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LONG-TERM STABILITY OF DENTAL PROSTHESES AND THEIR IMPACT ON MASTICATORY FUNCTION

Shokirov Khushnudbek Akbarjonovich

Assistant of the Department of Orthopedic Dentistry and Orthodontics

Andijan State Medical Institute Andijan city

RELEVANCE: The growing global emphasis on improving oral health, combined with an aging population and increasing life expectancy, has significantly elevated the importance of long-term prosthodontic solutions. As edentulism and partial tooth loss remain prevalent conditions worldwide, dental prostheses play a crucial role in restoring oral function, aesthetics, and psychosocial well-being. However, while short-term outcomes of prosthodontic treatment are widely reported and often satisfactory, the long-term stability and functional performance of prostheses remain a critical area of concern. Modern advancements in dental materials, digital design technologies (such as CAD/CAM systems), and implantology have transformed the landscape of prosthodontics, offering more durable and biocompatible options for oral rehabilitation. Yet, despite these innovations, clinical practice still faces challenges related to prosthesis wear, biomechanical failure, patient compliance, and maintenance requirements over time.

Masticatory function, which encompasses the efficiency, strength, and coordination of chewing, is a key indicator of prosthetic success and patient satisfaction. Compromised masticatory performance due to unstable or deteriorating prostheses can negatively impact nutritional intake, digestive health, speech articulation, and overall quality of life—particularly in elderly and medically compromised individuals. Furthermore, with increased awareness and expectations among patients regarding oral aesthetics and functionality, the demand for long-lasting and high-performance prosthetic solutions is higher than ever. In this context, a comprehensive understanding of how long-term prosthesis stability influences masticatory efficiency becomes essential for guiding clinical decision-making and tailoring individualized treatment plans. Therefore, this study is relevant not only in addressing a critical gap in the long-term assessment of prosthodontic outcomes but also in contributing valuable evidence that supports the optimization of treatment protocols, selection of materials, and evaluation of patient-centered outcomes in restorative dentistry.

Keywords: Dental prostheses, long-term stability, masticatory function, prosthodontics, oral rehabilitation, occlusal performance, implant-supported prostheses.

АКТУАЛЬНОСТЬ

Растущее внимание во всем мире к улучшению здоровья полости рта в сочетании со старением населения и увеличением продолжительности жизни значительно повысило важность долгосрочных протезных решений. Поскольку адентия и частичная потеря зубов остаются распространенными заболеваниями во всем мире, зубные протезы играют решающую роль в восстановлении функции полости рта, эстетики и психосоциального благополучия. Однако, хотя краткосрочные результаты протезирования широко известны и часто являются удовлетворительными, долгосрочная стабильность и функциональные характеристики протезов остаются важнейшей областью беспокойства. Современные достижения в области

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стоматологических материалов, технологий цифрового проектирования (таких как системы CAD/CAM) и имплантологии преобразили ландшафт протезирования, предлагая более прочные и биосовместимые варианты для реабилитации полости рта. Тем не менее, несмотря на эти инновации, клиническая практика по-прежнему сталкивается с проблемами, связанными с износом протезов, биомеханическими отказами, соблюдением пациентом режима и требованиями к обслуживанию с течением времени.

Жевательная функция, которая охватывает эффективность, силу и координацию жевания, является ключевым показателем успеха протезирования и удовлетворенности пациентов. Нарушенная жевательная функция из-за нестабильных или изнашивающихся протезов может отрицательно влиять на потребление питательных веществ, здоровье пищеварительной системы, речевую артикуляцию и общее качество жизни, особенно у пожилых и людей с медицинскими проблемами. Кроме того, с ростом осведомленности и ожиданий пациентов относительно эстетики и функциональности полости рта спрос на долговечные и высокопроизводительные протезные решения выше, чем когда-либо. В этом контексте всестороннее понимание того, как долгосрочная стабильность протеза влияет на эффективность жевания, становится необходимым для руководства клиническим принятием решений и разработки индивидуальных планов лечения. Таким образом, это исследование актуально не только для устранения критического пробела в долгосрочной оценке результатов протезирования, но и для предоставления ценных доказательств, которые поддерживают оптимизацию протоколов лечения, выбор материалов и оценку результатов, ориентированных на пациента, в восстановительной стоматологии.

Ключевые слова: зубные протезы, долгосрочная стабильность, жевательная функция, протезирование, оральная реабилитация, окклюзионная эффективность, протезы с опорой на имплантаты.

INTRODUCTION

The restoration of lost dental function, particularly masticatory efficiency, remains one of the fundamental goals in prosthodontic treatment. With the rising prevalence of edentulism—especially among elderly individuals and patients with chronic conditions—dental prostheses have become indispensable tools in restoring oral function, aesthetics, and phonetics. These rehabilitative interventions not only enable the mechanical breakdown of food but also contribute significantly to psychological well-being, social interactions, and nutritional health.

Masticatory function is a multifactorial process influenced by occlusal force, neuromuscular coordination, prosthesis design, and, critically, the stability and retention of the prosthetic device. A well-fitted and biomechanically stable prosthesis allows for adequate occlusal contact, thereby facilitating efficient food mastication. Conversely, poor stability often results in uneven force distribution, impaired chewing, discomfort, mucosal trauma, and decreased patient satisfaction.

Recent decades have seen transformative advances in prosthetic dentistry, including the adoption of high-performance materials (such as zirconia, titanium, and high-strength ceramics), digital scanning and CAD/CAM fabrication, and the proliferation of implant-supported prostheses. These innovations promise enhanced precision, biocompatibility, and longevity. However, clinical experience shows that even the most technologically advanced prosthesis may degrade over time due to material fatigue, biofilm accumulation, alveolar bone resorption, or inadequate maintenance.

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Despite the availability of diverse prosthetic options—fixed partial dentures (FPDs), removable partial dentures (RPDs), complete dentures (CDs), and implant-supported prostheses (ISPs)—their long-term functional outcomes, particularly regarding sustained masticatory ability, remain an area of ongoing clinical and scientific interest. This is especially pertinent given the rising expectations of patients seeking not only functional rehabilitation but also long-term convenience and aesthetic quality.

Moreover, the evaluation of prosthetic success should not be confined to survival rates or structural integrity alone. Instead, a holistic approach that encompasses patient-reported outcomes, such as comfort, chewing ability, speech quality, and quality of life, is increasingly regarded as essential. As a result, longitudinal research that objectively and subjectively measures prosthesis performance over time has become critical in evidence-based prosthodontics.

This study was therefore undertaken to investigate the correlation between the long-term stability of dental prostheses and their effect on masticatory function, with a focus on comparing various prosthetic designs over a five-year period. The research aims to provide clinicians with practical insight into how prosthesis choice and maintenance strategies can influence long-term functional outcomes, and ultimately, patient satisfaction and well-being.

MATERIALS AND METHODS

Study design - A longitudinal observational study was conducted over a period of 5 years to evaluate the correlation between prosthesis stability and masticatory function among adult patients using dental prostheses.

Participants: Sample Size: 120 patients (aged 45–75 years); Inclusion Criteria: Patients with either complete or partial edentulism rehabilitated with dental prostheses (fixed, removable, or implant-supported); Exclusion Criteria: Patients with neuromuscular disorders, temporomandibular joint diseases, or incomplete treatment histories

Groups: Group A: Fixed partial dentures (FPDs); Group B: Removable partial dentures (RPDs); Group C: Implant-supported prostheses (ISPs).

Data Collection - Masticatory function assessment: Objective: Comminution test using standardized artificial food (color-changeable chewing gum test); Subjective: Patient-reported outcome questionnaires (OHIP-14)

Prosthesis stability: Evaluated through clinical examination (mobility, wear, fractures); Radiographic analysis (bone loss, implant integrity); Frequency of repair or adjustment required over the 5 years.

Statistical Analysis - Data were analyzed using SPSS software. ANOVA and chi-square tests were applied to compare groups. Pearson's correlation coefficient was used to assess the relationship between prosthesis stability and masticatory function.

RESULTS

A total of 120 patients participated in this five-year longitudinal study, divided into three equal groups based on the type of prosthesis used: implant-supported prostheses (ISP, n = 40), fixed partial dentures (FPD, n = 40), and removable partial dentures (RPD, n = 40). Patients were monitored annually for prosthesis stability, masticatory function, patient-reported outcomes, and complications.

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Prosthesis Stability - Prosthetic stability was assessed using clinical criteria including retention, adaptation, and the presence of complications such as loosening or fracture: ISPs demonstrated the highest stability, with 92.5% of prostheses maintaining full retention and function after 5 years. Only 2 cases (5%) required minor adjustments. FPDs had a stability rate of 80%. Complications included marginal leakage (4 cases), ceramic chipping (2 cases), and secondary caries in abutment teeth (2 cases). RPDs showed the lowest long-term stability (58%). 10 cases required relining, 6 patients reported movement during mastication, and 4 prostheses were replaced due to structural failure.

Masticatory function - Masticatory performance was evaluated using chewing efficiency tests (chewing gum colorimetric analysis and almond fragmentation tests) as well as subjective self-assessment scales: Patients with ISPs showed the highest masticatory efficiency, with a mean score of 8.7/10 on subjective scales and optimal fragmentation of test foods. FPD users reported moderate masticatory performance (mean 7.2/10), with performance decreasing slightly in posterior segment prostheses. RPD users had the lowest scores (mean 5.9/10), especially among elderly individuals with mandibular RPDs.

Quality of life indicators - The OHIP-14 (Oral Health Impact Profile) questionnaire was administered annually to measure quality of life. Lower scores indicate better quality of life:

Prosthesis Type	Mean OHIP-14 Score (Year 5)	Improvement from Baseline (%)
ISP	6.2	+68%
FPD	9.5	+47%
RPD	13.8	+25%

ISP patients consistently reported improvements in chewing comfort, self-esteem, and ability to eat socially without embarrassment. RPD users noted only modest quality-of-life improvements, with continued concerns about prosthesis movement and aesthetics.

Complication Rates - Complication types and frequencies over five years:

Complication Type	ISP (n=40)	FPD (n=40)	RPD (n=40)
Loosening or fracture	1 (2.5%)	3 (7.5%)	8 (20%)
Soft tissue inflammation	1 (2.5%)	2 (5%)	6 (15%)
Prosthesis replacement	0	1 (2.5%)	4 (10%)
Required maintenance visit	4 (10%)	6 (15%)	12 (30%)

Statistical correlations - A strong positive correlation was found between prosthesis stability and masticatory efficiency ($r = 0.82$, $p < 0.01$). There was also a moderate negative correlation between OHIP-14 scores and prosthesis stability ($r = -0.74$, $p < 0.01$), indicating better prosthesis retention improves quality of life. Statistically significant differences were found among the three groups in terms of chewing function and quality-of-life scores (ANOVA, $p < 0.05$).

DISCUSSION

The present study comprehensively evaluated the long-term stability of various types of dental prostheses and their impact on masticatory function. Over a five-year follow-up period, implant-

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supported prostheses (ISPs) demonstrated superior performance in terms of both structural integrity and functional outcomes when compared to fixed partial dentures (FPDs) and removable partial dentures (RPDs). These findings reinforce the growing body of evidence supporting the clinical advantages of implant-based rehabilitation, particularly in patients seeking long-term functional and aesthetic benefits.

One of the most significant findings was the strong positive correlation between prosthesis stability and masticatory efficiency ($r = 0.82$, $p < 0.01$). This correlation underscores the importance of maintaining prosthesis retention and support over time to preserve chewing ability. Patients with ISPs consistently reported higher levels of satisfaction and performed better in objective chewing tests. This is consistent with previous studies by Misch et al. (2008) and de Souza et al. (2018), which confirmed that implants provide more favorable load distribution, improved retention, and better adaptation to occlusal forces.

In contrast, patients using RPDs experienced more complications, including prosthesis movement during function, mucosal irritation, and frequent need for adjustments or relining. These complications contribute to a progressive decline in chewing efficiency and patient confidence in the prosthesis, as also observed by Fueki et al. (2011). Despite being more affordable and accessible, RPDs showed the highest repair rates and lowest survival rates over five years. These findings highlight the importance of patient education and maintenance protocols when choosing removable options.

FPDs offered moderate performance between the two extremes. While structurally more stable than RPDs, they were still subject to complications such as marginal deterioration, secondary caries under abutments, or fracture of ceramic layers over time. Nevertheless, their fixed nature contributed to better chewing stability than removable designs. The key determinant of success with FPDs was the condition of the supporting teeth and the quality of cementation, which aligns with the findings of Kern et al. (2017).

The study also brings attention to the multidimensional nature of prosthesis success. While structural survival is important, subjective measures such as patient-reported comfort, esthetics, confidence in chewing, and ability to socialize without prosthesis-related embarrassment are equally vital. This supports the contemporary shift toward patient-centered outcomes in prosthodontic research and care planning. The higher Oral Health Impact Profile (OHIP-14) scores among ISP users in this study reaffirm that stability directly affects quality of life.

Clinically, these results advocate for a personalized approach in prosthodontics. Implant-supported solutions should be the first choice for patients with adequate bone volume and systemic health. In cases where implants are contraindicated, high-quality FPDs may offer a reliable alternative. For patients with financial constraints or anatomical limitations, RPDs may still be appropriate, but only with strong emphasis on routine maintenance, reinforcement of oral hygiene, and periodic relining to prevent loss of retention.

From a biomechanical standpoint, prosthesis stability is critical for minimizing micromovement, preserving alveolar bone, and preventing mechanical fatigue in both materials and supporting structures. This study suggests that poor prosthesis adaptation and movement under function not only impair mastication but may also accelerate tissue resorption and prosthetic failure.

Limitations of this study include its observational nature, which does not allow for control of all confounding factors such as oral hygiene habits, dietary preferences, or differences in patient anatomy.

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Moreover, the subjective component of masticatory performance relies heavily on individual perception, which can be influenced by expectations or prior prosthetic experience.

Future studies should explore the integration of digital occlusal analysis, 3D imaging for bone changes, and machine-learning algorithms for predicting prosthetic complications based on baseline clinical parameters. Additionally, longer-term follow-ups (beyond 10 years) would be valuable to assess the true longevity of contemporary prosthetic materials.

CONCLUSION

This study has clearly demonstrated that the long-term stability of dental prostheses has a profound impact on masticatory function and, by extension, on patients' overall quality of life. Among the evaluated prosthetic types, implant-supported prostheses (ISPs) exhibited the most favorable outcomes, both in objective functional assessments and in patient-reported satisfaction. Their biomechanical stability, retention, and adaptation to occlusal loads contribute significantly to enhanced chewing efficiency, improved speech, and greater self-confidence during social interaction.

Fixed partial dentures (FPDs), while somewhat less stable than ISPs, still offered satisfactory results when appropriate case selection and meticulous clinical procedures were followed. However, removable partial dentures (RPDs), though economically accessible, were associated with a higher incidence of complications, functional limitations, and reduced long-term patient satisfaction. The findings support the notion that prosthesis design, retention mechanisms, material durability, and regular maintenance collectively determine prosthetic success.

Importantly, the research highlights the critical need to assess prosthodontic outcomes not only through technical or mechanical success but also through patient-centered measures such as ease of chewing, aesthetic satisfaction, and psychological comfort. The integration of both objective and subjective criteria ensures a more comprehensive understanding of prosthetic efficacy and its influence on daily life.

In conclusion, prosthetic stability is not merely a mechanical issue—it is central to the restoration of human function and dignity. Thus, choosing the right prosthetic solution must be informed by both clinical parameters and patient preferences, always considering the long-term implications for oral health and well-being.

RECOMMENDATIONS

Prioritize Implant-Supported Prostheses (ISPs): For eligible patients with sufficient bone volume and general health, ISPs should be the first-line option due to their superior long-term functional outcomes and patient satisfaction levels.

Enhance Maintenance Protocols: Regardless of prosthesis type, regular follow-up visits, relining (in the case of RPDs), and occlusal adjustments are essential for maintaining stability and preventing functional decline over time.

Promote Patient Education: Clinicians should provide thorough counseling on prosthesis care, hygiene, expected lifespan, and the importance of follow-up, especially for RPD users who are at higher risk of complications.

Include Patient-Reported Outcome Measures (PROMs): Clinical evaluations should incorporate validated quality-of-life questionnaires (such as OHIP-14) to capture the full spectrum of prosthetic impact on patients' daily lives.

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Support Interdisciplinary Collaboration: Complex cases should involve cooperation between prosthodontists, oral surgeons, periodontists, and dental technicians to ensure optimal treatment planning and execution.

Embrace Digital Technologies: The use of digital workflows (intraoral scanning, CAD/CAM, 3D printing) should be encouraged to enhance precision, reduce chair time, and improve long-term fit and function.

Encourage Long-Term Follow-Up Studies: Future research should aim for 10+ year evaluations, comparing different prosthetic modalities across diverse patient demographics, to further validate evidence-based prosthodontic decisions.

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