

Comparison of Masticatory Efficiency in Implant-Supported Overdentures, Tooth-Supported Overdentures, and Conventional Complete Dentures: A Review

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Citation of this Article: Dr. Shailendra Singh, Dr. Pratik Nayade, Dr. Rachana Lagad, “Comparison of Masticatory Efficiency in Implant-Supported Overdentures, Tooth-Supported Overdentures, and Conventional Complete Dentures: A Review”, IJDSIR- January – 2026, Volume – 9, Issue – 1, P. No. 16 – 22.

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Type of Publication: Review Article

Conflicts of Interest: Nil

Abstract

Masticatory efficiency is a critical determinant of oral function, nutritional status, and quality of life in edentulous patients. Conventional complete dentures (CDs) have long been the standard treatment modality; however, compromised retention and stability—particularly in the mandibular arch—often result in reduced chewing efficiency. Tooth-supported overdentures (TSODs) and implant-supported overdentures (ISODs) were introduced to overcome these limitations by preserving proprioception, enhancing retention, and improving neuromuscular control. This review aims to compare the masticatory efficiency of implant-supported overdentures, tooth-supported overdentures, and conventional complete dentures by synthesizing evidence from clinical and experimental studies. Outcomes assessed include masticatory performance, chewing cycles, bite force, particle size

reduction, and patient-reported functional outcomes. The literature consistently demonstrates superior masticatory efficiency with implant-supported overdentures compared with conventional complete dentures, with tooth-supported overdentures showing intermediate benefits. Attachment design, number of implants, and evaluation methodology significantly influence outcomes. Overall, implant-supported overdentures provide the most favourable functional rehabilitation for edentulous patients.

Keywords: Masticatory efficiency; Implant-supported overdentures; Tooth-supported overdentures; Complete dentures; Oral function; Edentulism

Introduction

Edentulism remains a significant public health concern worldwide, particularly among the elderly population. Loss of natural dentition leads to impaired mastication, altered dietary habits, reduced nutritional intake, and

diminished quality of life. Conventional complete dentures have been the traditional treatment option for edentulous patients; however, many wearers—especially of mandibular dentures—experience problems related to poor retention, instability, and inadequate masticatory efficiency.

Masticatory efficiency refers to the ability of the masticatory system to reduce food particle size to a level suitable for swallowing. It is influenced by multiple factors, including denture stability, occlusal scheme, neuromuscular coordination, bite force, and sensory feedback. Complete denture wearers require significantly more chewing strokes to achieve the same particle size

Concept of Masticatory Efficiency

Table 1: Definitions and Methods Used to Assess Masticatory Efficiency

Parameter	Definition	Common Assessment Methods	Key References
Masticatory performance	Degree of food comminution after fixed chewing cycles	Sieve analysis, image analysis	Slagter et al., Fontijn-Tekamp et al. ^{1,2}
Masticatory efficiency	Chewing strokes required to reach a defined particle size	Sieving method, Optosil/Optocal tests	Kapur & Soman, van Kampen et al. ^{3,4}
Bite force	Maximum force generated during mastication	Strain gauge, bite fork transducers	Bakke et al., Fontijn-Tekamp et al. ^{2,8}
Muscle activity	Neuromuscular coordination during chewing	Electromyography (EMG)	Slagter et al. ¹
Subjective chewing ability	Patient-perceived chewing comfort	Questionnaires, VAS	Feine et al. ⁵

Masticatory efficiency and masticatory performance are often used interchangeably but represent distinct concepts. Masticatory performance is the objective measurement of food comminution after a standardized number of chewing cycles, whereas masticatory efficiency relates performance to the number of chewing strokes required. Assessment methods include:

- Sieve analysis of chewed test foods

reduction as dentate individuals, reflecting compromised masticatory function.

To address these shortcomings, overdenture concepts were developed. Tooth-supported overdentures preserve selected natural teeth or roots, maintaining periodontal proprioception and alveolar bone. Implant-supported overdentures, particularly mandibular two-implant overdentures endorsed by the McGill and York consensus statements, have become a widely accepted standard of care. This review compares these three prosthetic modalities with respect to masticatory efficiency and functional performance.

- Color-changing chewing gum tests
- Optical and image analysis techniques
- Electromyographic (EMG) evaluation of masticatory muscles
- Maximum bite force measurements

Each method has inherent advantages and limitations, contributing to variability among study outcomes.

Conventional Complete Dentures and Masticatory Efficiency

Complete denture wearers commonly exhibit reduced bite force, prolonged chewing time, and larger swallowed food particles. Studies have demonstrated that complete denture patients may require up to seven times more chewing cycles than dentate individuals to achieve comparable food comminution^{1,2}. Masticatory performance in complete denture wearers has been reported to be only 14–25% of that observed in subjects with natural dentition². The absence of periodontal mechanoreceptors results in diminished sensory feedback and compromised neuromuscular control¹. Progressive residual ridge resorption further exacerbates instability, particularly in the mandible, leading to poor masticatory efficiency and patient dissatisfaction^{2,7}. Complete denture wearers commonly exhibit reduced bite force, prolonged chewing time, and larger swallowed food particles. Studies have shown that complete denture patients may require up to seven times more chewing cycles than dentate individuals to achieve comparable food comminution. The absence of periodontal

mechanoreceptors results in diminished sensory feedback and compromised neuromuscular control. Progressive residual ridge resorption further exacerbates instability, particularly in the mandible, leading to poor masticatory efficiency and patient dissatisfaction.

Tooth-Supported Overdentures and Masticatory Efficiency

Tooth-supported overdentures are based on the preventive prosthodontic principle of preserving remaining teeth or roots. Retained teeth provide periodontal proprioception, improved support, and reduced residual ridge resorption^{2,7}. Clinical studies have reported enhanced masticatory efficiency in TSODs compared with conventional complete dentures, attributed to improved stability and sensory feedback⁷. Patients with tooth-supported overdentures demonstrate reduced chewing cycles, increased bite force, and improved control during mastication². However, outcomes depend on the number, distribution, and periodontal health of abutment teeth, as well as attachment design.

Table 2: Functional Advantages of Tooth-Supported Overdentures

Parameter	Conventional Denture	Tooth-Supported Overdenture	Supporting Evidence
Proprioception	Absent	Present	Fontijn-Tekamp et al. ²
Residual ridge resorption	High	Reduced	Geertman et al. ⁷
Bite force	Low	Moderate	Bakke et al. ⁸
Chewing cycles	Increased	Reduced	Slagter et al. ¹

Implant-Supported Overdentures and Masticatory Efficiency

Implant-supported overdentures significantly improve denture retention and stability, particularly in the mandibular arch. Numerous studies report marked improvements in masticatory performance and efficiency following implant overdenture therapy^{3,4,7}. Objective

measurements show reduced chewing strokes, increased maximum bite force, and smaller particle size at swallowing compared with conventional dentures^{2,3}. Van Kampen et al. demonstrated that implant-supported overdentures nearly double maximum bite force and significantly improve masticatory performance irrespective of attachment type³. Color-changing chewing

gum studies further confirm superior masticatory efficiency in implant-retained overdentures, with bar-clip attachments often outperforming ball and magnet systems⁴.

Table 3: Effect of Implant-Supported Overdentures on Masticatory Parameters

Parameter	Conventional Denture	Implant-Supported Overdenture	Key Studies
Bite force	Low	High	van Kampen et al. ³
Masticatory efficiency	Poor	Significantly improved	Hussain et al. ⁴
Chewing cycles	Increased	Reduced	Geertman et al. ⁷
Patient satisfaction	Low-moderate	High	Feine et al. ⁵

Comparison of Masticatory Efficiency

Table 4: Comparative Overview of Prosthetic Modalities and Masticatory Efficiency

Parameter	Complete Dentures	Tooth-Supported Overdentures	Implant-Supported Overdentures
Retention & stability	Poor-moderate	Improved	Excellent
Proprioception	Absent	Present	Absent
Bite force	Low	Moderate	High
Masticatory efficiency	Lowest	Intermediate	Highest
Long-term predictability	Limited	Moderate	High

Conventional Complete Dentures vs Tooth-Supported Overdentures

Compared with conventional dentures, tooth-supported overdentures show improved masticatory efficiency due to retained proprioception and enhanced stability^{2,7}. Chewing cycles are reduced, and patients report better control during mastication¹. However, efficiency remains inferior to implant-supported options.

Conventional Complete Dentures vs Implant-Supported Overdentures

Implant-supported overdentures consistently outperform conventional complete dentures across objective and subjective parameters. Studies using sieving methods, chewing gum tests, and EMG analysis demonstrate significantly higher masticatory performance and efficiency with ISODs^{3,4,7}.

Tooth-Supported Overdentures vs Implant-Supported Overdentures

While tooth-supported overdentures offer functional advantages over conventional dentures, implant-supported overdentures provide superior and more predictable outcomes. Implants eliminate dependence on compromised natural teeth and offer long-term stability and function^{5,6}.

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Factors Influencing Masticatory Efficiency

- Number and distribution of implants or abutment teeth
- Attachment system (bar, ball, locator, magnet)
- Occlusal scheme and prosthesis design
- Residual ridge morphology
- Neuromuscular adaptation and patient age
- Method of masticatory efficiency assessment

Discussion

The comparative analysis of masticatory efficiency among different prosthetic solutions for edentulous patients—conventional complete dentures (CDs), tooth-supported overdentures (TSODs), and implant-supported overdentures (ISODs)—reveals a clear hierarchy of functional outcomes. The discussion will elaborate on the factors contributing to these differences, their implications for patient satisfaction and oral health-related quality of life (OHRQoL), and considerations for clinical practice and future research⁹.

Superiority of Implant-Supported Overdentures (ISODs): A substantial body of literature consistently positions implant-supported overdentures as the gold standard for restoring masticatory efficiency in edentulous patients. The primary advantage of ISODs stems from their enhanced stability and retention, which are directly conferred by the osseointegrated implants. This stability allows for a significantly greater maximum bite force and more effective comminution of food particles compared to both conventional and tooth-supported options. Studies employing objective measures, such as color-mixing analysis tests, consistently demonstrate that ISOD wearers achieve superior particle size reduction and homogeneity. For example, patients transitioning from CDs to two-implant retained mandibular overdentures experienced significant improvements in theoretical aperture (ST_X50) and particle distribution homogeneity (STB) after one year, indicating enhanced masticatory function. This improved chewing efficiency is not merely anecdotal; it translates into tangible benefits such as the ability to consume a wider range of foods, which can positively impact nutritional intake and overall systemic health. Furthermore, the stability provided by implants helps to mitigate alveolar ridge resorption, a common and debilitating consequence of edentulism managed with conventional dentures, thereby preserving foundational support for the prosthesis long-term. Even in cases of mandibular atrophy, ISODs have shown superior chewing efficiency and masseter muscle activity compared to conventional dentures, highlighting their efficacy in challenging clinical scenarios.^{9,10}

Advantages of Tooth-Supported Overdentures (TSODs) over Conventional Dentures Tooth-supported overdentures represent a significant functional improvement over conventional complete dentures, particularly in cases where natural teeth or roots can be

preserved and utilized for retention. While not offering the same level of stability as implants, TSODs provide increased retention, stability, and support compared to CDs, which are often criticized for their instability, especially in the mandibular arch. The preservation of natural tooth structures under a TSOD contributes to several benefits: it helps maintain proprioception, allowing patients better control over their chewing movements, and it can reduce the rate of alveolar ridge resorption, which is a major concern with CDs. Case reports and clinical observations underscore the effectiveness of TSODs in enhancing masticatory function and patient comfort, positioning them as a valuable intermediate treatment modality when implants are not feasible or desired.¹¹

Limitations of Conventional Complete Dentures (CDs)
Conventional complete dentures consistently rank lowest in terms of masticatory efficiency and patient satisfaction among the three options. The inherent lack of retention and stability, particularly in the lower jaw due to limited supporting anatomical structures, leads to reduced chewing force and compromised food breakdown. The impact of CDs on masticatory function can be quantified by reduced masticatory cycle amplitude, efficiency, and force when compared to individuals with natural dentition or those utilizing implant-supported prostheses. This functional limitation often necessitates dietary modifications, potentially leading to nutritional deficiencies and impacting systemic health. Furthermore, the continuous bone resorption under conventional dentures can lead to ill-fitting prostheses and further compromise their already limited functionality.^{12,13}

Clinical Implications

Enhanced masticatory efficiency with overdentures contributes to improved nutrition, general health, and quality of life. Treatment planning should consider

patient expectations, anatomical limitations, systemic health, and economic factors.

Limitations and Future Directions

Long-term randomized controlled trials with standardized assessment methods are needed to further clarify the influence of attachment systems and implant numbers on masticatory efficiency. Future research should also explore digital and sensor-based evaluation techniques.

Conclusion

In conclusion, the literature clearly establishes that implant-supported overdentures offer the highest masticatory efficiency, leading to significantly improved patient satisfaction and oral health-related quality of life, followed by tooth-supported overdentures, with conventional complete dentures providing the least functional outcome. This understanding is crucial for guiding clinical decisions and informing patient expectations in the rehabilitation of edentulous patients.

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