MEANDROS
MEDICAL AND DENTAL JOURNAL
June 2024 25(2):109-118

*Meandros Medical and Dental Journal*
*doi: 10.69601/meandrosmdj.1529356*

*Research Article*

# COMPARISON OF TENSILE BOND STRENGTH OF SOFT DENTURE LINER MATERIAL ON DENTURE BASE RESINS

**Pınar YILDIZ [1]*, Esra TALAY ÇEVLİK [2], Göknil ALKAN DEMETOĞLU [2]**

[1] Nimet Bayraktar Oral and Dental Health Center, Kayseri, TURKEY
[2] Department of Prosthodontics, Faculty of Dentistry, Aydın Adnan Menderes University, Aydın, TURKEY

*Correspondence: dentistpinar@hotmail.com

## ABSTRACT

**Objective:** This study aims to evaluate the tensile bond strength of a silicone-based soft denture liner material on denture bases produced via conventional, subtractive, and additive manufacturing techniques and examine the effect of aluminum oxide particle abrasion on tensile bond strength.

**Materials and Methods:** A total of 48 cylindrical denture base resin samples were manufactured using three different techniques: conventional, subtractive, and additive manufacturing. The samples were divided into two groups: control and aluminum oxide particle abrasion. All samples were separated at the center, and the soft liner was applied to the corresponding surfaces. The specimens then underwent tensile bond strength testing. Data were analyzed using Two-way ANOVA and Bonferroni post hoc tests. Failure-type analyses have been conducted.

**Results:** Two-way ANOVA results indicated a significant difference among the denture base resins, while no significant difference was found between the control and aluminum oxide particle abrasion groups. The highest tensile bond strength was observed in the subtractive-manufactured aluminum oxide particle abrasion group, while the lowest tensile bond strength was in the additive-manufactured aluminum oxide particle abrasion group. Significant differences were found between the subtractive and additive-manufactured groups ($p=0.022$).

**Conclusion:** This study demonstrates that tensile bond strength varies with the denture bases manufacturing technique. While aluminum oxide particle abrasion increased tensile bond strength in subtractive manufacturing, it had no statistically significant effect. Further research should explore different soft-lining materials and consider in vivo conditions for more comprehensive insights.

**Keywords:** Denture base resins, denture liners, tensile bond strength

**Received:** 07 August 2024
**Revised:** 16 August 2024
**Accepted:** 21 August 2024
**Published:** 31 August 2024

## INTRODUCTION

When polymethyl methacrylate (PMMA) was first introduced into clinical practice, it quickly became an accepted standard among the materials used to fabricate denture bases (DBs) (1). Typically, DBs are made from poly methyl methacrylate-based polymers due to their wide availability and cost-effectiveness (2). However, these resins exhibit a volumetric shrinkage of approximately 7% (3). Technological advancements now allow for the digital production of dentures using computer-aided design (CAD) and computer-aided manufacturing (CAM) techniques, including subtractive milling (subtractive-manufacturing) and three-dimensional (3D) printing (additive-manufacturing) (2) Milled CAD-CAM DBs exhibit less volumetric deviation since they are crafted from disks of pre-polymerized acrylic resin, thereby eliminating additional polymerization shrinkage (4). CAD-CAM DBs have recently been produced via additive manufacturing (5). One of additive manufacturing's benefits over milling is its capacity to produce items of any quantity or dimensional complexity. Furthermore, additive manufacturing produces less waste and makes it possible to replicate minute details (5).

Denture relining, a frequently performed procedure in dental clinics, extends the usability of existing dentures by adjusting the DB to accommodate changes in soft and hard tissues. This procedure is notably quicker and more cost-effective compared to creating a new denture (6,7). Additionally, DBs can be easily bonded to the housing systems in implant-supported over-denture prostheses by denture liners (8). It involves the use of both hard and soft denture liners, with soft liners available in silicone and acrylate formulations suitable for both short- and long-term applications (6,7).

By providing cushioning and ensuring a uniform distribution of functional loads on denture-bearing areas, soft denture liners (SDL) improve patient comfort. This is particularly helpful in cases of bruxism, sensitive mucosa, and undercuts (7,9). SDLs also help with immediate dentures and post-surgery, as evidenced by increases in masticatory performance, overall patient happiness, and quality of life related to dental health (10, 11).

Stress concentration is decreased and bonding contact is effectively improved by surface modifications made by mechanical and chemical means (12). By increasing the surface area for mechanical retention, mechanical roughening of surfaces via burr grinding (13) and particle abrasion using airborne aluminum oxide ($Al_2O_3$) particles (14) are useful methods to improve bonding strength.

The tensile bond strength (TBS) of SDL materials to milled DBs has not been extensively studied, and as far as the authors are aware, no research has looked into the effects of aluminum oxide particle abrasion on the TBS of denture reline materials to DBs that are manufactured subtractively or additively. The purpose of this in vitro investigation was to assess the tensile bond strength of SDL material on DBs made using various production techniques. The null hypothesis was that particle abrasion treatment has no effect on the TBS between soft liner materials and DBs manufactured using multiple techniques.

## MATERIALS AND METHODS

Three different DB resin materials (conventional, subtractive, and additive-manufactured) and a soft lining material were utilized. Table 1 shows the materials that were used in this study.

**Table 1.** Materials used in the study

| Material | Brand | Material type |
|---|---|---|
| Panacryl | Arma Dental, İstanbul, Türkiye | Heat-cured acrylic resin (conventional) |
| Keymill | Keystone, Singen, Germany | Milled DB disc (subtractive) |
| Power Resins Denture | Power Resins, İstanbul, Türkiye | 3D-printed acrylic resin (additive) |
| Mollosil Plus | Detax, Detax, Ettlingen, Germany | Auto-polymerized, silicone-based, permanent, soft lining material (auto-polymerized) |

The visual sample, designed as a cylinder, has dimensions of 1 cm in diameter and 25 mm in length. It was generated using CAD (ExcoCAD, DentalCAD, ExcoCAD GmbH, Darmstadt, Germany) software and saved in the standard tessellation language (STL) file format. Subsequently, pre-polymerized CAD/CAM PMMA discs (98.5 ⌀ and 25 mm in length) were utilized for milling. This process enabled the production of 16 DB resins using a subtractive-manufacturing technique facilitated by CAM (BLX5, DentalPlusCo Ltd., Gyeonggi-do, Korea).

An impression was taken using silicone impression material (Durosil L, PD President, Munich, Germany) from a sample manufactured using the subtractive manufacturing technique. Wax cylinder samples were prepared and conventionally flasked using a dental flask and clamp. The flask was filled with a 1:1 mixture of dental plaster type II and dental stone type IV. After the dental stone set, the flask underwent a water bath to eliminate the wax. Next, a conventional heat-cure acrylic DB resin (Panacryl, Arma Dental, Istanbul, Turkey) was prepared at a ratio of 25 g (polymer) to 10 ml (monomer) and packed into the mold according to the manufacturer's instructions. The molds were incubated for 8 hours at 74 ºC in water, followed by a 2-hour boiling period. And 16 cylindrical acrylic specimens were fabricated measuring 1 cm in diameter and 25 mm in length. After retrieving the resin samples from the molds, acrylic burrs were cleaned using a tungsten carbide bur (HM251 FF, Hager& Meisinger GmbH, Neuss, Germany).

The identical STL file of the visual sample was uploaded into the slicing software (Alpha3D, Harju, Estonia). The print orientation was configured to 0°, supported by 3-mm structures. Parameters were established with a layer thickness of 50 µm and a baseplate thickness of 0.5 mm. A 3D print denture-base resin (PowerResins Denture, PowerResins, Istanbul, Turkey) was utilized, and the printing was performed using a 3D printer (Ackuretta FreeShape 120, Ackuretta Technologies, Taipei, Taiwan). The samples (n=16) were printed using an additive-manufacturing method with DB resin. The printed output was washed for 5 min in a rotary washing machine (CLEANI, Ackuretta Technologies, Taipei, Taiwan) with 99% pure isopropyl alcohol (Wogens Pure; Wogens Chemistry and Engineering, Konya, Turkey). Then, polymerization was completed with a UV irradiation device (UV CURIE; Ackuretta Technologies, Taipei, Taiwan) with a wavelength of 405 nm for 3 minutes. And supports were removed.

All cylindrical samples were separated from the center without undergoing any polishing process to simulate the inner surfaces of DB surfaces. To establish surface standardization for the application of soft lining material, circular abrasions were made using a tungsten carbide cutter, with consistent movements applied for 10 seconds by the same researcher. Subsequently, all samples underwent a 10-minute cleaning cycle in distilled water using an ultrasonic cleaner. Silicone molds were then prepared to accommodate the separated cylinders, which were divided into two sections for the application of 3 mm thick soft lining material (Figure 1a).

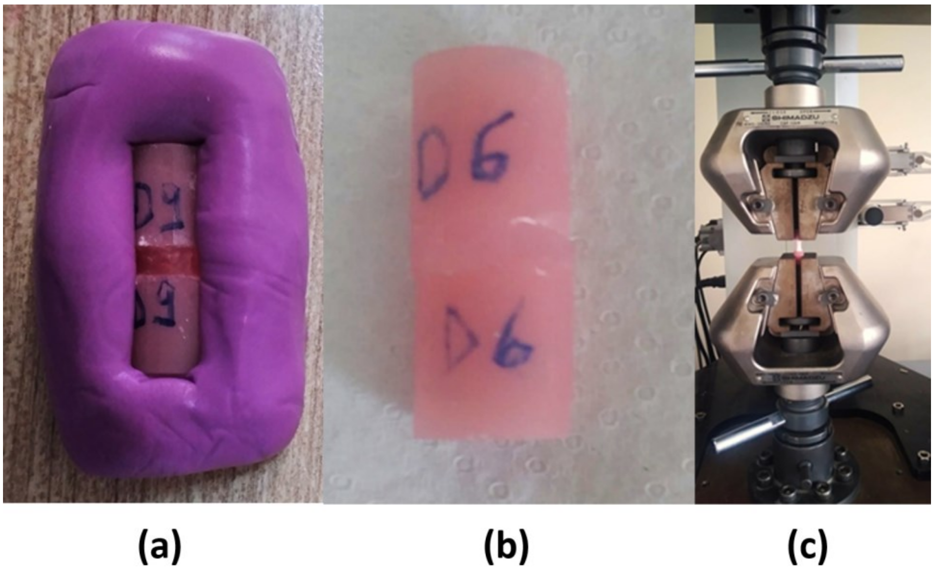

**Figure 1.** a. Photo of the silicone mold that allows the preparation of equal amounts of soft relining material, b. A test sample prepared with soft lining material between acrylic resin cylinders, c. TBS test of DB and soft relining material with universal testing machine.

Subsequently, the samples for all DB resins were divided into two subgroups (n=8). The first subgroup, serving as the control group, received no treatment on the surfaces designated for soft relining material application. The second subgroup, serving as the experimental group, underwent airborne particle abrasion (APA) using 50 µm aluminum oxide particles. This abrasion process occurred at a distance of 10 mm from the samples, applying a pressure of 0.2 MPa. Following abrasion, the samples in the second subgroup underwent a 10-minute cleaning cycle in distilled water using an ultrasonic cleaner.

The primer (Mollosil Plus Primer, Detax, Ettlingen, Germany) was initially applied to the rough surfaces of identical cylinder parts facing each other in all groups, following the user instructions for soft lining materials (Mollosil Plus, Detax, Ettlingen, Germany), and left to set for 20 seconds. Subsequently, a second layer of primer was applied and left to set for an additional 20 seconds. Afterward, the cylinders were positioned within silicone molds, ensuring that the primer-coated surfaces faced each other. The soft lining material was then dispensed from an automix cartridge and applied between the cylinder parts. Following a 2-minute hardening period, the cylinder samples were carefully removed from the silicone molds. Any excess soft lining material was removed using the tungsten carbide bur included in the set (Figure 1b).

Before the TBS test, all samples were immersed in distilled water for 24 hours (15). Subsequently, DB resin specimens were subjected to tension until failure using a universal testing machine (AG-X 50kN, Shimadzu, Kyoto, Japan) at a crosshead speed of 5 mm/min (Figure 1c). The maximum TBS values, measured in Newton (N), before failure, were recorded. TBS values (in MPa) were then calculated by dividing the maximum load (N) by the standardized cross-sectional area of the interface (78.5 $mm^2$) for all DB specimens.

The type of failure was examined using a stereomicroscope (SZ61; Olympus Optical Co., Ltd, Tokyo, Japan) at 20x magnification. Failure types were classified into three categories: adhesive (type 1), cohesive (type 2), or mixed mode (type 3). The adhesive failure occurred when there was complete separation at the interface between the liner material and the DB. Cohesive failure was identified by rupture within the liner material itself. Mixed failure exhibited characteristics of both cohesive and adhesive failures.

### *Statistical analysis*

Using the Minitab Statistical Program (Minitab 22, Minitab LLC), the minimum sample size was determined based on data from previous studies (16). With a power (β) of 0.80 and a significance level (α) of 0.05, each of the four study groups required a minimum sample size of 8 to detect significant differences in TBS values.

Subsequently, statistical analysis was conducted using SPSS V22 (SPSS Inc., Chicago, IL, USA). Normal distribution and homogeneity of variance of the TBS data were assessed using the Shapiro-Wilk and Levene tests, respectively. The data were analyzed using a two-way ANOVA followed by a post hoc Bonferroni correction test for pairwise comparisons. Descriptive analyses were used to present the results of the type of failure evaluations.

## RESULTS

The mean ± standard deviation values of TBS for DB resins manufactured using three different techniques, along with those for the control and APA groups, are presented in Table 2. Additionally, the results of the Two-way ANOVA and Bonferroni post hoc tests are included in Table 2. The effect of the material was found to be significantly different (f=4.105, p=0.024), whereas the effects of surface treatment (f=0.107, p=0.745) and the interaction between these two parameters (f=0.831, p=0.443) were not significant.

The highest TBS value was observed in the subtractive-manufactured APA group (1.76±0.24), whereas the lowest TBS value was observed in the additive-manufactured APA group (1.05±0.135).

The Bonferroni test indicated significant differences between the subtractive-manufactured and additive-manufactured groups (f=4.196, p=0.022). Still, no significant differences were found between the conventional-manufactured and subtractive-manufactured groups or between the conventional-manufactured and additive-manufactured groups. The types of failures are given in Table 3.

**Table 2.** Mean ± standard deviations of TBS values, Two-way ANOVA, and Bonferroni test results

| | **DB Resins** | | | **Test Statistics†** | |
|---|---|---|---|---|---|
| | **Conventional-manufacturing** | **Subtractive-manufacturing** | **Additive-manufacturing** | | |
| | x̄± *sd* | x̄± *sd* | x̄± *sd* | *F* | *p* |
| **Treatment** | | | | | |
| **Control** | 1.39±0.39 | 1.46±0.92 | 1.17±0.37 | 0.740 | 0.483 |
| **APA** | 1.36±0.49$^{a,b}$ | 1.76±0.24$^{a}$ | 1.05±0.135$^{b}$ | 4.196 | 0.022 |
| **Test Statistics‡** | | | | | |
| ***F*** | 0.019 | 1.485 | 0.265 | | |
| ***p*** | 0.891 | 0.230 | 0.609 | | |
| **Material Effect:** *F=4.105* ***p*=0.024*** **Treatment Effect:** *F*=0.107 *p*=0.745 **Material x Treatment Effect:** *F=0.831 p=0.443* | | | | | |

x̄:Mean, *sd*: Standard deviations, †: Intergroup comparisons for treatments, The superscripts a and b indicate groups with statistically significant differences in each measurement. Groups with the same superscripts are statistically similar. ‡: Intergroup comparisons for DB materials

**Table 3.** Failure types

| | | **Adhesive (Type 1)** | **Cohesive (Type 2)** | **Mixed (Type 3)** |
|---|---|---|---|---|
| **Conventional-manufacturing** | Control | 4 (50%) | 0 | 4 |
| | APA | 6 (75%) | 0 | 2 (25%) |
| **Subtractive-manufacturing** | Control | 3 (37.5%) | 4 (50%) (soft lining rupture) | 1 (12.5%) |
| | APA | 8 (100%) | 0 | 0 |
| **Additive-manufacturing** | Control | 7 (87.5%) | 1 (12.5%) (acrylic fracture) | 0 |
| | APA | 8 (100%) | 0 | 0 |

## DISCUSSION

One frequent problem is the debonding of denture liners from the DBs (17). This study evaluated the tensile bond strength of an SDL material with conventional, subtractive, and additive-manufactured DB materials, as well as the effect of aluminium oxide particle abrasion on the tensile bond strength. The results of the study indicate that there is a difference in TBS among the different DB materials. Additionally, aluminum oxide particle abrasion does not affect TBS. Therefore, the null hypothesis was partially accepted.

The chemical structure of the materials varies throughout the three DBs (additive, subtractive, and conventional manufacturing), which accounts for the variation in TBS. Although Aydın et al. (18) recommended selecting DB and SDL materials with the same polymerization method for optimal tensile bond strength, in our study statistically, no significant difference was found between the conventional-manufactured and subtractive-manufactured DBs, as well as between the conventional-manufactured and additive-manufactured DBs.

The literature shows mixed results regarding the tensile bond strength (TBS) of SDL materials and DB resins made using different methods. A previous study (19) found no significant difference in TBS among various DB materials (conventional, subtractive, and additive manufacturing) when paired with an SDL, with adhesive failure being the only type observed. In contrast, Choi et al. (17) reported the lowest TBS between subtractive-manufactured DB materials and a soft liner, with adhesive failure also being predominant. On the other hand, Azpiazu-Flores et al. (20) noted the lowest TBS for additive-manufactured DB materials when used with long-term soft liners. Additionally, Awad et al. (15) demonstrated that CAD-CAM milled DBs had more pores than the other DB specimens in SEM images. They suggested that the higher mean tensile bond strength values of the CAD-CAM milled DBs could be attributed to the increased mechanical retention provided by these pores. In our study, the additive-manufactured DBs exhibited the lowest mean tensile bond strength values in line with the findings of Azpiazu-Flores et al. (20), whereas the subtractive-manufactured DBs had the highest values. This result is consistent with the study of Awad et al. (15). Additionally, in this study, adhesive-type failure was predominantly observed in all groups.

The study used a silicone-based SDL material, which does not form a chemical bond with PMMA DBs. Therefore, the bond strength depends mainly on the tensile strength of the material and the adhesive used (21). Kawano et al. (22) indicated that an SDL material with a bond strength of 0.44 MPa is acceptable for clinical use, a standard supported by other authors (9,17). In this study, the protocol included applying a primer before the reline material. Despite Bayati et al. (23) suggesting that the primer might reduce the mean tensile bond strength, all TBS values in this study were above the clinically acceptable threshold.

There exist several methods to improve the surface morphology of the DB material and facilitate adhesion (24). Mechanical roughening of surfaces using airborne particle abrasion with aluminum oxide ($Al_2O_3$) particles (14) is an effective method for enhancing strength by augmenting the surface area to promote mechanical retention. Due to the lack of consensus in the literature regarding the impact of aluminum oxide particle abrasion on TBS, the samples in the APA subgroups were treated with aluminum oxide particles according to the same protocol used in a previous study (24). Although the APA application did not produce a statistically significant difference, it did result in an increase in the TBS value for DBs produced through subtractive manufacturing.

Acrylic resins and silicone elastomers are the two categories of SDL materials. Acrylic polymers, copolymers, a liquid containing an acrylic monomer, and plasticizers like ethyl alcohol or ethyl acetate—which assist preserve softness—are all present in plasticized acrylic resins. On the other hand, silicone elastomers, which resemble silicone impression materials, are composed of dimethylsiloxane polymers and retain their elasticity over time without the need for leachable plasticizers. Kimoto et al. (25) discovered that the duration of edentulism was positively correlated with the perceived ability to chew and that the application of an acrylic-based SDL to mandibular complete dentures had no discernible effect on the chewing ability of edentulous patients when compared to a conventional acrylic resin. Therefore, a silicone-based soft lining material was preferred in this study. However, the use of a single type of silicone material can be considered a limitation of this study.

To replicate clinical conditions, no treatment was performed on the acrylic surfaces after separation. Additionally, this study was planned as an in vitro study; however, studies conducted under in vivo conditions could provide insights into long-term performance. Another limitation of this study is the use of only one type of silicone-based SDL. To draw more definitive conclusions, future investigations should include a broader range of SDL materials. Further studies should also consider utilizing liners specifically designed for additive-manufactured materials.

## CONCLUSIONS

Within the limitations of this study; there are significant differences in TBS among the various DB materials. These differences can be attributed to variations in the chemical composition of the materials. This study did not find any statistically significant difference in TBS between conventional-manufactured and subtractive-manufactured DBs, or between conventional-manufactured and additive-manufactured DBs. APA had no significant effect on the TBS of the SDL material across the different DB materials. Further research should explore different soft lining materials and consider in vivo conditions for more comprehensive insights.

**Acknowledgments**
None

### Authorship contributions

Concept: PY, ETÇ, GAD; Design: PY, ETÇ, GAD; Data Collection or Processing: PY, ETÇ, GAD, Analysis or Interpretation: PY, ETÇ, GAD; Literature Search: GAD; Writing: PY, ETÇ

### Data availability statement

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

### Declaration of competing interest

No conflict of interest was declared by the authors.

### Ethics

This article does not contain any studies with human participants or animals performed by any of the authors.

**Funding**
This work has not received any funding support.

## REFERENCES

1. Aguirre BC, Chen J-H, Kontogiorgos ED, Murchison DF, Nagy WW. Flexural strength of DB acrylic resins processed by conventional and CAD-CAM methods. J Prosthet Dent 2020; 123: 641-6.

2. Choi JJE, Uy CE, Plaksina P, Ramani RS, Ganjigatti R, Waddell JN. Bond strength of denture teeth to heat-cured, CAD/CAM and 3D printed denture **acrylics**. J Prosthodont 2020; 29: 415-21.

3. Anusavice KJ, Shen C, Rawls HR. Phillips' science of dental materials. Elsevier Health Sciences; 2012: 477-8.

4. Goodacre BJ, Goodacre CJ, Baba NZ, Kattadiyil MT. Comparison of DB adaptation between CAD-CAM and conventional fabrication techniques. J Prosthet Dent 2016; 116: 249-56.

5. Inokoshi M, Kanazawa M, Minakuchi S. Evaluation of a complete denture trial method applying rapid prototyping. Dent Mater J 2012; 31: 40-6.

6. Kim B-J, Yang H-S, Chun M-G, Park Y-J. Shore hardness and tensile bond strength of long-term soft denture lining materials. J Prosthet Dent 2014; 112: 1289-97.

7. Hashem MI. Advances in soft denture liners: An update. J Contemp Dent Pract 2015; 16: 314-8.

8. Şeker H, Okutan Y, Demetoğlu GA. Effect Of Air-Abrasion And Er: Yag Laser On The Bond Strength Between The Metal Housing Of An Overdenture Attachment System And The Hard Relining Material. Meandros Med Dent J 2024; 25: 51-6.

9. Khanna A, Bhatnagar VM, Karani JT, Madria K, Mistry S. A comparative evaluation of shear bond strength between two commercially available heat cured resilient liners and DB resin with different surface treatments. J Clin Diagn Res 2015; 9: 30.

10. Pisani MX, Malheiros-Segundo AdL, Balbino KL, Souza RdF, Paranhos HdFO, Lovato da Silva CH. Oral health related quality of life of edentulous patients after denture relining with a silicone-based soft liner. Gerodontology 2012; 29: 474-80.

11. Sônego MV, Neto CLMM, Dos Santos DM, de Melo Moreno AL, de Magalhães Bertoz AP, Goiato MC. Quality of life, satisfaction, occlusal force, and halitosis after direct and indirect relining of inferior complete dentures. Eur J Dent 2022; 16: 215-222.

12. Sarac YS, Sarac D, Kulunk T, Kulunk S. The effect of chemical surface treatments of different DB resins on the shear bond strength of denture repair. J Prosthet Dent 2005; 94: 259-66.

13. Jagger RG, al-Athel MS, Jagger DC, Vowles RW. Some variables influencing the bond strength between PMMA and a silicone denture lining material. Int J Prosthodont 2002; 15: 55-8.

14. Li P, Kraemer-Fernandez P, Klink A, Xu Y, Spintzyk S. Repairability of a 3D printed DB polymer: Effects of surface treatment and artificial aging on the shear bond strength. J Mech Behav Biomed Mater 2021; 114: 104227.

15. Awad AN, Cho S-H, Kesterke MJ, Chen J-H. Comparison of tensile bond strength of denture reline materials on DBs fabricated with CAD-CAM technology. J Prosthet Dent 2023; 129: 616-22.

16. Vuksic J, Pilipovic A, Poklepovic Pericic T, Kranjcic J. Tensile bond strength between different DB materials and soft denture liners. Materials 2023; 16: 4615.

17. Choi JE, Ng TE, Leong CK, Kim H, Li P, Waddell JN. Adhesive evaluation of three types of resilient denture liners bonded to heat-polymerized, autopolymerized, or CAD-CAM acrylic resin DBs. J Prosthet Dent 2018; 120: 699-705.

18. Aydın A, Terzioğlu H, Akınay A, Ulubayram K, Hasırcı N. Bond strength and failure analysis of lining materials to denture resin. Dent Mater 1999; 15: 211-8.

19. Wemken G, Burkhardt F, Spies BC, et al. Bond strength of conventional, subtractive, and additive manufactured DBs to soft and hard relining materials. Dent Mater 2021; 37: 928-38.

20. Azpiazu-Flores FX, Schricker SR, Seghi RR, Johnston WM, Del Rio DL. Adhesive strength of 3 long-term resilient liners to CAD-CAM DB polymers and heat-polymerized polymethyl methacrylate with thermocycling. J Prosthet Dent 2024; 131: 494-9.

21. Pinto JRR, Mesquita MF, de Arruda Nóbilo MA, Henriques GEP. Evaluation of varying amounts of thermal cycling on bond strength and permanent deformation of two resilient denture liners. J Prosthet Dent 2004; 92: 288-293.

22. Kawano F, Dootz ER, Koran III A, Craig RG. Comparison of bond strength of six soft denture liners to DB resin. J Prosthet Dent 1992; 68: 368-71.

23. Bayati OH, Yunus N, Ahmad SF. Tensile bond strengths of silicone soft liners to two chemically different DB resins. Int J Adhes Adhes. 2012; 34: 32-7.

24. Gibreel M, Perea-Lowery L, Garoushi S, Wada J, Lassila L, Vallittu P. Effect of different surface treatments on shear bond strength of autopolymerizing repair resin to DB materials processed with different technologies. J Prosthodont Res 2024; 23: 00149.

25. Kimoto S, Kimoto K, Gunji A et al. Randomized controlled trial investigating the effect of an acrylic based resilient liner on perceived chewing ability in edentulous patients wearing mandibular complete dentures. Int J Prosthodont 2010; 23: 110–116