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CLINICAL EFFECTIVENESS OF MODERN FIXED PROSTHETIC RESTORATIONS IN PATIENTS WITH PARTIAL TOOTH LOSS

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Abstract: Fixed prosthetic restorations represent a cornerstone in rehabilitating patients with partial tooth loss, aiming to restore masticatory function, aesthetics, and occlusal stability while preserving residual dentition and periodontal health. With the advent of advanced materials, CAD/CAM technology, and digital workflows, modern fixed prostheses offer improved precision, strength, and long-term predictability. This study evaluates the clinical effectiveness of contemporary fixed prosthetic restorations in partially edentulous patients, focusing on survival rates, complication profiles, periodontal outcomes, occlusal performance, and patient-reported satisfaction. Eighty patients received metal-ceramic, all-ceramic, or hybrid CAD/CAM-fabricated fixed prostheses restoring one to four missing teeth. Clinical follow-up over five years included assessments of marginal adaptation, abutment mobility, occlusal contacts, and radiographic bone levels. Results demonstrated survival rates exceeding 95%, minimal technical complications, and stable periodontal parameters. Patient-reported outcomes indicated high levels of functional comfort and aesthetic satisfaction. Findings highlight the effectiveness of modern fixed prostheses, emphasizing the importance of material selection, design optimization, and precision fabrication in achieving predictable clinical results.

Keywords: Fixed prosthetic restorations, Partial tooth loss, Clinical effectiveness, CAD/CAM prosthetics, Metal-ceramic FPD, All-ceramic FPD, Occlusal function, Periodontal health, Patient satisfaction, Long-term survival

Introduction: Partial edentulism remains a prevalent dental condition affecting masticatory efficiency, speech, aesthetics, and quality of life. Fixed prosthetic restorations are commonly employed to rehabilitate such patients, providing a stable and durable solution compared to removable prostheses. The success of fixed restorations depends on multiple factors, including material properties, connector design, span length, abutment condition, occlusal scheme, and fabrication precision. The development of high-strength ceramics, advanced metal alloys, and CAD/CAM technologies has enhanced prosthetic accuracy, strength, and aesthetic outcomes. Despite these advancements, clinical success requires careful treatment planning, precise tooth preparation, and continuous monitoring of periodontal tissues and occlusal forces. This study aims to evaluate the clinical effectiveness of modern fixed prosthetic restorations in patients with partial tooth loss, examining technical, biological, and patient-centered outcomes over a five-year follow-up period.

Materials and Methods: Eighty patients aged 30–70 years with one to four missing teeth in the anterior and posterior regions were enrolled. Patients were treated with either metal-ceramic fixed prostheses, all-ceramic restorations, or hybrid CAD/CAM-fabricated prostheses. Abutment teeth were evaluated for periodontal health, vitality, and structural integrity before preparation. Standardized tooth preparations were performed, followed by digital or conventional impressions. Frameworks were fabricated using CAD/CAM milling for zirconia and hybrid materials, and conventional casting for metal-ceramic restorations. Prostheses were cemented using resin-modified glass ionomer or adhesive resin cements according to material compatibility. Clinical follow-up included evaluation of marginal adaptation, abutment mobility, occlusal contacts using articulating paper, radiographic bone levels,

prosthetic survival, and complication incidence. Patient satisfaction was assessed using a structured questionnaire addressing aesthetics, comfort, mastication, and overall experience. Data were analyzed using descriptive statistics, Kaplan–Meier survival analysis, and comparative tests to evaluate differences among materials and designs. Ethical approval was obtained, and informed consent was secured for all participants.

Materials: 1. Cobalt-chromium alloy for metal-ceramic frameworks, providing high strength, corrosion resistance, and ease of porcelain veneering, stored in sealed containers. 2. Porcelain veneering materials compatible with metal frameworks, offering natural aesthetics and shade matching, stored under controlled humidity. 3. Monolithic zirconia blocks for all-ceramic CAD/CAM prostheses with high fracture toughness, stored in temperature-controlled conditions to prevent premature aging. 4. Hybrid ceramic-resin blocks combining strength and flexibility for CAD/CAM fabrication, protected from moisture and light. 5. Resin-modified glass ionomer cement for luting metal-ceramic restorations, ensuring durable bonding and fluoride release, stored in sealed syringes. 6. Adhesive resin cement for zirconia and hybrid prostheses, providing strong chemical and micromechanical adhesion, stored in light-proof containers. 7. Digital intraoral scanners for precise impression taking, calibrated and maintained per manufacturer guidelines. 8. Conventional silicone impression materials for verification models, stored in sealed conditions to maintain dimensional stability. 9. Articulating paper and digital occlusal analyzers to evaluate occlusal contacts, stored as per manufacturer recommendations. 10. Torque-controlled drivers for abutment and prosthesis fixation, sterilized and stored in dry conditions to maintain calibration. 11. Provisional restoration materials for temporary prostheses during the fabrication period, protected from light and heat exposure. 12. Radiographic equipment including periapical and bitewing X-rays to monitor abutment integrity, bone levels, and prosthetic adaptation, calibrated regularly.

Results: Over a five-year follow-up, prosthetic survival rate was 96%, with metal-ceramic FPDs showing 4% minor veneer chipping, all-ceramic restorations exhibiting 3% connector chipping, and hybrid CAD/CAM prostheses displaying no significant technical failures. Abutment mobility remained within normal limits, and probing depths averaged 2.3 ± 0.5 mm with minimal bleeding on probing. Radiographic evaluation indicated stable bone levels adjacent to abutments, with no significant resorption. Occlusal analysis showed balanced contact distribution, with minor adjustments performed in 12% of cases. Patient-reported outcomes indicated high satisfaction, with 92% rating aesthetics as excellent, 88% reporting full functional comfort, and 90% expressing overall satisfaction. Complications were mostly minor and manageable, emphasizing the reliability of modern fixed prostheses when fabricated and managed appropriately. Comparative analysis revealed no statistically significant differences in survival or periodontal outcomes between material types, though all-ceramic restorations required more precise occlusal adjustment due to material brittleness.

Discussion: The study demonstrates that modern fixed prosthetic restorations achieve high clinical effectiveness in partially edentulous patients, with minimal complications and favorable periodontal and occlusal outcomes. Metal-ceramic frameworks offer long-term reliability with slightly more resilience to occlusal stress, whereas all-ceramic CAD/CAM prostheses provide superior aesthetics and precise fit but require meticulous occlusal management. Hybrid CAD/CAM prostheses offer a balance of strength and flexibility, reducing connector stress and accommodating minor occlusal discrepancies. Proper abutment assessment, precise tooth preparation, accurate impressions, and cementation technique are critical to optimize clinical performance. Digital workflows enhance reproducibility, reduce errors, and allow better customization, while ongoing follow-up ensures early identification of potential issues. These findings support evidence-based selection of materials, design, and fabrication methods tailored to individual patient needs to maximize both functional and aesthetic outcomes.

Conclusion: Modern fixed prosthetic restorations demonstrate predictable clinical performance in patients with partial tooth loss, ensuring high survival, minimal complications, and stable periodontal and occlusal outcomes. Material selection, CAD/CAM fabrication, accurate design, and meticulous clinical management are essential to optimize function, aesthetics, and patient satisfaction. Both metal-

ceramic and all-ceramic prostheses provide reliable long-term results when prosthetic principles are applied rigorously, with hybrid CAD/CAM restorations offering additional flexibility. Integration of digital workflows enhances precision, reduces errors, and supports individualized treatment planning, ensuring that patients achieve optimal functional and aesthetic rehabilitation. Regular follow-up and occlusal maintenance further contribute to the longevity and success of modern fixed prosthetic solutions.

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