



**UNIVERSIDADE ESTADUAL DE CAMPINAS
FACULDADE DE ODONTOLOGIA DE PIRACICABA**

OLÍVIA MARIA COSTA DE FIGUEREDO

**INFLUÊNCIA DO TIPO DE ADESIVO PROTÉTICO NA FUNÇÃO
MASTIGATÓRIA DE IDOSOS USUÁRIOS DE PRÓTESE TOTAL:
REVISÃO SISTEMÁTICA E META-ANÁLISE**

**INFLUENCE OF THE DENTURE ADHESIVE TYPE ON MASTICATORY
FUNCTION OF ELDERLY COMPLETE DENTURE WEARERS:
SYSTEMATIC REVIEW AND META-ANALYSIS**

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FUNCTION OF ELDERLY COMPLETE DENTURE WEARERS:
SYSTEMATIC REVIEW AND META-ANALYSIS**

Tese apresentada à Faculdade de Odontologia de Piracicaba da Universidade Estadual de Campinas como parte dos requisitos exigidos para obtenção do título de Doutora em Clínica Odontológica, na Área de Prótese Dental.

Thesis presented to the Piracicaba Dental School of the University of Campinas in partial fulfillment of the requirements for the degree of Doctor in Clinical Dentistry, in Prosthodontics area.

Orientadora: Profa. Dra. Renata Cunha Matheus Rodrigues Garcia

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UNIVERSIDADE ESTADUAL DE CAMPINAS
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RESUMO

Os adesivos protéticos (AP) foram desenvolvidos para minimizar a falta de retenção encontrada nas próteses totais (PT), principalmente em pacientes com rebordos severamente reabsorvidos. Apesar dos estudos comprovarem melhorias na mastigação de usuários de PT após o uso de AP, o impacto de diferentes apresentações dos adesivos protéticos na mastigação permanece desconhecido. Portanto, o trabalho apresentado nesta tese teve como objetivo avaliar, através de uma revisão sistemática e meta-análise, a influência das diferentes apresentações de AP na função mastigatória de pacientes edêntulos. Para isto, o estudo seguiu as recomendações do Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). Buscas foram realizadas em seis principais bases de dados (Cochrane Library, Embase, Latin American Caribbean Health Sciences [LILACS], PubMed-MEDLINE, Scopus, and Web of Science) e na literatura cinzenta (Google Scholar, Clinical trials, Open Grey, and ProQuest Dissertations), até julho de 2021. De acordo com a estratégia Population, Intervention, Comparison and Outcomes (PICO), foram incluídos estudos clínicos randomizados e não randomizados comparando o uso (I) de diferentes apresentações de AP (creme, pó ou fita) (C) na mastigação (O) de usuários de PTs (P), sem restrição de idioma ou tempo de acompanhamento. O risco de viés foi avaliado por meio do Risk of Bias Tool (RoB 2.0) e Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I), para estudos randomizado e não randomizados, respectivamente. Performance mastigatória com peneira única e múltiplas, performance mastigatória com goma de mascar colorida (capacidade de mistura), limiar de deglutição (tamanho de partícula e número de ciclos), cinemática mandibular (movimentos mandibulares) e força oclusal foram os desfechos considerados. Meta-análises foram conduzidas para avaliar a performance mastigatória (peneira única) entre os AP creme e pó, e força oclusal entre creme e fita, considerando $\alpha = 0,05$. A certeza da evidência foi determinada pelo The Grading of Recommendations Assessment, Development and Evaluation (GRADE). Nove estudos (6 ensaios clínicos randomizados e 3 ensaios clínicos não randomizados) foram incluídos. O risco de viés foi considerado moderado. Após análise quantitativa, não foi observada diferença significativa entre os AP para performance mastigatória com peneira única (diferença média padrão = 0,02; IC 95% = -0,46 a 0,50, $P = 0,93$) ou força oclusal (diferença média = 14,35; IC 95% = -11,14 a 39,84], $P = 0,27$). A certeza da evidência foi muito baixa para todos os resultados avaliados. Considerando a análise qualitativa, os AP em creme

e pó foram semelhantes para performance mastigatória com goma de mascar, limiar de deglutição (tamanho da partícula e número de ciclos), cinemática mandibular e força oclusal ($P > 0,05$). Para pacientes que apresentaram rebordo reabsorvido, o creme demonstrou melhor performance mastigatória quando comparado a fita ($P < 0,05$). Ainda, quando comparado a fita, o pó apresentou maior força oclusal ($P < 0,05$). Assim, observa-se que diferentes apresentações de AP se comportam de forma semelhante em usuários de PT. Em adição, apesar da análise qualitativa demonstrar que o uso do creme traz melhores resultados em pacientes com rebordo reabsorvido, são necessários novos estudos avaliando o uso de diferentes apresentações de AP.

Palavras-chave: Prótese dentária completa. Idosos. Adesivos. Mastigação.

ABSTRACT

Denture adhesives (DA) were developed to minimize the lack of retention found in complete dentures (CD), especially in patients with severely reabsorbed ridges. Although studies have proven improvements in the mastication of CD wearers after DA use, the impact of different presentations of denture adhesives on mastication remains unknown. Therefore, the study presented in this thesis aimed to evaluate, through a systematic review and meta-analysis, the influence of different presentations of DA on masticatory function of edentulous patients. This study followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines. Six main databases (Cochrane Library, Embase, Latin American Caribbean Health Sciences [LILACS], PubMed-MEDLINE, Scopus, and Web of Science) and gray literature (Google Scholar, Clinical trials, Open Grey, and ProQuest Dissertations) were searched, up to July 2021. According to the Population, Intervention, Comparison and Outcomes (PICO) strategy, randomized and non-randomized clinical trials comparing the use (I) of different presentations of DA (cream, powder or strip) (C) on mastication (O) of CD wearers (P) were included, without language or follow-up restrictions. The risk of bias was assessed by Risk of Bias Tool (RoB 2.0) and Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I), for randomized and non-randomized studies, respectively. Masticatory performance with single and multiple sieves, masticatory performance with color-changing chewing gum (mixing ability), swallowing threshold (particle size and number of cycles), jaw kinematics (mandibular movements) and occlusal force were the outcomes considered. Meta-analyses were conducted to evaluate masticatory performance (single sieve) between cream and powder DA, and occlusal force between cream and strip, considering $\alpha = 0.05$. The certainty of the evidence was determined by The Grading of Recommendations Assessment, Development and Evaluation (GRADE). Nine studies (6 randomized clinical trials and 3 non-randomized clinical trials) were included. The risk of bias was considered moderate. After quantitative analysis, no significant differences were observed between DA for masticatory performance with single sieve (mean standard difference = 0.02; CI 95% = -0.46 to 0.50, $P = 0.93$) or occlusal force (mean difference = 14.35; CI 95% = -11.14 to 39.84], $P = 0.27$). The certainty of evidence was very low for all analyzed results. Considering the qualitative analysis, cream and powder DA were similar to masticatory performance with chewing gum, swallowing threshold (particle size and number of cycles), jaw kinematics and occlusal force ($P >$

0.05). On the other hand, the cream showed better results for masticatory performance when compared to strip, in patients with reabsorbed ridge ($P < 0.05$). Also, when compared to strip, the powder presented higher occlusal force ($P < 0.05$). Thus, different DA presentations behaved similarly in CD wearers. In addition, although qualitative analysis demonstrates better results to use of cream in patients with reabsorbed ridges, further studies evaluating the use of different presentations of DA are needed.

Key Words: Complete dentures. Older people. Adhesives. Mastication.

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1 INTRODUÇÃO

A população brasileira será representada por mais de 30 milhões de idosos (IBGE, 2018) no ano de 2025, o que colocará o Brasil em sexto lugar em contingente idoso no mundo. Considerando que a ausência dentária está associada ao envelhecimento (Tsakos *et al.*, 2015; Peyron *et al.*, 2017), cerca de 63,1% dos idosos brasileiros entre 65 e 74 anos são usuários de prótese total (PT) superior e 37,5% utilizam PT inferior (SB Brasil, 2010). Embora o tratamento com PTs possua limitações, esse tipo de reabilitação oral exerce influência direta na função mastigatória, possibilitando adequada trituração dos alimentos e reestabelecendo o tônus muscular (Carletti *et al.*, 2019), com reflexo direto no consumo de alimentos, qualidade nutricional da dieta (Goiato *et al.*, 2008; van der Bilt *et al.*, 2010; Cheng *et al.*, 2012; Cardoso *et al.*, 2016) e longevidade desses pacientes (Cannella *et al.*, 2009). Ademais, o reestabelecimento da dimensão vertical de oclusão e, conseqüentemente, do suporte dos tecidos adjacentes também podem influenciar positivamente na estética, com impacto na qualidade de vida (Müller *et al.*, 2014, Sivakumar *et al.*, 2015).

Entretanto, a PT mandibular é alvo de frequentes queixas relacionadas à retenção e estabilidade insuficientes (Stellingsma *et al.*, 2004; Huumonen *et al.*, 2012), uma vez que o osso alveolar mandibular reabsorve cerca de quatro vezes mais do que o maxilar (Bays, 1986; Klemetti, 1996). Fatores funcionais, anatômicos, metabólicos e protéticos estão relacionados à essa reabsorção que ocorre na mandíbula, principalmente em espessura na região anterior e em altura na região posterior (Blahout *et al.*, 2007; Chrcanovic *et al.*, 2011). A crista do rebordo inferior, por exemplo, sofre maior intensidade às forças funcionais transmitidas pela prótese devido à menor área e ao formato desfavorável da mandíbula (Atwood & Coy, 1971; Tallgren, 1972; Atwood, 2001). Além disso, a mandíbula possui uma área de suporte 1,8 vezes menor que a maxila, concentrando maiores forças compressivas e acelerando o processo de reabsorção mandibular (Tallgren, 1972). Portanto, este fenômeno está geralmente associado com o deslocamento da prótese, que pode variar de acordo com a resiliência, formato e/ou altura do rebordo (Ribeiro *et al.*, 2014). Além disto, pacientes com rebordos alveolares severamente reabsorvidos podem apresentar um comprometimento ainda maior na estabilidade das próteses (Stellingsma *et al.*, 2004; Huumonen *et al.*, 2012; Khuder *et al.*, 2017), levando a traumas teciduais e desconforto durante o uso. Como consequência, muitos pacientes descontinuam o uso da prótese inferior, reduzindo sua capacidade mastigatória.

Visando minimizar a falta de retenção das PTs, os adesivos protéticos (AP) foram desenvolvidos em meados de 1930 (Mañes *et al.*, 2011). Esses produtos aumentam a viscosidade da saliva, melhorando, assim, as propriedades adesivas/coesivas entre a prótese e o rebordo alveolar (Polyzois *et al.*, 2011), reduzindo o deslocamento da prótese durante a função (Grasso *et al.*, 2000; Rendell *et al.*, 2000; Hasegawa *et al.*, 2003; de Baat *et al.*, 2007; Munoz *et al.*, 2012). O mecanismo de ação dos APs se dá através de forças adesivas que mantêm a prótese em estabilidade. O adesivo absorve água através da atração produzida entre os seus ânions e os cátions da mucosa tecidual, alterando seu volume após esse contato, aumentado de 50% a 150%, e preenchendo o espaço existente entre a prótese e os tecidos. A saliva promove o aumento da viscosidade do adesivo, resultando no aumento da força necessária para separar a prótese do tecido (Shay, 1991).

Dessa forma, o uso do AP parece reduzir a retenção de partículas de alimento sob a base da prótese e, conseqüentemente, a frequência de úlceras de compressão e irritação da mucosa (Nicolas *et al.*, 2010; Munoz *et al.*, 2012). Sendo assim, os APs são indicados principalmente para pacientes que, mesmo fazendo uso de próteses bem confeccionadas, não obtiveram a adaptação desejada, tendo em vista a altura óssea reduzida e/ou mucosa delgada ou flácida, mais suscetível ao trauma. Ainda, casos em que as próteses implantossuportadas não representam uma escolha possível aos pacientes, devido limitações anatômicas, fisiológicas ou financeiras (Gonçalves *et al.*, 2014; Pan *et al.*, 2014), próteses totais convencionais ainda são a opção de tratamento mais adequada. Dessa forma, o uso associado da PT e AP pode representar uma alternativa viável.

Diferentes apresentações de APs estão disponíveis no mercado, incluindo creme, pó e fita. Naturezas diferentes podem refletir em composições específicas e atuações distintas de cada adesivo (Papadiochou *et al.*, 2015), promovendo características particulares. A solubilidade, por exemplo, é encontrada nos cremes e ocorre pela presença de um polímero sintético longo cuja ação aumenta a viscosidade (Grasso, 2004). Por outro lado, as fitas contêm componentes ativados por água, que após o contato tornam-se pegajosos (Grasso, 2004; Muñoz *et al.*, 2012). Além disso, considerando sua característica física, as fitas apresentam uma conformação que pode dificultar sua fácil distribuição em rebordos altos, o que aumentaria a dimensão vertical nesses pacientes. Os pós são tipicamente compostos de ácido-polimetilviniléter maleico de sódio-cálcio misturado com sal, goma de celulose e aroma; enquanto os cremes contêm mais compostos hidrofóbicos, como veículos de hidrocarbonetos (óleo mineral e petrolatum), além do copolímero de ácido-metilviniléter maleico (An *et al.*, 2016). Dessa maneira, a presença de compostos distintos pode

afetar a hidratação dos polímeros e a formação do gel, resultando em diferentes comportamentos de adesão (Grasso, 2004).

Diversos profissionais ainda relutam em indicar APs aos pacientes, ao considerar que ele pode encobrir possíveis erros clínicos e/ou laboratoriais ocorridos durante a confecção das PTs (Shamsolketabi & Nili, 2018). Isso pode ser resultado de práticas mantidas ao longo do tempo, onde os adesivos eram utilizados em próteses mal confeccionadas (Coates, 2000). Em contrapartida, a literatura demonstra que, quando bem indicados, os APs melhoram a performance mastigatória (Fujimori *et al.*, 2002; Oliveira Junior *et al.* 2014), a força de mordida (Fujimori *et al.*, 2002), proporcionam equilíbrio da musculatura mastigatória (Fujimori *et al.*, 2002) e melhoram os movimentos mandibulares (Rendell *et al.*, 2000; Gonçalves *et al.*, 2014; Marin *et al.*, 2014; Abdelnabi *et al.* 2016). Além disso, o uso de APs aumenta a aceitação e satisfação do paciente em relação à prótese (Marin *et al.*, 2014). Vale ressaltar que melhorias encontradas com o uso do AP podem ser representadas por resultados sutis e, portanto, não reflete em uma mudança extraordinária no desempenho da prótese frente aos mais diversificados parâmetros funcionais. Embora os estudos demonstrem os benefícios dos APs associados às PT (Tarbet *et al.*, 1980; Pradíes *et al.*, 2009), questionamentos se estendem a escolha do tipo de adesivo a ser utilizado, uma vez que ainda não há consenso sobre qual seria a formulação que proporciona melhor desempenho mastigatório.

Diversas revisões sistemáticas (Shu *et al.*, 2021; Elabbasy *et al.*, 2021; Lemos *et al.*, 2021) constatarem os benefícios do uso de APs, porém nenhuma buscou responder a influência das diferentes apresentações na função mastigatória de pacientes edêntulos. Tendo em vista a diversidade de métodos que avaliam a função mastigatória, os desfechos elegidos abrangem a performance mastigatória, limiar de deglutição, cinemática mandibular e força oclusal, muito usados e considerados adequados para análise. Ainda, em estudos mastigatórios, termos diferentes são por vezes utilizados para descrever metodologias semelhantes. Assim, um estudo de termos específicos que avaliam a função mastigatória foi levado em consideração (Gonçalves *et al.*, 2021), facilitando a compreensão sobre cada variável e análise dos dados. Sabendo que o tratamento protético para esse grupo continua sendo um desafio para a Odontologia, e que informações sólidas devem ser obtidas para garantir melhores tratamentos aos pacientes, este trabalho teve como objetivo avaliar, por meio de uma revisão sistemática da literatura e meta-análise, a influência das diferentes apresentações de AP na função mastigatória de pacientes reabilitados com PTs.

2 ARTIGO: Influence of different presentations of denture adhesives on masticatory function of complete denture wearers: A systematic review and meta-analysis.

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ABSTRACT

Statement of problem. Denture adhesives improve the mastication of complete denture wearers. However, the impact of denture adhesives with different presentations on mastication remains unclear.

Purpose. The purpose of this systematic review was to answer the focused question, “Do different presentations of denture adhesives affect the masticatory function of complete denture wearers?”.

Material and methods. This review was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Six databases and the non-peer-reviewed literature were searched up to July 2021. Only clinical studies (randomized clinical trials and nonrandomized clinical trials) comparing the use of different denture adhesive presentations (cream, powder, or strips) were included, without language or follow-up restrictions. The risk of bias was assessed by using the Cochrane tools (RoB 2.0 and ROBINS-I). Masticatory performance, by using single and multiple sieves, masticatory performance with color-changing chewing gum (mixing ability), swallowing threshold (particle size and number of cycles), jaw kinematics, and occlusal force were considered. Meta-analyses were conducted to evaluate masticatory performance (single sieve) and occlusal force outcomes ($\alpha=.05$), and the certainty of the evidence was determined with the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) evaluations.

Results. Nine studies (6 randomized and 3 nonrandomized clinical trials) were included. The risk of bias was considered moderate. Meta-analyses showed no differences between cream and powder denture adhesives for masticatory performance (standard mean difference=0.02; 95% CI=-0.46 to 0.50, $P=.93$) or between cream to strip denture adhesives for occlusal force (mean difference=14.35; 95% CI=-11.14 to 39.84, $P=.27$). Similarly, in qualitative analysis, cream and powder denture adhesives’ performances were similar regarding masticatory performance with color-changing chewing gum (mixing ability), occlusal force, swallowing threshold (particle size and number of cycles), and jaw kinematics ($P>.05$). However, for resorbed ridges, cream denture adhesive resulted in a higher masticatory performance than strip ($P<.05$). When comparing powder to strip denture adhesives, the occlusal force was higher in the powder group ($P<.05$). The certainty of evidence was very low for all evaluated outcomes.

Conclusions. Different presentations of denture adhesives seem to improve the masticatory function of complete denture wearers in a similar way. However, the qualitative analysis showed

that, in patients with a resorbed ridge, a cream denture adhesive may be better than strips to improve mastication, although the certainty of evidence was very low.

CLINICAL IMPLICATIONS

This systematic review showed that all denture adhesive presentations are similarly efficient in improving mastication. Therefore, dentists and patients should choose a product based on other factors.

INTRODUCTION

Although the 2-implant mandibular overdenture is the standard management for edentulous mandibular arches,^{1,2} implant-supported prostheses may not be feasible for some patients because of anatomic, physiologic, or financial limitations.^{3,4} For this population, conventional complete dentures are still the most suitable treatment option.

Complete denture wearers may report dissatisfaction with the treatment, with problems related to comfort, retention, and adaptation,⁵ especially dislodgement of the mandibular complete denture. Lack of retention may be accompanied by the discontinuation of complete denture use, impairing mastication and directly impacting food consumption and diet quality.⁶⁻⁸ In addition, the lack of retention may reduce the masticatory cycle velocity, hindering good mastication.⁹

Denture adhesives were developed to improve denture retention¹⁰ and are mainly indicated for patients with reduced bone height and/or thin or flaccid mucosa, which is more susceptible to trauma.¹¹ Denture adhesives are typically made of carboxymethylcellulose, increasing saliva viscosity and improving the adhesive and cohesive properties between the intaglio surface of the denture base and the oral mucosa.¹² A denture adhesive reduces prosthesis displacement during function, minimizing the retention of food particles under the denture base and, consequently, the occurrence of compression ulcers and mucosal irritation.¹³ Moreover, it improves masticatory performance,^{4,14,15} occlusal force,¹⁴ and jaw kinematics,^{4,16} leading to increased oral health-related quality of life.¹⁷

Several presentations of denture adhesives, including powder, cream, strips, and cushions, are commercially available. Although the effectiveness of denture adhesives has been established,¹⁸⁻²⁰ different natural or synthetic compounds can alter the properties of the denture adhesives and even make the denture adhesive soluble or insoluble in saliva.²¹ For instance, cream and powder presentations contain a long-acting synthetic polymer or gantries salt that increases viscosity in the presence of saliva.²² Differently, strip and cushions are insoluble and contain water-activated components, which make them sticky after water adsorption.^{13,22} In addition to solubility properties, each denture adhesive presentation has specific characteristics related to its composition. The powders are typically composed of polymethylvinylethermaleic acid sodium-calcium mixed with partial salt, cellulose gum, and aroma, while the creams contain more hydrophobic compounds such as hydrocarbon vehicles (mineral oil and petrolatum) in addition to

the methylvinylether-maleic acid copolymer.²³ These compounds may affect the hydration of the polymers and gel formation, resulting in different adhesion behaviors.²²

According to Koronis et al,²⁴ 30% of complete denture wearers eventually use denture adhesive, but the choice of the type of denture adhesive is highly subjective.²⁵ Among different ways to assess the masticatory function,²⁶ recent systematic reviews concluded that the regular use of denture adhesive significantly increased the overall masticatory performance, occlusal force, retention, stability, comfort, and satisfaction of complete denture wearers.²⁷⁻³⁰ However, data that summarized which presentation of denture adhesive would lead to the optimal masticatory function are lacking. Considering that different presentations might produce distinct effects and aiming to assist clinicians in deciding which denture adhesive presentation to recommend, this systematic review was designed to answer the following focused question: “Do different presentations of denture adhesive affect the masticatory function of complete denture wearers?”. The null hypothesis was that the different presentations of denture adhesive would influence the masticatory function of complete denture users without differences among them.

MATERIAL AND METHODS

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines³¹ and was registered at the International Prospective Register of Systematic Reviews (PROSPERO)³² under CRD42021230921. According to the Population, Intervention, Comparison, and Outcomes (PICO) strategy, only clinical studies evaluating the mastication (O) of complete denture wearers (P) by using (I) different presentations of denture adhesive (C) were selected. No restrictions on language, publication date, or follow-up duration were applied. Clinical studies evaluating the use of denture adhesive only in the maxillary complete denture, studies that had missing information not provided by the authors even after contact, reviews, clinical reports, protocols, letters, conference abstracts, posters, personal opinions, and laboratory research were excluded.

The search on 6 electronic databases (Cochrane Library, Embase, Latin American Caribbean Health Sciences [LILACS], PubMed-MEDLINE, Scopus, and Web of Science) was carried out up to July 2021. The non-peer-reviewed literature (Google Scholar, Clinical trials, Open Grey, and ProQuest Dissertations) was also searched. The MeSH terms and free terms were adapted for each database and were supervised by an expert librarian (Supplemental Table 1, available online).

Additional manual search was also performed, and researchers were contacted to check unpublished material and ongoing research. The references were imported from databases into a manager software program (EndNote X9; Thomson Reuters), and all duplicates were removed. Titles and abstracts were evaluated with an online software program (Rayyan; Qatar Computing Research Institute).³³

Study selection was performed by 2 independent and calibrated researchers (O.M.C.F., L.T.G.) in a 2-phase process. The titles and abstracts were screened first, and then the full text was read. In both phases, disagreements were resolved by discussion, and, when necessary, a consensus session was performed with the coordinator (R.C.M.R.G.). Data were extracted by the same independent researchers (O.M.C.F., L.T.G.). To retrieve unreported related information, up to 3 attempts were made to contact the corresponding author.

The risk of bias across studies was verified by 2 researchers (O.M.C.F., L.T.G.), and the Cochrane Risk of Bias Tool for Randomized Trials (RoB 2.0)³⁴ was used to analyze the randomized clinical trials, while the Cochrane Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I)³⁵ was applied for non-randomized clinical trials. Any disagreement was resolved in a consensus meeting with the coordinator (R.C.M.R.G.).

The variables of interest considered for this review were masticatory performance evaluated by single and multiple sieves, masticatory performance with color-changing chewing gum (mixing ability), swallowing threshold (particle size and number of cycles), jaw kinematics, and occlusal force, which were qualitatively evaluated. The meta-analyses were performed by using a software program (Review Manager v. 5.3; The Cochrane Collaboration) ($\alpha=.05$). The outcomes of different denture adhesive presentations were evaluated by standard mean difference and standard error for masticatory performance (single sieve) and by mean difference and standard deviation for maximum occlusal force. The heterogeneity was evaluated with I^2 values, and the random effect was applied. Publication bias was not assessed as there were insufficient studies to be grouped in a funnel plot.³⁶ The certainty of evidence (certainty in the estimates of effect) was determined for each outcome by using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach,³⁷ applied only to the studies included in the meta-analyses.

RESULTS

After searching the databases and non-peer-reviewed literature, 8806 manuscripts were found. After duplicate removal and title and abstract reading, 25 manuscripts were read in full, of which 16 were excluded according to the established criteria (Fig. 1). Thus, 9 articles were suitable for the qualitative synthesis,^{4,13,15,17,38-42} and 4 of them for the quantitative analysis.^{13,15,40,41} Interexaminer agreement in the search for articles was obtained by a Kappa test ($\kappa=0.9$).

The study's characteristics are summarized in Table 1. The included studies were published between 1967 and 2019. Six studies were randomized clinical trials,^{4,13,15,17,38,39} and 3 nonrandomized clinical trials.⁴⁰⁻⁴² A total of 378 participants were evaluated, with a mean age of 67.8 years and range of 45 to 87 years. Four different presentations of denture adhesive were identified: cream or paste, powder, strips, and cushions. Several brands of denture adhesives were identified, including Corega (Glaxo-SmithKline)⁴; Ultra Corega (Glaxo-SmithKline Consumer Healthcare)^{15,38}; Poligrip (Glaxo-SmithKline Consumer Healthcare)^{17,39}; Super Poligrip Free (Glaxo-SmithKline Consumer Healthcare)¹³; Super Poligrip Comfort Seal Strip (Glaxo-SmithKline Consumer Healthcare)^{13,42}; unmarketed adhesive (Glaxo-SmithKline Consumer Healthcare)¹³; Poligrip (Stafford-Miller Ltd)⁴¹; Fittydent (Dr Reddy Laboratories)⁴¹; Fixon (ICPA Health Products)⁴¹; Typical Powder (Fasteeth)⁴⁰; Typical (Wernet's Adhesive Cream; Block Drug Co, Inc)⁴⁰; Protefix Adhesive (Queisser Pharma)⁴²; and unbranded experimental adhesives.⁴⁰

The following outcomes were reported in the selected studies: masticatory performance,^{4,15,17,39,40} occlusal force,^{13,17,39,41,42} swallowing threshold,⁴⁰ and jaw kinematics^{4,38} (Table 2). The nomenclature used to differentiate each masticatory test was based on the recent consensus.²⁶ Thus, masticatory tests were divided into “masticatory performance with multiple sieves,” “masticatory performance with color-changing chewing gum,” and “masticatory performance with single sieve.” For the swallowing threshold, the particle size (swallowing threshold with particle size-single sieve) and the number of cycles (swallowing threshold-number of cycles) were considered. The evaluation of mandibular movements and occlusal force were nominated for “jaw kinematics” and “maximum occlusal force,” respectively.

The risk of bias assessments are shown in Figures 2, 3. Most randomized clinical trials were classified as “some concerns,”^{4,13,15,38} and only 2 studies were considered as with “low risk of bias.”^{17,39} According to ROBINS-I, the 3 nonrandomized clinical trials evaluated were classified as being of “moderate” risk of bias.⁴⁰⁻⁴² The randomization process,^{13,15,38} measurement of the

outcome,⁴ and selection of the reported result^{4,13} were deficient in the randomized clinical trials, while for the nonrandomized clinical trials, the description of confounding factors,⁴⁰⁻⁴² missing outcome data,⁴² and measurement of outcomes⁴⁰⁻⁴² indicated major problems.

The two meta-analyses performed showed no differences between cream or powder denture adhesives for masticatory performance with single sieve (standard mean difference=0.02; 95% CI=-0.46 to 0.50, $P=.93$) (Fig. 4) or between cream or strip denture adhesives for occlusal force (mean difference=14.35; 95% CI=-11.14 to 39.84, $P=.27$) (Fig. 5). However, the certainty of this evidence was considered very low for both outcomes (Table 3).

Similarly, no differences between cream and powder denture adhesives were found in the qualitative analysis of the selected studies in terms of mixing ability (masticatory performance with color-changing chewing gum),^{17,39} swallowing threshold, particle size, or the number of cycles⁴⁰ (Table 2). Likewise, different denture adhesive presentations did not modify the jaw kinematics.³⁸ In terms of maximum occlusal force, no significant differences between cream and powder denture adhesives were found³⁹ although the cream increased the occlusal force more effectively (Table 2).⁴¹ Additionally, greater displacement during mastication was observed in the maxillary complete denture when the powder denture adhesive was used.³⁸

The qualitative analysis comparing cream and strip denture adhesives also showed no differences in general for occlusal force (Table 2).^{13,42} However, a higher incisal force was observed in the cream denture adhesive when compared with that in the strip denture adhesive in 1 study⁴¹ (Table 2). With regard to the masticatory performance, cream denture adhesive was better than strip denture adhesive only for participants with extensive alveolar resorption.⁴ In participants with a normal alveolar ridge, both denture adhesives were equally effective in improving masticatory performance, without differences between the denture adhesive presentations (Table 2).⁴ In terms of jaw kinematics, faster mastication movements were found in participants by using both denture adhesive presentations; however, in those with a normal alveolar ridge, the cream denture adhesive was even more efficient⁴ (Table 2). The powder denture adhesive produced a significantly higher occlusal force than the strip denture adhesive⁴¹ (Table 2).

DISCUSSION

The authors are unaware of a previous review that has evaluated the influence of different presentations of denture adhesives on masticatory function. Primary studies^{13,41} have suggested that the cream denture adhesive might be more efficient than the others because it significantly increased occlusal force. However, no significant differences were found in the present review for masticatory performance, maximum occlusal force, swallowing threshold, or jaw kinematics among the different denture adhesive presentations. Similarly, the present meta-analysis detected no significant changes in masticatory performance between cream and powder denture adhesives or in occlusal force between cream and strip denture adhesives (Figs. 4, 5). Therefore, the null hypothesis was accepted; however, the review and analysis also indicated important strategies for further studies on the relationship between denture adhesives and mastication.

The chemical compounds in each denture adhesive presentation may differ, which may influence the clinical performance of the product. A slightly better performance was detected with the cream denture adhesive than with the powder and strip,⁴¹ but it occurred only for incisal force. However, the pooled estimates results showed a similar performance of all denture adhesive presentations for all the remaining masticatory parameters assessed. Previous studies¹⁸⁻²⁰ have also reported the effectiveness of denture adhesives, regardless the brand or presentation. Although strong evidence concerning this topic is lacking, these results seem to be positive, and clinicians may suggest their patients use their preferred product. The clinical recommendation should also consider manual dexterity, cleanability, mucosal condition, and remaining residual ridge height.

The critical situation of extensive residual ridge resorption seems to be more crucial to the performance of denture adhesives than the presentation itself. For instance, in the comparison between cream and strip denture adhesives, the masticatory performance was higher for the cream group only when patients with extensively resorbed ridges were assessed. In the group with normal ridges, the masticatory performance of both denture adhesives was similar.⁴ In addition, in comparison with the strip denture adhesive, the cream denture adhesive seems to also increase the masticatory cycle velocity of patients with normal ridges. More rapid cycles and a horizontal pattern have been reported to be associated with better mastication.⁹ Thus, in patients with exceptionally poor complete denture retention and stability, such as those with extensively resorbed ridges, the improved distribution of the cream denture adhesive seems to improve mastication. However, future studies with robust methodology are necessary to confirm these findings.

Most randomized clinical trial studies were classified as having “some concerns,”^{4,13,15,38} and all non-randomized clinical trial studies were classified as being of “moderate risk of bias.”^{40,42} Risks of bias are related to the “randomization process,” “measurement of the outcome,” “selection of the reported result,” “confounding factors,” and “missing data,” with “measurement of the outcome” being a bias found in randomized clinical trials and nonrandomized clinical trials studies. The classifications attributed to the studies were mainly influenced by the lack of specific information about the randomization process in the methodology description^{13,15,38} or by the impossibility of blinding denture adhesive presentation used by the participants.^{4,40-42} Considering the selection of the reported result, it was not possible to access the analysis plan of most of the studies; therefore, whether the researchers followed what they proposed could not be determined.^{4,13} As expected, the lack of randomization in the nonrandomized clinical trial studies³⁹⁻⁴² acted as a potential confounding factor for the intervention. In addition, participant withdrawal in the study by Polyzois et al⁴² impaired data assessment.

In masticatory studies, similar terms are sometimes used to describe different methodologies, jeopardizing generalized conclusions. In the present review, the terminology proposed by Goncalves et al was followed.²⁶ These authors defined specific terms to define each method or technique related to evaluating masticatory function in this consensus article. It facilitated data analysis in this review, avoiding the comparison of heterogeneous studies.

Limitations of this review included that some of the included studies had little information about the randomization process^{13,15,38} and outcome measurement,^{4,40-42} mainly because it was not possible to blind the participant to the intervention. Despite this difficulty, criteria regarding the randomization process, the selection of reported results, and confounding factors should be included in future clinical trials. In addition, methodological variations of the same outcome impaired the quantitative comparison of most studies, resulting in only 2 meta-analyses with few studies included and very low certainty of evidence. Therefore, the authors of the present systematic review encourage the development of new primary clinical trials with standardized study protocols and terminologies to produce more reliable and comparable findings and to allow stronger conclusions.

CONCLUSIONS

Based on the findings of this systematic review and meta-analysis, the following conclusions were drawn:

1. The different presentations of denture adhesives (cream, powder, and strip) appeared to have a similar and positive impact on complete denture wearers, improving the overall mastication and occlusal force without differences among them.
2. Although qualitative data suggest masticatory superiority with cream denture adhesive in patients with extensively resorbed residual ridges, only highly heterogeneous studies were available, jeopardizing conclusions.
3. Considering the very low certainty of evidence from the studies, the results should be carefully evaluated. Well-designed randomized long-term clinical trials are needed to confirm these findings.

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TABLES

Table 1. Characteristics of included studies

Author, Year and Country	Study Design	N (Total) Sex (F/M) Age: Mean (SD), Median or Range	Classification of the Residual Ridge	Denture Adhesive Presentation (brand)	Groups	Adaptation Time	Application Area	Edentulous Jaw Applied	Amount of Adhesive Used	Conclusion
Gonçalves et al, 2014 ⁴ Brazil	Parallel (RCT)	N=30 Female: 13 Male: 17 Mean age: 68.1(±7.9) Range: 55-87	NRR=15 RR=15 (Kapur Method)	Strips (Corega, Glaxo- SmithKline) Cream (Corega, Glaxo- SmithKline)	Control (without DA)=10 Cream=10 Strip=10	3 mo (with denture)	According to manufacturer's instructions on mandibular denture resin base	Mandible	NR	Study showed positive influence of DA on masticatory function of CD users. Although all presentations of adhesives have shown improvements, cream presentation achieved best results.
Kalra, Nadiger, and Shah, 2012 ⁴¹ Saudi Arabia	N-RCT	N=30 Sex and age: NR	NR	Fittydent Paste (Dr Reddy Laboratories) Fixon Powder (ICPA Health Products) Poligrip Comfort Seal Strips (Stafford-Miller Ltd)	Control (without DA)=Baseline (Cream + Powder + Strip=30) Cream=10 Powder=10 Strip=10	NR	Denture base (as recommended by manufacturer)	Maxilla Mandible	NR	Study concluded that use of DA improves incisal occlusal force. Paste presentation showed better results, followed by powder and adhesive strips.

Kapur, 1967 ⁴⁰ USA	N-RCT	N=26 Female: 16 ^a Male: 8 ^a Mean age: 63.3 (±8.91) Range: 45–80	NR	Typical Powder (Fasteeth) Typical Cream (Wernet's Adhesive Cream; Block Drug Co, Inc) Experimental adhesive	Control (without DA)=26 ^b Paste=26 ^b Powder=26 ^b Experimental adhesive=26 ^b	NR	NR	Maxilla Mandible	NR	Three presentations of DA significantly improved retention of maxillary and mandibular dentures. Conversely, did not significantly increase mastication performance, and after masticating test food, mandibular denture had significant loss of retention.
Munoz et al, 2012 ¹³ USA	Parallel (RCT)	N=37 Female: 18 Male: 19 Mean age: 70.65 (±11.0)	NR	Super Poligrip Free Cream (Glaxo-SmithKline) Unmarketed cream adhesive (Glaxo-SmithKline) Super Poligrip Free Comfort Seal Strips (Glaxo-SmithKline)	Control (without DA)=37 ^b Cream=36 ^b Unmarketed Cream=37 ^b Strip=36 ^b	NR	According to manufacturer's instructions, DAs applied to maxillary denture and mandibular denture.	Maxilla Mandible	Cream adhesives: 1g weighed out and applied to maxillary denture and 0.6 g to mandibular denture. Strips: 3 strips were applied to maxillary denture, and 2 strips to mandibular denture.	Denture adhesives increased retention and stability of well- adjusted prostheses. Use of DA reduced CD movement, improving comfort, confidence, and user satisfaction.
Nishi et al, 2019 ³⁹ ; Ohwada et al, 2019 ¹⁷ Japan	Parallel (RCT)	N=200 Group 1(cream) Female: 33 Male: 31 Group 2(powder) Female: 34 Male: 35 Group 3(control) Female: 38 Male: 29 Median age: 77	NR	Poligrip S Cream (Glaxo-SmithKline) Poligrip Powder (Glaxo-SmithKline)	Control (saline)=67 Cream=64 Powder=69	NR	Surface of denture where contacts mucosa	Maxilla Mandible	Appropriate amount of adhesive (cream or powder) according to manufacturer instructions	After using DA, patients using CD showed better results of masticatory performance, retention, and satisfaction.

Oliveira Junior et al, 2014 ¹⁵ ; Rodriguez et al, 2014 ³⁸ Brazil	Cross-over (RCT)	N=40 Female: 26 Mean age: 62.3 (±4.8) Male: 14 Mean age: 65.2 (±7.9)	NRR=40 (author's methodology)	Ultra Corega Cream Tasteless (Glaxo-SmithKline) Ultra Corega Powder Tasteless (Glaxo-SmithKline)	Control (without DA)=Baseline (Cream+powder=30) Cream=15 Powder=15	30 d	Intaglio region of maxillary and mandibular CD (anterior and posterior area)	Maxilla Mandible	Cream: 3 portions (approximately 1 cm) Power: sprinkled uniformly in entire denture base (manufacturer's recommendations)	No significant difference found between cream and powder adhesives, since both increased masticatory performance.
Polyzois et al, 2014 ⁴² Greece	N-RCT	N=15 Female: 6 ^a Male: 7 ^a Mean age: 68.2 ^a Range: 59–79	NR	Super Poligrip Comfort Seal Strips (Glaxo-SmithKline) Protefix Adhesive Cushions (Queisser Pharma)	Control (without DA)=13 ^b Strip=13 ^b Cushions=13 ^b	NR	According to manufacturer's instructions	Maxilla Mandible	NR	Strips and cushions adhesives have similar effect in relation to occlusal force of displacement (OFD). Use of both increased OFD and did not change adaptation period.

CD, complete denture; DA, denture adhesives; N-RCT, nonrandomized clinical trials; NR, not reported; NRR, normal residual ridge; RCT, randomized clinical trials; RR, ridge resorption. ^aNumber considering dropouts. ^bParticipants tested in all groups.

Table 2. Main outcomes of selected studies

Author, Year	Outcomes				Results (P)
	Masticatory Performance (Multiple Sieves) (Mean ±Standard Deviation)				
	NORMAL RESIDUAL RIDGE		RIDGE RESORPTION		Ridge Resorption
Gonçalves et al, 2014 ⁴	Control Group (without DA): 5.17 ±0.62 Cream: 4.76 ±0.8 Strip: 4.76 ±0.68		Control Group (without DA): 5.4 ±0.85 Cream: 4.58 ±0.84 Strip: 4.9 ±0.87		C>S (<.001)
	Masticatory Performance With Color-Changing Chewing Gum (Mean)				
	GUM				
Nishi et al, 2019 ³⁹ Ohwada et al, 2019 ¹⁷	Control Group (Saline): ΔE 33.4 Cream: ΔE 30.2 Powder: ΔE 30.1				C=P (.49)
	Masticatory Performance (Single Sieve) (Mean % ±Standard Deviation)				
	PEANUTS		CARROTS		Peanuts
	RIGHT SIDE	PREFERRED SIDE PERFORMANCE	RIGHT SIDE	PREFERRED SIDE PERFORMANCE	C=P=EA (≥.05)
Kapur, 1967 ⁴⁰	Control Group: 33% ±19.8 Paste: 36% ±17.5 Powder: 36% ±16.0 EA: 36% ±19.3	Control Group: 35% ±19.9 Paste: 42% ±20.6 Powder: 38% ±14.3 EA: 39% ±19.6	Control Group: 26% ±20.5 Paste: 27% ±20.8 Powder: 32% ±25.5 EA: 36% ±19.3	Control Group: 27% ±21.6 Paste: 28% ±22.6 Powder: 28% ±18.7 EA: 29% ±20.2	Carrots C=P=EA (≥.05)
	ALMONDS				
Oliveira Junior et al, 2014 ¹⁵	Control Group (Baseline): 19.8% ±14.7% Cream: 32.6% ±18.2% Powder: 31.23% ±17.6%				C=P (>.05)
	Swallowing Threshold (Particle Size – Single Sieve) (Mean % ±Standard Deviation)				
	PEANUTS		CARROTS		
Kapur 1967 ⁴⁰	Control Group: 51% ±22.0 Paste: 53% ±16.8 Powder: 55% ±22.3 EA: 52% ±21.7		Control Group: 42% ±28.7 Paste: 40% ±29.1 Powder: 43% ±29.6 EA: 42% ±28.7		C=P=EA (≥.05)
	Swallowing Threshold (Number of Cycles) (Mean ±Standard Deviation)				
	PEANUTS		CARROTS		
Kapur 1967 ⁴⁰	Control Group: 49 ±22.4 Paste: 46 ±19.2 Powder: 52 ±33.7 EA: 46 ±17.5		Control Group: 61 ±31.0 Paste: 55 ±26.3 Powder: 60 ±32.9 EA: 63 ±33.6		C=P=EA (≥.05)

Jaw Kinematics (Mandibular Movements) (Mean ±Standard Deviation)

	PEANUTS		OPTOCAL		
	OPENING TIME	CYCLE TIME	OPENING TIME	CYCLE TIME	
Gonçalves et al, 2014 ⁴	Normal Residual Ridge Control Group: 212.71 ±48.55 Cream: 184.33 ±42.94 Strip: 189.39 ±42.67	Normal Residual Ridge Control Group: 677.36 ±137.22 Cream: 598.35 ±109.40 Strip: 629.68 ±114.33	Normal Residual Ridge Control Group: 230.99 ±34.61 Cream: 204.76 ±33.81 Strip: 213.97 ±35.09	Normal Residual Ridge Control Group: 673.14 ±111.49 Cream: 625.29 ±114.07 Strip: 645.24 ±104.47	
	Ridge Resorption Control Group: 191.93 ±46.02 Cream: 155.41 ±35.04 Strip: 175.21 ±38.84	Ridge Resorption Control Group: 669.24 ±138.86 Cream: 574.73 ±109.33 Strip: 608.59 ±119.35	Ridge Resorption Control Group: 201.87 ±50.31 Cream: 180.07 ±46.90 Strip: 188.95 ±52.50	Ridge Resorption Control Group: 642.90 ±135.22 Cream: 595.74 ±124.96 Strip: 608.88 ±123.50	
	CLOSING TIME	MAXIMUM VELOCITY DURING CHEWING (Opening)	CLOSING TIME	MAXIMUM VELOCITY DURING CHEWING (Opening)	Cycle Time
	Normal Alveolar Ridge Control Group: 306.76 ±75.42 Cream: 259.67 ±58.05 Strip: 283.57 ±68.06	Normal Alveolar Ridge Control Group: 112.00 ±43.97 Cream: 133.43 ±47.68 Strip: 122.34 ±39.30	Normal Residual Ridge Control Group: 305.65 ±60.13 Cream: 281.96 ±58.4 Strip: 291.57 ±54.21	Normal Residual Ridge Control Group: 128.21 ±42.97 Cream: 147.03 ±46.15 Strip: 143.93 ±41.20	C>S (<.001)
	Alveolar Resorption Control Group: 297.21 ±61.02 Cream: 254.79 ±58.73 Strip: 272.33 ±55.4	Alveolar Resorption Control Group: 129.13 ±44.26 Cream: 155.20 ±53.79 Strip: 138.64 ±49.69	Ridge Resorption Control Group: 303.33 ±59.47 Cream: 272.03 ±58.18 Strip: 282.9 ±59.98	Ridge Resorption Control Group: 152.34 ±51.91 Cream: 164.48 ±51.66 Strip: 164.87 ±59.76	Maximum velocity (peanuts) C>S (<.001)
	OCCLUSAL TIME	MAXIMUM VELOCITY DURING CHEWING (Closing)	OCCLUSAL TIME	MAXIMUM VELOCITY DURING CHEWING (Closing)	
	Normal Alveolar Ridge Control Group: 173.45 ±41.7 Cream: 139.83 ±31.14 Strip: 155.68 ±35.19	Normal Alveolar Ridge Control Group: 77.05 ±31.33 Cream: 97.11 ±36.71 Strip: 88.09 ±32.07	Normal Residual Ridge Control Group: 152.19 ±38.91 Cream: 128.18 ±32.63 Strip: 134.97 ±32.59	Normal Residual Ridge Control Group: 92.83 ±26.67 Cream: 102.98 ±30.25 Strip: 100.77 ±23.89	
	Alveolar Resorption Control Group: 195.82 ±50.34 Cream: 141.63 ±39.75 Strip: 168.28 ±42.94	Alveolar Resorption Control Group: 85.58 ±30.57 Cream: 111.31 ±37.30 Strip: 95.73 ±36.55	Ridge Resorption Control Group: 151.4 ±39.70 Cream: 133.23 ±30.14 Strip: 133.74 ±30.98	Ridge Resorption Control Group: 102.34 ±32.66 Cream: 113.83 ±32.95 Strip: 111.81 ±36.07	
THREE-DIMENSIONAL MANDIBLE MOVEMENTS					
Rodriguez et al, 2014 ³⁸	VERTICAL	ANTEROPOSTERIOR	LATERAL		
	Control Group: 14.1 ±2.5 Cream: 14.8 ±2.4 Powder: 14.8 ±2.1	Control Group: 3.0 ±2.6 Cream: 2.6 ±2.4 Powder: 2.7 ±2.2	Control Group: 0.4 ±2.3 Cream: 0.0 ±2.1 Powder: 0.1 ±1.9		

UPPER CD MOVEMENTS (VERTICAL INTRUSION)

VERTICAL
Control Group: 0.7 ±0.4
Cream: 0.8 ±0.4
Powder: 0.8 ±0.4

ANTEROPOSTERIOR
Control Group: 0.4 ±0.3
Cream: 0.4 ±0.3
Powder: 0.4 ±0.3

LATERAL
Control Group: 0.1 ±0.4
Cream: 0.0 ±0.3
Powder: 0.0 ±0.4

Vertical
Dislodgement
C>P
($<.05$)

UPPER CD MOVEMENTS (VERTICAL DISLODGEEMENT)

VERTICAL
Control Group: 0.0 ±0.1
Cream: 0.1 ±0.2
Powder: 0.2 ±0.2

ANTEROPOSTERIOR
Control Group: 0.0 ±0.3
Cream: 0.0 ±0.1
Powder: 0.0 ±0.2

LATERAL
Control Group: 0.1 ±0.3
Cream: 0.0 ±0.3
Powder: 0.0 ±0.2

Maximum Occlusal Force

INCISAL REGION (N) (Mean ±Standard Deviation)

	Control Group (without DA)	Cream	Powder	Strip	Good Denture
Kalra, Nadiger, and Shah, 2012 ⁴¹	Fair denture: 18.34 ±1.76 Good denture: 24.32 ±1.57 Poor denture: 9.90 ±1.67	Fair denture: 52.37 ±1.76 Good denture: 58.94 ±1.08 Poor denture: 42.85 ±2.55	Fair denture: 32.85 ±1.37 Good denture: 33.64 ±1.18 Poor denture: 42.85 ±1.37	Fair denture: 31.48 ±1.18 Good denture: 31.58 ±0.88 Poor denture: 29.32 ±1.37	C>P>S ($<.001$)

INCISAL REGION (N) (Mean ±Standard Deviation)

Munoz et al, 2012 ¹³	Control Group (without DA): 9.07 ±0.60 Cream: 12.58 ±0.47 Unmarketed Cream: 13.63 ±0.40 Strip: 11.23 ±0.47	C>S ($<.001$)
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INCISAL REGION (N) (Median)

Nishi et al, 2019 ³⁹ Ohwada et al, 2019 ¹⁷	Control Group (Saline): 52.8 Cream: 42.4 Powder: 51.6	C=P (.58)
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INCISAL REGION (N) (Mean ±Standard Deviation)

PREMOLAR REGION (N) (Mean ±Standard Deviation)

	Control Group (without DA)	Strip	Cushion	Control Group (without DA)	Strip	Cushion	S=Cu
Polyzois et al, 2014 ⁴²	0 days: 36.2 ±34.6 45 days: 44.1 ±31.4 90 days: 44.8 ±35.1	0 days: 45.6 ±40.9 45 days: 52.5 ±40.6 90 days: 51.4 ±39.5	0 days: 44.0 ±43.3 45 days: 49.6 ±37.5 90 days: 50.3 ±39.0	0 days: 102.01 ±52.08 45 days: 103.3 ±45.1 90 days: 118.0 ±60.7	0 days: 117.3 ±46.0 45 days: 130.0 ±60.6 90 days: 147.0 ±83.0	0 days: 116.2 ±47.0 45 days: 132.1 ±66.6 90 days: 140.0 ±76.7	(.433)

C, Cream; CD, Complete denture; Cu, Cushion; DA, Denture adhesive; EA, Experimental adhesive; P, Powder; S, Strip.

Table 3. Certainty of evidence

Certainty Assessment						No. of Patients	Effect	Certainty
No. of Studies Study Design	Risk of Bias	Inconsistency	Indirectness	Imprecision	Other Considerations		Absolute (95% CI)	

Masticatory Performance (Single Sieve) – Powder vs Cream

2 Clinical trials	Serious ^a	Not serious	Serious ^b	Serious ^c	None	Powder 34	Cream 34	SMD 0.02 higher (0.46 lower to 0.5 higher)	⊕○○○ VERY LOW
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Maximum Occlusal Force – Strip vs Cream

2 Clinical trials	Serious ^a	Serious ^d	Very serious ^{b,e}	Very serious ^{c,f}	None	Strip 45	Cream 45	MD 14.35 higher (11.14 lower to 39.84 higher)	⊕○○○ VERY LOW
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CI, confidence interval; MD, mean difference; SMD, standardized mean difference.

^aAll included studies presented some type of risk of bias. ^bAuthors could not confirm that results can extrapolate to reabsorbed residual ridge. ^cTotal number of participants evaluated less than 400. ^dI²=100%. ^eAuthors could not confirm that results can extrapolate to men and women. ^fUpper or lower confidence limit crosses effect size of 0.5 in either direction.

FIGURES

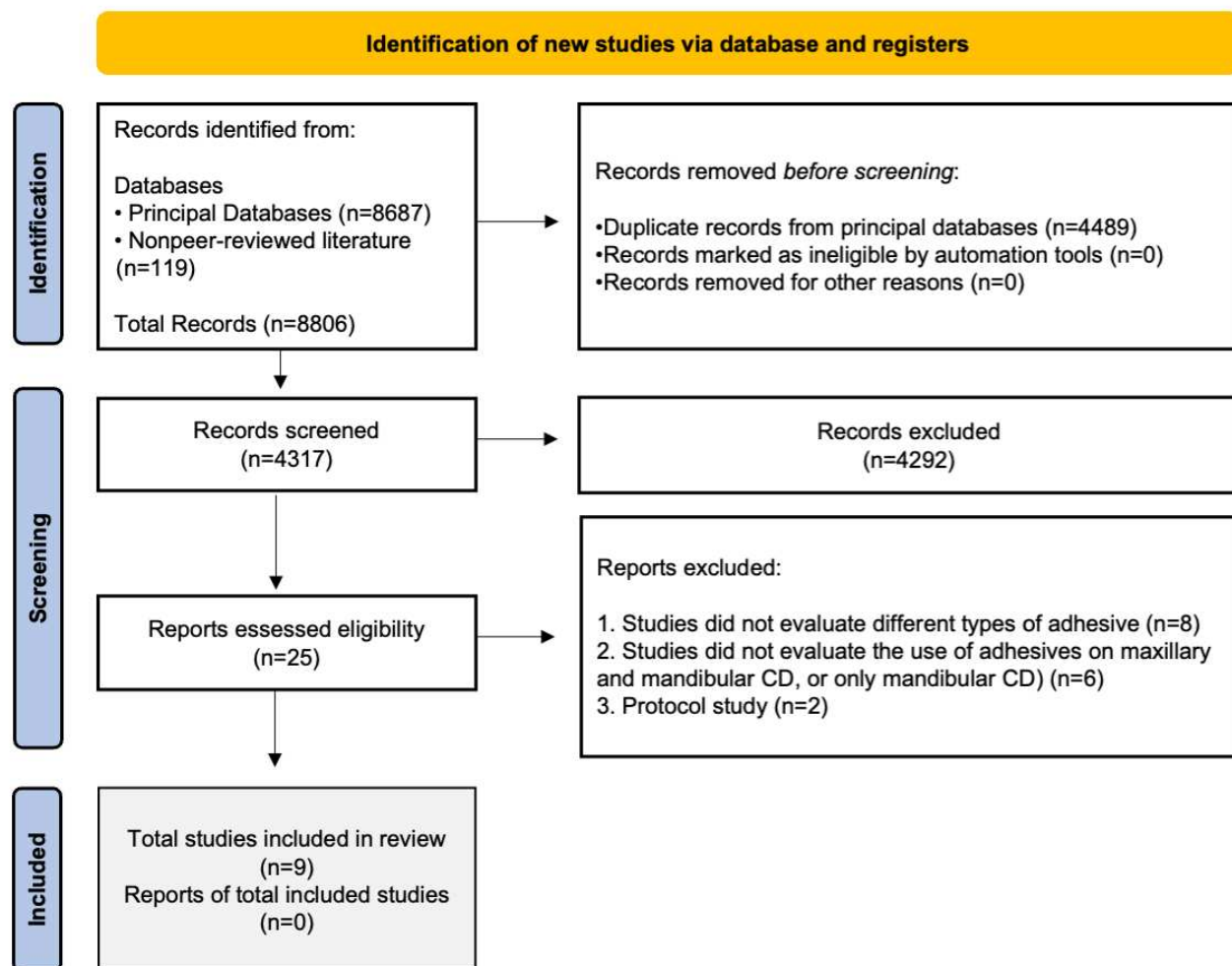


Figure 1. Flowchart of study selection, presenting number of studies identified, eligible, and included in review.

		Risk of bias domains					
		D1	D2	D3	D4	D5	Overall
Study	Munoz et al, 2012						
	Gonçalves et al, 2014						
	Oliveira Júnior et al, 2014						
	Rodriguez, 2014						
	Nishi et al, 2019						
	Ohwada et al, 2019						
Domains:		Judgement					
D1: Bias arising from the randomization process.		 Some concerns					
D2: Bias due to deviations from intended intervention.		 Low					
D3: Bias due to missing outcome data.							
D4: Bias in measurement of the outcome.							
D5: Bias in selection of the reported result.							

Figure 2. Cochrane risk-of-bias summary for randomized clinical trials (RoB 2.0).

		Risk of bias domains							
		D1	D2	D3	D4	D5	D6	D7	Overall
Study	Kapur, 1967								
	Kalra, Nadiger, and Shah, 2012								
	Polyzois et al, 2014								

Domains:

D1: Bias due to confounding.
D2: Bias due to selection of participants.
D3: Bias in classification of interventions.
D4: Bias due to deviations from intended interventions.
D5: Bias due to missing data.
D6: Bias in measurement of outcomes.
D7: Bias in selection of the reported result.

Judgement

 - Moderate

 + Low

Figure 3. Cochrane risk-of-bias summary in nonrandomized studies (ROBINS-I).

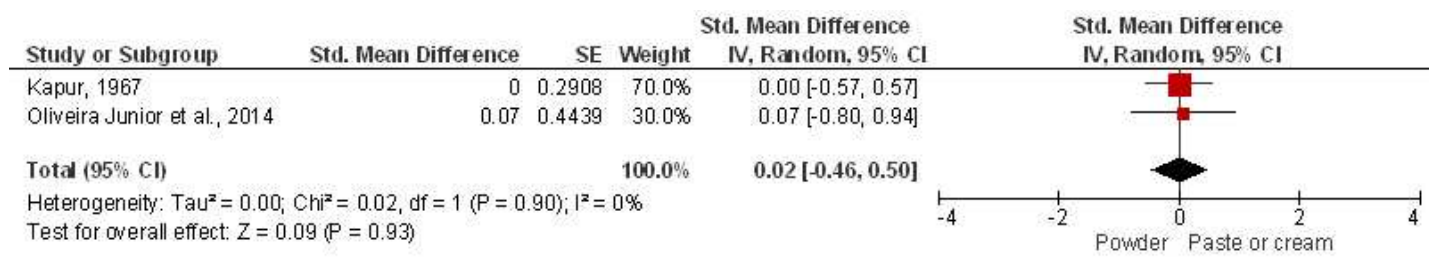


Figure 4. Standard mean difference and standard error of mastication (masticatory performance – single sieve) when comparing cream and powder presentations of denture adhesives.

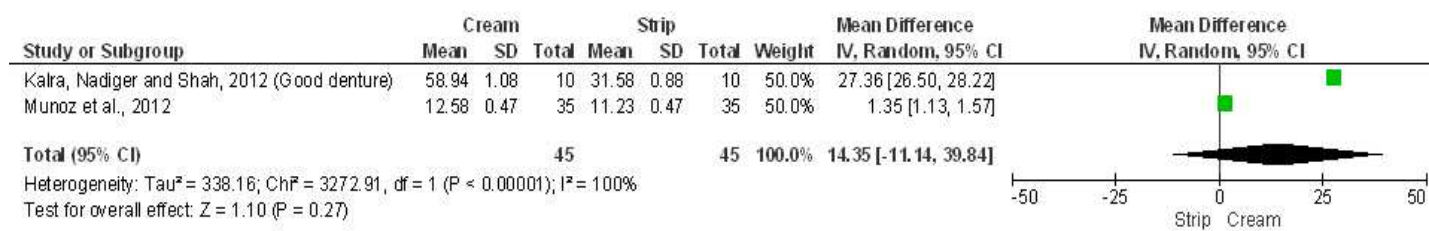


Figure 5. Mean difference (standard deviation) of maximum occlusal force when comparing cream and strip presentations of denture adhesives.

SUPPLEMENTARY TABLE

Supplementary Table 1. Search strategy for each database Jul 12th 2021.

Databases	Search strategy
PubMed (n=1,848)	("Denture, Complete"[MeSH Terms] OR Dentures[MeSH Terms] OR "Denture, Complete, Lower"[MeSH Terms] OR Denture*[Title/Abstract] OR prosthesis*[Title/Abstract]) AND (Adhesives[MeSH Terms] OR adhesive*[Title/Abstract])
Scopus (n=2,467)	INDEXTERMS ({Denture,Complete} OR {Dentures} OR {Denture, Complete, Lower}) OR TITLE-ABS-KEY (denture* OR prosthesis*) AND INDEXTERMS ({Adhesives}) OR TITLE-ABS-KEY (adhesive*) AND (LIMIT-TO (SUBJAREA, "DENT"))
Web of Science (n=1,584)	TS=("Denture, Complete" OR "Denture, Complete, Lower" OR Denture* OR prosthesis*) AND TS=(adhesive*)
Embase (n=1,918)	('Complete denture'/mj OR 'Denture'/mj OR 'complete lower denture'/mj OR denture*:ti,ab,kw OR prosthesis*:ti,ab,kw) AND ('adhesive agent'/mj OR adhesive*:ti,ab,kw)
Cochrane Library (n=368)	#1 (MeSH descriptor: [Denture, Complete]; #2 MeSH descriptor: [Denture, Complete] [Dentures]; #3 MeSH descriptor: [Denture, Complete, Lower]); #4 (Denture* OR prosthesis*):ti,ab,kw #1 OR #2 OR #3 OR #4 = #5 #6 (MeSH descriptor: [Adhesives]); #7(adhesive*): ti,ab,kw #6 OR #7 = #8 #5 AND #8
LILACS (n=504)	((mh:("Denture, Complete" OR "Dentures" OR "Denture, Complete, Lower")) OR (tw:(denture* OR prosthesis*))) AND ((mh:(adhesive)) OR (tw:(adhesive*)))
Clinical Trials (n=17)	(denture AND adhesive)
Open Grey (n=2)	(denture AND adhesive)
Google Scholar (n=100)	(denture AND adhesive)

3 CONCLUSÃO

Diante dos resultados obtidos no estudo apresentado, observa-se que os adesivos protéticos em forma de creme, pó e fita têm um impacto semelhante e positivo em usuários de próteses totais, melhorando a mastigação geral e a força oclusal. Apesar da apresentação em forma de creme demonstrar melhores resultados na análise qualitativa, poucos são os estudos disponíveis para suportar essa afirmação. Além disso, deve-se manter uma avaliação cautelosa dos resultados, considerando a heterogeneidade dos estudos, evitando conclusões não condizentes com a realidade clínica. Ademais, análises relacionadas à quantidade de adesivo utilizado, formas de aplicação, consequências do seu uso e influência da instrução profissional podem guiar futuras pesquisas; tendo em vista que essas variáveis podem interferir na percepção do paciente sobre o produto e, consequentemente, na adesão ou não desse tratamento. Dessa forma, ensaios clínicos randomizados bem delineados e com avaliações a longo prazo, incluindo investigações subjetivas através de questionários, são necessários.

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* De acordo com as normas da UNICAMP/FOP, baseadas na padronização do International Committee of Medical Journal Editors - Vancouver Group. Abreviatura dos periódicos em conformidade com o PubMed.

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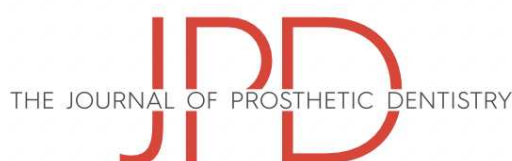
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ANEXOS

ANEXO 1 – Comprovante de publicação do artigo “Influence of different presentations of denture adhesives on masticatory function of complete denture wearers: A systematic review and meta-analysis” na revista *The Journal of Prosthetic Dentistry*.

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SYSTEMATIC REVIEW

Influence of different presentations of denture adhesives on masticatory function of complete denture wearers: A systematic review and meta-analysis

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 Marcela Baraúna Magno, DDS, MSc, PhD,^e Lucianne Cople Maia, DDS, MSc, PhD,^f
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 Renata Cunha Matheus Rodrigues Garcia, DDS, MSc, PhD^h

ABSTRACT

Statement of problem. Denture adhesives improve the mastication of complete denture wearers. However, the impact of denture adhesives with different presentations on mastication remains unclear.

Purpose. The purpose of this systematic review was to answer the focused question, “Do different presentations of denture adhesives affect the masticatory function of complete denture wearers?”.

Material and methods. This review was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Six databases and the non-peer-reviewed literature were searched up to July 2021. Only clinical studies (randomized clinical trials and nonrandomized clinical trials) comparing the use of different denture adhesive presentations (cream, powder, or strips) were included, without language or follow-up restrictions. The risk of bias was assessed by using the Cochrane tools (RoB 2.0 and ROBINS-I). Masticatory performance, by using single and multiple sieves, masticatory performance with color-changing chewing gum (mixing ability), swallowing threshold (particle size and number of cycles), jaw kinematics, and occlusal force were considered. Meta-analyses were conducted to evaluate masticatory performance (single sieve) and occlusal force outcomes ($\alpha=.05$), and the certainty of the evidence was determined with the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) evaluations.

Results. Nine studies (6 randomized and 3 nonrandomized clinical trials) were included. The risk of bias was considered moderate. Meta-analyses showed no differences between cream and powder denture adhesives for masticatory performance (standard mean difference=0.02; 95% CI=-0.46 to 0.50, $P=.93$) or between cream and strip denture adhesives for occlusal force (mean difference=14.35; 95% CI=-11.14 to 39.84, $P=.27$). Similarly, in qualitative analysis, cream and powder denture adhesives’ performances were similar regarding masticatory performance with color-changing chewing gum (mixing ability), occlusal force, swallowing threshold (particle size and number of cycles), and jaw kinematics ($P>.05$). However, for resorbed ridges, cream denture adhesive resulted in a higher masticatory performance than strip ($P<.05$). When comparing powder to strip denture adhesives, the occlusal force was higher in the powder group ($P<.05$). The certainty of evidence was very low for all evaluated outcomes.

Conclusions. Different presentations of denture adhesives seem to improve the masticatory function of complete denture wearers in a similar way. However, the qualitative analysis showed that, in patients with a resorbed ridge, a cream denture adhesive may be better than strips to improve mastication, although the certainty of evidence was very low. (J Prosthet Dent 2021;■:■-■)

ANEXO 2 – Relatório de Similaridade gerado pelo software Turnitin®.

INFLUÊNCIA DO TIPO DE ADESIVO PROTÉTICO NA FUNÇÃO MASTIGATÓRIA DE IDOSOS USUÁRIOS DE PRÓTESE TOTAL: REVISÃO SISTEMÁTICA E META-ANÁLISE

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