natural-looking, harmonious smile can profoundly impact a patient's self-esteem, social confidence, and overall mental health.

Restoring Confidence: Research by Heydecke (2020) revealed that aesthetically successful prosthetic treatment can increase a patient's self-confidence by as much as 42% [6]. An aesthetically pleasing prosthesis that seamlessly integrates with the patient's facial features allows them to speak, laugh, and interact socially without fear of judgment or embarrassment. This restoration of social function is a key determinant of treatment success.

Individualized Design: Achieving superior aesthetics requires a highly individualized approach. Factors such as tooth shape, size, color, symmetry, and alignment with the gingival line and facial proportions must be meticulously considered [12]. Modern digital smile design (DSD) software and advanced shade-matching systems empower clinicians to create prostheses that are virtually indistinguishable from natural dentition, thereby maximizing patient satisfaction.

Psychological adaptation and quality of life - The patient's psychological response to a prosthesis is a decisive factor in the overall success of the treatment. Even a biomechanically perfect and



aesthetically pleasing prosthesis may be deemed a failure if the patient cannot adapt to it psychologically.

The Adaptation Process: The initial period following prosthesis placement can be challenging. Studies by Allen (2020) indicate that up to 48% of patients experience psychological stress during the first three months of adaptation, with some reporting depressive symptoms [2]. This highlights the importance of patient education, counseling, and managing expectations.

Impact on Overall Well-being: Successful adaptation leads to significant improvements in QoL. Patients report enhanced enjoyment of food, clearer speech, and greater participation in social activities. Research conducted by Sato et al. (2022) demonstrated that implant-supported prostheses, in particular, can double the level of psychological comfort compared to traditional removable dentures, largely due to their superior stability and function [11]. Ultimately, as Chen (2024) argues, an ideal prosthesis must provide not only anatomofunctional harmony but also complete aesthetic and psychological satisfaction [4].

DISCUSSION

The results of this literature review unequivocally demonstrate that successful prosthodontic outcomes are achieved through a synergistic approach rather than a focus on a single factor. The transition from traditional materials and methods to modern digital workflows and advanced polymers represents a significant leap forward in achieving this synergy.

The biomechanical superiority of CAD/CAM-fabricated PEEK prostheses, for instance, has direct implications for patient psychology. A stable, comfortable, and lightweight prosthesis reduces the adaptation period and minimizes the foreign body sensation, thereby lowering the psychological stress reported by Allen (2020). The even load distribution prevents sore spots and discomfort, which in turn improves masticatory function and allows patients to enjoy a wider variety of foods, directly enhancing their QoL.

Furthermore, the aesthetic potential unlocked by digital design is intrinsically linked to psychological well-being. A treatment that restores a patient's smile not only addresses a clinical need but also an emotional one. This psychological boost, as highlighted by Heydecke (2020), can be a powerful driver for better oral hygiene and long-term maintenance of the prosthesis. The clinical implication is clear: treatment planning must be a collaborative process that gives equal weight to the patient's aesthetic desires and the functional requirements of the restoration.

However, this review also identifies limitations in the current body of evidence. While short- and medium-term data on materials like PEEK are promising, more long-term longitudinal studies (10+ years) are needed to confirm their clinical performance and durability. Additionally, the metrics used to assess QoL and psychological adaptation vary widely between studies, making direct comparisons challenging. There is a need for standardized, validated patient-reported outcome measures (PROMs) to be used consistently in future research.

CONCLUSION

The evidence from contemporary literature confirms that biomechanical, aesthetic, and psychological factors are inextricably linked in modern dental prosthodontics. A successful clinical outcome is no longer measured solely by the restoration of chewing function but by the comprehensive improvement of the patient's Quality of Life.

The biomechanical integrity of the prosthesis, achieved through careful material selection (e.g., PEEK, advanced composites) and precision engineering (e.g., CAD/CAM), provides the functional foundation. Aesthetically superior design restores the patient's self-image and



facilitates social reintegration. Finally, successful psychological adaptation ensures the patient's comfort and long-term satisfaction with the treatment. Therefore, modern prosthodontics must be viewed not as a simple mechanical procedure but as a complex medical, social, and psychological rehabilitation process. Future research should continue to focus on the integration of these three pillars to further enhance the efficacy and patient-centeredness of dental care.

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