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Effectiveness of Silicone-based resilient denture liners on masticatory function: A systematic review

(Eficacia de los revestimientos resilientes de prótesis dentales a base de Silicona en la función masticatoria: Una revisión sistemática)

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Abstract (english)

Silicone-based resilient denture liners are increasingly being used to increase the masticatory efficiency of edentulous patients. Such materials seek to overcome the limitations of traditional acrylic dentures by offering greater flexibility, shock absorption, and patient comfort, thus overcoming pain relief and biting effectiveness issues. A systematic search was conducted in PubMed, Scopus, and Web of Science databases using the keywords "silicone denture liners" AND "masticatory function," from 2006 to 2023. The review adhered to PRISMA guidelines. Eligible studies were randomized controlled trials (RCTs) evaluating masticatory function parameters such as maximum bite force, masticatory performance, pain perception, and patient-reported outcomes. Five studies met the inclusion criteria. The studies included herein proved that resilient liners made of silicone have a positive influence on maximum bite force, improve patient comfort, and minimize pain upon mastication. However, enhancement of masticatory function, especially with specific food texture, was inconsistent between studies. Silicone-based liners overall, were more satisfactory for patients compared to conventional acrylic bases. Resilient denture liners based on silicone considerably enhance specific masticatory function qualities, such as peak bite and perception of pain. Their effect on general masticatory competence remains to be assessed. Clinically, silicone liners represent a valuable adjunct for enhancing the quality of life in complete denture wearers.

Keywords(english)

Silicone denture liner, masticatory function, maximum bite force, chewing ability, edentulous patients.

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Resumen(español)

Los revestimientos resilientes de silicona para prótesis dentales se utilizan cada vez más para mejorar la eficiencia masticatoria de los pacientes edéntulos. Estos materiales buscan superar las limitaciones de las prótesis acrílicas tradicionales al ofrecer mayor flexibilidad, absorción de impactos y comodidad para el paciente, lo que permite aliviar el dolor y mejorar la eficacia de la masticación. Se realizó una búsqueda sistemática en las bases de datos PubMed, Scopus y Web of Science utilizando las palabras clave "silicone denture liners" AND "masticatory function", desde 2006 hasta 2023. La revisión se adhirió a las directrices PRISMA. Los estudios elegibles fueron ensayos controlados aleatorizados (ECA) que evaluaron parámetros de la función masticatoria como la fuerza máxima de mordida, el rendimiento masticatorio, la percepción del dolor y los resultados informados por el pacente. Cinco estudios cumplieron con los criterios de inclusión. Los estudios incluidos demostraron que los revestimientos resilientes de silicona tienen una influencia positiva en la fuerza máxima de mordida, mejoran la comodidad del paciente y minimizan el dolor durante la masticación. Sin embargo, la mejora de la función masticatoria, especialmente con texturas de alimentos específicas, fue inconsistente entre los estudios. En general, los revestimientos a base de silicona resultaron más satisfactorios para los pacientes en comparación con las bases acrílicas convencionales. Los revestimientos resilientes para prótesis dentales a base de silicona mejoran considerablemente ciertas características de la función masticatoria, como la oclusión máxima y la percepción del dolor. Su efecto sobre la competencia masticatoria general aún debe evaluarse. Clínicamente, los revestimientos de silicona representan un valioso complemento para mejorar la calidad de vida de los usuarios de prótesis completas.

Palabras clave(español)

Revestimiento de silicona para prótesis dentales, función masticatoria, fuerza máxima de mordida, capacidad de masticación, pacientes edéntulos.

Introduction

Edentulism is a major and chronic worldwide health problem, especially among the aging population, where loss of natural dentition significantly affects oral and systemic health-related quality of life (1). Tooth loss leads to a cascade of functional, esthetic, and psychological impairments. Functionally, tooth loss impairs articulation of the speech, diminishes masticatory effectiveness, and weakens swallowing, thereby contributing to diminished nutritional uptake and resulting in malnutrition (2). Aesthetically, vertical dimension loss and facial support deficiency lead to premature aging of the face, leading to social embarrassment and psychological distress. Subsequently, edentulous patients become socially withdrawn, with decreased self-esteem and a decline in quality of life, thus accelerating systemic health deterioration (3, 4).

Complete dentures are still the most available and widely used prosthetic option for the treatment of edentulous patients. But traditional acrylic resin dentures usually fail to replace the biomechanical and functional dynamics of the natural dentition (5). The inflexibility of acrylic dentures can lead to nonuniform distribution of occlusal forces, resulting in localized pressure points, mucosal irritation, masticatory instability, and gradually progressive resorption of the underlying alveolar bone. In addition, impaired masticatory efficiency of traditional dentures restricts the variety of food choices, which tends to oblige patients into a preponderance of soft, processed foods of limited nutritional quality, thereby enhancing the risk of systemic comorbidities (6).

In response to such clinical problems, the evolution of silicone-based hard-wearing denture liners brought with it an important innovation in prosthodontic materials. These liners are designed with superior elastic and viscoelastic characteristics, and augmented shock absorption capacity, that interact synergistically to buffer masticatory loads, minimize mucosal trauma in a localized area, and enhance patient comfort. The inherent flexibility of silicone liners allows for improved adaptation to underlying tissues, increased denture stability, and a more even distribution of occlusal forces during mastication. In addition, their long-term stability offers ongoing support, minimizing the number of adjustment appointments and enhancing prosthesis life (7).

Despite their expanding clinical use and material advantages, the size and consistency of functional benefit offered by silicone-based resilient liners are contentious issues in the literature. Variability in study design, liner formulation, fabrication protocols, test methods, and patient-related variables contribute to heterogeneity of reported outcomes. Although numerous studies have established pain relief, efficiency of biting, and gains in patient satisfaction,

others have found modest or unreliable gains in objective measures of masticatory function (7).

With the anticipated increase in the number of elderly people and concomitant rise in edentulism, there is an important need for evidence-based prosthetic care that not only restores esthetics but also maximizes functional outcomes and enhances quality of life. Thus, this systematic review will critically evaluate and integrate the existing clinical evidence regarding the efficacy of silicone-based resilient denture liners in enhancing the major functional parameters such as masticatory performance, maximum bite force, pain perception, and patient satisfaction among complete denture wearers.

Materials and Methods

Search Strategy. A systematic review was performed in strict adherence to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (8). Searched databases included PubMed, Scopus, and Web of Science. The terms "silicone-based denture liner" AND "masticatory function" AND "complete denture" were used. Boolean operators were used to limit search sensitivity. The review included articles from the year 2006 to 2023.

Inclusion Criteria

- Randomized controlled trials (RCTs)
- Studies that analyze the impact of silicone-based resilient liners on masticatory function
- English language publications

Exclusion Criteria

- In vitro studies
- Non-randomized clinical trials
- Case reports or review papers
- Studies that compare acrylic-based liners to other liners, and not silicone-based liners

Data Extraction. The data were extracted independently and involved author information, study design, sample size, assessment parameters (e.g., maximum bite force, masticatory performance, pain perception), and important results. (Figure 1)

Assessment of Study Quality. The methodological quality of studies included was evaluated by applying the CONSORT guidelines (9), and the STROBE checklist (10) to guarantee the validity and reliability of clinical evidence.

Results

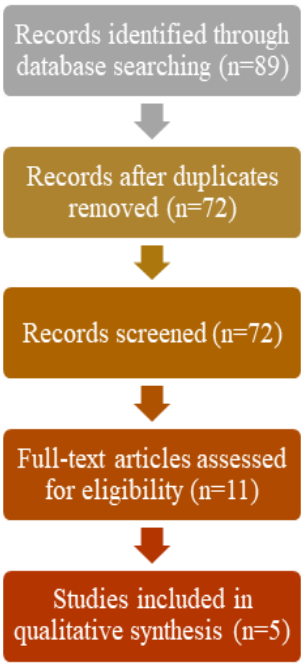


Figure 1. Prisma flowchart

A total of 89 studies were identified through database searches. After removing duplicates and applying eligibility criteria, 11 full-text articles were reviewed, of which five randomized controlled trials (RCTs) met the inclusion criteria and were included in the final analysis (table 1).

Across all the studies included, silicone resilient denture liners showed consistent improvement in maximum bite force and patient satisfaction throughout. Pain sensation was substantially diminished in studies comparing sensory thresholds. Nevertheless, improvement in objective masticatory function depended on study design, test method, and texture of foods being tested.

Discussion.

The findings of this systematic review verify the clinical efficacy of silicone-based resilient denture liners in enhancing various aspects of masticatory function in edentulous patients. Alqutaibi et al. (2023) (11), showed greater improvement in maximum bite force and oral health-related quality of life (OHRQoL) with silicone-based liners over acrylic-based liners, with

Table. 1. Summary of characteristics and outcomes of included studies.

Author	Year	Study Design	Sample Size	Intervention	Comparison	Outcome
Alqutaibi et al.[11]	2023	RCT	28 patients	Silicone-based soft liner	Acrylic-based soft liner	Improved maximum bite force and OHRQoL at 3 months.
Furuya et al.[12]	2022	RCT	36 patients	Silicone-based resilient liner	Conventional denture	Improvement in patient-reported chewing ability for hard foods after 3 months.
Furuya et al. [7]	2021	RCT	30 patients	Silicone-based resilient liner	Conventional denture	Increased maximum occlusal force but no significant improvement in masticatory performance.
Furokawa et al.[13]	2020	RCT	40 patients	Silicone-based resilient liner	Conventional denture	Reduced pain thresholds and psychological discomfort after 3 months.
Kimoto et al.[14]	2006	RCT	28 patients	Silicone-based resilient liner (SR)	Acrylic resin denture (AR)	Significant improvements in masticatory performance and patient satisfaction.

functional as well as psychosocial advantages. This was also evidenced by Furokawa et al. (2020) (13), which showed considerable reduction in pain sensation of silicone liners, as evinced by current perception threshold (CPT) test. This reflects improved comfort with improved masticatory load distribution.

But Furuya et al. (2021) (7) introduced a more neutral view with increased maximum occlusal force reported for silicone liners without an ensuing significant boost in masticatory performance. This indicates that superior occlusal force may not necessarily be synonymous with superior food comminution, maybe as a function of the liners' elastic characteristics in bolus manipulation.

Strengthening the evidence for long-term adaptability, Furuya et al. (2022) (12), reported notable improvements in patient-reported chewing ability for hard foods after a three-month adaptation period, underscoring the importance of longitudinal assessments in detecting functional enhancements. By the same token, Kimoto et al. (2006) (14), used objective sieving procedures and Biopak system analysis to show enhanced masticatory performance and longer occlusal phases to promote the mechanical advantages provided by resilient liners under mastication.

The findings put forth by Palla et al. (2015) (15), also corroborated the present synthesis. Through their systematic review, they concluded that the long-term usage of silicone soft liners was superior to mastication parameters when compared to conventional hard bases. They reported that silicone liners reduced chewing strokes, reduced chewing time, and enhanced rhythmic masticatory muscle activity without inducing muscular fatigue, according to directly Kimoto et al. (2006) (14), and Furuya et al. (2022) (12) reports.

Notably, Palla et al.'s (15) review also emphasized the ongoing need for standardized measuring tools, the principal gap also present in the current evidence base. Their narrative synthesis also confirms the multifactorial influence of liner composition, denture quality, adaptation time, and food consistency on functional outcomes.

In general, the cumulative evidence repeatedly shows that silicone-based resilient denture liners improve patient comfort, maximum bite force, and satisfaction. Yet, the heterogeneity of objective masticatory performance outcomes highlights the need for precise patient selection, standardized functional testing, and extended follow-up to fully explain the clinical effectiveness of these materials.

Emerging studies must focus on standardized assessment protocols, deeper investigation of liner-food interaction dynamics, and the incorporation of both objective and subjective patient-centered outcomes to enhance the real-world validity of silicone-based resilient liners in prosthetic rehabilitation.

Limitations. Whilst this systematic review is informative, there are certain limitations that need to be considered. The existing evidence base is limited by low numbers of high-quality randomized controlled trials testing silicone-based resilient denture liners. There is significant heterogeneity in study design, sample size, follow-up period, and outcome measurement approach, which makes direct comparison between studies challenging. Furthermore, the absence of worldwide standardized assessment tools for quantifying patient-reported and masticatory function outcomes restricts aggregating quantitative data consistently.

Differences in liner material, manufacturing method, and adaptation durations with the patient add additional sources of potential bias. Moreover, most short- to medium-term follow-up in included studies in this review restricts investigation of long-term functional stability, durability, and resistance of silicone-based liners. The subjective nature of several of the patient-reported outcome measures also adds

variability, which could affect the generalizability of the results.

Future studies need to overcome these deficiencies using standardized procedures, validated measures of outcome, longer follow-up, and more heterogeneous and larger patient populations. Improved methodology is needed to enhance the quality of evidence and the clinical impact of silicone-based resilient denture liners.

Conclusion

This systematic review offers strong evidence that silicone-based resilient denture liners substantially improve masticatory function in complete denture wearers, reliably increasing maximum bite force, decreasing pain perception, and increasing patient satisfaction compared with conventional acrylic dentures. Heterogeneity of objective masticatory performance outcomes among different food textures is likely to be due to methodological heterogeneity, variations in liner characteristics, adaptation times, and testing protocols. In spite of these discrepancies, the overall results strongly validate the clinical incorporation of silicone-based liners as a beneficial treatment for the management of functional impairments and enhancing the quality of life in edentulous patients. Long-term, well-designed randomized controlled trials with standardized outcomes and validated patient-reported measures should be the focus of future research to further define the overall clinical advantages of these materials.

Conflict of interest

None to declare.

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