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Factors affecting bond strength between acrylic dental elements and thermoplastic nylon bases: a systematic literature review

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Abstract: *Objective: To determine the factors influencing bond strength between acrylic tooth elements and thermoplastic nylon denture bases. Methods: A systematic literature review was conducted using the PRISMA framework. An electronic search was conducted in Semantic Scholar, Google Scholar, Crossref, and Scopus for studies published between 2015 and 2025. Keywords included "thermoplastic nylon," "polyamide denture base," "acrylic denture," and "bond strength." In vitro experimental studies examining bond strength at the tooth-base interface were included. After screening 185 identified records, 18 studies met eligibility criteria and were included in the qualitative synthesis. Results: Four primary factors influence bond strength: (1) the role of surface treatment in enhancing bond strength, (2) material composition and brand variation, (3) processing and repair techniques, and (4) denture design. Mechanical surface treatments, specifically, aluminum oxide sandblasting and macro-retentive preparation, consistently improved shear and tensile bond strength. Significant variability was observed between nylon brands, with some materials demonstrating superior bond performance. Reinjection techniques and microwave polymerization improved interfacial integrity compared to manual heating or conventional repair methods. Conversely, some modified materials, such as nanoparticle incorporation, negatively impacted mechanical stability. Conclusion: The bond strength between acrylic dentures and thermoplastic nylon bases is largely governed by mechanical retention rather than chemical adhesion. Optimal bonding requires integrated consideration of material selection, standardized surface treatments, and controlled maintenance techniques. Further standardized and long-term studies are needed to establish evidence-based clinical guidelines.*
Keywords: *Thermoplastic Nylon; Polyamide Denture Bases; Acrylic Dentures; Bond Strength; Surface Treatments; Transmission Techniques.*

Abstrack: Tujuan: Menentukan faktor-faktor yang memengaruhi kekuatan ikatan antara elemen gigi akrilik dan basis gigi tiruan thermoplastic nylon. Metode: Sebuah tinjauan literatur sistematis dilakukan menggunakan kerangka kerja PRISMA. Pencarian elektronik dilakukan di Semantic Scholar, Google Scholar, Crossref, dan Scopus untuk studi-studi yang dipublikasikan antara tahun 2015 hingga 2025. Kata kunci yang digunakan antara lain "thermoplastic nylon," "polyamide denture base," "acrylic denture," dan "bond strength." Studi eksperimental in vitro yang menguji kekuatan ikatan pada interface gigi-basis dimasukkan dalam tinjauan ini. Setelah melakukan penyaringan terhadap 185 rekaman yang teridentifikasi, 18 studi memenuhi kriteria kelayakan dan dimasukkan dalam sintesis kualitatif. Hasil: Empat faktor utama memengaruhi kekuatan ikatan: (1) peran perlakuan permukaan dalam meningkatkan kekuatan ikatan, (2) komposisi material dan variasi merek, (3) teknik pemrosesan dan perbaikan, dan (4) desain gigi tiruan. Perlakuan permukaan mekanik, khususnya sandblasting oksida aluminium dan persiapan makro-retentif, secara konsisten meningkatkan kekuatan ikatan geser dan tarik. Variabilitas yang signifikan diamati antara merek nylon, dengan beberapa material menunjukkan kinerja ikatan yang superior. Teknik reinjeksi dan polimerisasi mikrogelombang meningkatkan integritas antar-muka dibandingkan dengan pemanasan manual atau metode perbaikan konvensional. Sebaliknya, beberapa material yang dimodifikasi, seperti inkorporasi nanopartikel, berdampak negatif terhadap stabilitas mekanik. Kesimpulan: Kekuatan ikatan antara gigi tiruan akrilik dan basis thermoplastic nylon sebagian besar dikendalikan oleh retensi mekanik daripada adhesi kimia. Pengikatan optimal memerlukan pertimbangan terintegrasi dari pemilihan material, perlakuan permukaan yang terstandarisasi, dan teknik pemeliharaan yang terkontrol. Penelitian lebih lanjut yang terstandarisasi dan jangka panjang diperlukan untuk menetapkan pedoman klinis berbasis bukti.
Kata Kunci: Thermoplastic Nylon; Polyamide Denture Bases; Acrylic Dentures; Bond Strength; Surface Treatments; Transmission Techniques

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INTRODUCTION

Thermoplastic polyamide (nylon) denture base materials have been increasingly adopted in removable prosthodontics as an alternative to conventional polymethyl methacrylate (PMMA) due to their superior aesthetics, flexibility, fracture resistance, and biocompatibility (Fueki *et al.*, 2014; Radev *et al.*, 2023). Their injection-molding processing technique results in reduced polymerization shrinkage and improved dimensional stability (Naji, 2020; Khaleel *et al.*, 2024). Clinically, thermoplastic nylon bases are particularly indicated in patients with metal allergies, aesthetic concerns, and undercut areas where flexible clasp design is advantageous (Fueki K, Ohkubo C, Yatabe M, Arakawa I, Arita M, Ino S, 2014). Despite these benefits, accumulating evidence indicates that polyamide materials exhibit lower hardness and variable flexural properties than PMMA, with significant differences across brands and compositions (Abdellah, Ali and Abdelrahim, 2020; Radev *et al.*, 2023). Such mechanical variability may directly influence the long-term performance of denture components, particularly at the tooth–base interface.

A critical clinical limitation of thermoplastic nylon denture bases is the insufficient bond strength between the base material and acrylic artificial teeth. The highly crystalline structure of polyamide limits chemical interaction with PMMA, resulting in predominantly mechanical rather than chemical retention (Rizani and Nasution, 2019; Barus, 2024). Clinically, detachment of artificial teeth constitutes a significant proportion of denture failures and repair cases (Rizani and Nasution, 2019). Previous investigations have demonstrated that shear bond strength varies significantly across nylon materials (Valplast™, TCS™, Biotone™) (Rizani and Nasution, 2019). surface treatment protocols such as sandblasting (Barus, 2024) and chemical surface modification, including monomer, acetone, ethyl acetate, and isopropanol (Naji, 2020). Moreover, repair techniques and processing methods (microwave polymerization, reinjection, manual heating) significantly influence tensile and transverse strength at the bonded interface (Khaleel *et al.*, 2024)(Naji, 2020). These findings suggest that bond performance is multifactorial and highly dependent on material-processing interactions.

In addition to surface treatment and processing variables, intrinsic material modification has also been shown to alter mechanical behavior. Incorporation of nanoparticles such as chitosan may adversely affect flexural strength and water sorption (Abdellah, Ali and Abdelrahim, 2020). Although numerous experimental studies have evaluated individual mechanical properties (flexural strength, tensile strength, fatigue strength, transverse strength), the available literature remains fragmented, focusing on isolated variables rather than systematically synthesizing the relative contributions of material composition, surface treatment, artificial tooth type, and processing technique to bond strength performance. Furthermore, variability among polyamide brands and methodological heterogeneity across studies limit the ability to draw consolidated clinical recommendations. Therefore, a comprehensive systematic literature review is necessary to critically analyze and integrate existing evidence on factors affecting the bond strength between acrylic dental elements and thermoplastic nylon denture bases, and to identify consistent determinants that may guide clinical decision-making and future material development.

Despite the growing clinical use of thermoplastic nylon denture bases, debonding of acrylic artificial teeth remains a persistent mechanical complication. Existing studies report inconsistent findings regarding the influence of surface treatment, processing technique, material modification, and nylon brand variation on bond strength. The absence of an integrated synthesis of these factors hinders the development of standardized clinical protocols to optimize tooth–base adhesion in thermoplastic nylon dentures. This systematic literature review aims to critically evaluate and synthesize the current evidence on factors affecting the bond strength between acrylic dental elements and thermoplastic nylon denture bases, including material composition, surface treatment methods, processing techniques, and mechanical modifications.

RESEARCH METHODS

1. Identification of Articles

This study was conducted as a systematic literature review to identify and synthesize evidence regarding factors affecting bond strength between acrylic dental elements and thermoplastic nylon denture bases. A comprehensive electronic search was performed using the following databases: **Semantic Scholar, Google Scholar, Crossref, and Google Scholar**. The search strategy combined controlled vocabulary (MeSH terms where applicable) and free-text keywords. The keywords used were combinations of the following terms:

- "thermoplastic nylon" OR "polyamide denture base" OR "flexible denture."
- "acrylic denture teeth" OR "artificial teeth."
- "bond strength" OR "shear bond strength" OR "tensile bond strength" OR "transverse strength."
- "surface treatment" OR "sandblasting" OR "chemical treatment."
- "repair technique" OR "processing technique."

Boolean operators (AND, OR) were applied to refine the search strategy. The search covered studies published from **January 2015 to December 2025**, considering the increasing clinical use of thermoplastic nylon materials during this period. All retrieved records were exported into a reference management software, and duplicate articles were removed before screening.

2. Selection of Articles

The article selection process was conducted in three sequential stages:

a. Stage 1 – Title Screening

Titles were screened to identify studies related to:

- Thermoplastic nylon or polyamide denture bases
- Bond strength between the denture base and artificial teeth
- Mechanical properties influencing interfacial adhesion. Irrelevant titles were excluded at this stage.

b. Stage 2 – Abstract Screening

Abstracts of potentially eligible studies were independently reviewed by **two reviewers** to assess relevance according to the predefined inclusion criteria. Studies not related to bond strength at the tooth–base interface were excluded. Disagreements between reviewers were resolved through discussion and consensus.

c. Stage 3 – Full-Text Assessment

Full-text articles of the remaining studies were retrieved and evaluated for methodological suitability, clarity of experimental design, and relevance to the review objective. The selection process followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow framework.

3. Eligibility of Articles

a. Eligibility Criteria (Inclusion and Exclusion Criteria)

The eligibility criteria for this systematic literature review were established based on the PICO framework. The inclusion criteria are: (1) in vitro experimental studies evaluating acrylic denture teeth bonded to thermoplastic nylon or polyamide denture base materials; (2) studies investigating factors or treatment interventions affecting bond strength, including surface treatments, mechanical modifications, chemical conditioning, adhesive or primer application, processing techniques, repair methods, or artificial aging procedures such as thermocycling; (3) studies that included a comparison group, either untreated specimens or alternative treatment protocols; and (4) studies reporting quantitative outcomes related to bond strength, such as shear bond strength, tensile bond strength, or failure mode analysis expressed in measurable units (e.g., MPa or Newton). Only original research articles published in peer-reviewed journals, available in full text, and written in English were considered eligible. Publications in the time span (2015–2025).

Studies were excluded if they: (1) involved denture base materials other than thermoplastic nylon or polyamide; (2) did not evaluate the bonding between acrylic denture teeth and denture base materials; (3) assessed material properties unrelated to bond strength, such as color stability, surface roughness, or flexibility without bonding evaluation; (4) were systematic reviews, literature reviews, case reports, clinical studies, editorials, conference abstracts, or non-experimental studies; or (5) lacked sufficient methodological details or quantitative bond strength data. (6) not open access and (7) incomplete.

RESULT AND DISCUSSION

A total of 185 records were initially identified through database searching. After removing duplicates (n = 2), excluding unpublished literature (n = 20), and eliminating studies published before 2020 that were not relevant to the topic (n = 820), 166 articles remained for screening. Following title and abstract evaluation, 143 articles were excluded for not meeting the inclusion criteria, leaving 23 articles for full-text assessment. Of these, five studies were excluded due to lack of open access or incomplete data, resulting in 18 studies that fulfilled all eligibility criteria and were included in the final qualitative synthesis of this systematic review.

Table 1. General characteristics of the selected studies

No	Item	Description
1	**Title**	Effect of Tooth Element Retention and Acrylic Resin Brand on the Tensile Bond Strength with Denture Base
	Journal	The Journal of Academic Science
	Author	Maesaroh I., Tetelepta M., Marpaung L., Wiyanti S.W., Mujiwati (Maesaroh *et al.*, 2024)
	Year	2024
	Country	Indonesia
	Objectives	To evaluate the effect of different retention forms of denture teeth and acrylic resin brands on tensile bond strength between denture teeth and denture base.
	Conclusion	Acrylic resin brand significantly influenced tensile bond strength, while retention form showed no significant effect.
2	**Title**	The Effect of Sandblasting Surface Treatment on Shear Bond Strength Between Acrylic Denture Teeth and Thermoplastic Nylon Denture Base
	Journal	Padjadjaran Journal of Dental Researchers and Students
	Author	Barus G.P., Köseoğlu M., Nasution H. (Barus, 2024)
	Year	2024
	Country	Indonesia
	Objectives	To analyze the effect of different aluminum oxide sandblasting particle sizes on shear bond strength.

No	Item	Description
	Conclusion	Sandblasting significantly increased shear bond strength, with 250 µm aluminum oxide showing the highest value.
3	Title	Clinical Application of Removable Partial Dentures Using Thermoplastic Resin. Part II: Material Properties and Clinical Features of Non-metal Clasp Dentures
	Journal	Journal of Prosthodontic Research
	Author	Fueki K. et al.(Fueki K, Ohkubo C, Yatabe M, Arakawa I, Arita M, Ino S, 2014)
	Year	2014
	Country	Japan
	Objectives	To review mechanical properties and clinical features of thermoplastic resins used in non-metal clasp dentures.
	Conclusion	Thermoplastic resins show variable mechanical properties and bonding limitations compared to PMMA; careful material selection is required.
4	Title	The Shear Bond Strength of Acrylic and Porcelain Teeth in Three Types of Thermoplastic Nylon Denture Bases
	Journal	Jurnal Kedokteran Gigi Universitas Padjadjaran
	Author	Rizani M, Nasution H (Rizani and Nasution, 2019)
	Year	2019
	Country	Indonesia
	Objectives	To compare shear bond strength of acrylic and porcelain artificial teeth to three thermoplastic nylon denture bases (Valplast™, TCS™, Biotone™).
	Conclusion	Valplast™ demonstrated the highest shear bond strength among tested materials.
5	Title	Bond Strength of Acrylic Soft Liner to Nd:YAG Laser-Treated Thermoplastic Acrylic Denture Base Material
	Journal	3C Tecnología
	Author	Alabady A.A., Khalaf B.S. (Alabady and Khalaf, 2023)
	Year	2023
	Country	Iraq
	Objectives	To evaluate the effect of Nd:YAG laser surface treatment on tensile bond strength and surface roughness between soft liner and thermoplastic acrylic denture base.
	Conclusion	Nd:YAG laser surface treatment significantly increased surface roughness and tensile bond strength.
6	Title	The Effect of Pineapple Peel Extract as a Denture Cleanser on Flexural Strength of Nylon Thermoplastic Denture Base Materials
	Journal	Denta, Jurnal Kedokteran Gigi
	Author	Paulus Budi Teguh, Oka Lestari, Chaterina Diyah Nanik (Gigi *et al.*, 2022)
	Year	2022
	Country	Indonesia
	Objectives	To determine the effect of 3.5% pineapple peel extract immersion on the flexural strength of nylon thermoplastic denture base materials (Valplast and Lucitone FRS).
	Conclusion	Immersion in 3.5% pineapple peel extract decreased the flexural strength of nylon thermoplastic denture base materials, with Lucitone FRS showing higher flexural strength than Valplast.
7	Title	Comparative Biomechanical Analyses for Kennedy's Class-I Cast Partial Denture Using Acrylic Denture Base with Co-Cr I Bar and Nylon Denture Base with Nylon Retentive Clasp: A 3D Finite Element Study
	Journal	University Journal of Dental Sciences
	Author	Sumeet Jain et al. (Jain, 2015)

No	Item	Description
	Year	2022
	Country	India
	Objectives	To compare biomechanical stress distribution between acrylic denture base with Co-Cr clasp and nylon denture base with nylon retentive clasp using finite element analysis.
	Conclusion	Nylon denture base with nylon retentive clasp produced greater stress and displacement under diagonal loading but remained within physiological limits.
8	Title	The Effect of Virgin Nylon Addition into Recycled Nylon on the Fatigue Strength of Thermoplastic Nylon Denture Base
	Journal	Padjadjaran Journal of Dentistry
	Author	Siti Wahyuni, Jeewena Ravichanthiran (Wahyuni and Ravichanthiran, 2020)
	Year	2020
	Country	Indonesia
	Objectives	To evaluate the effect of adding virgin nylon to recycled nylon on the fatigue strength of thermoplastic nylon denture base material.
	Conclusion	The combination of 60% virgin nylon and 40% recycled nylon showed significantly higher fatigue strength than 100% recycled nylon.
9	Title	Bond Strength of Artificial Teeth to Thermoplastic Denture Base Resin for Injection Molding
	Journal	Dental Materials Journal
	Author	Shu Tashiro et al. (Tashiro *et al.*, 2021)
	Year	2021
	Country	Japan
	Objectives	To evaluate the bond strength of artificial teeth to thermoplastic denture base resins with different surface preparations.
	Conclusion	T-shaped tunnel surface preparation significantly increased bond strength, whereas ethyl acetate treatment did not significantly improve bonding.
10	Title	Comparative Evaluation of Bond Strength Between Denture Base–Artificial Teeth
	Journal	International Dental Journal
	Author	Can Hakan Sarikaya, Hakan Terzioglu (Sarikaya and Terzioglu, no date)
	Year	2025
	Country	Turkiye
	Objectives	To compare bond strength and deflection at maximum load between denture teeth and denture base fabricated using milling, 3D printing, and conventional techniques before and after thermocycling.
	Conclusion	Monolithic milled groups exhibited higher bond strength and flexibility, while separate-unit milled systems showed the weakest bonding performance.
11	Title	Effect of Filler Nano Titanium Dioxide (TiO_2) Particles on Flexural Strength of Nylon Thermoplastic Denture Base
	Journal	MEDALI Journal
	Author(s)	Setiawan MJ, Hidayat R, Firdausy MD(Setiawan *et al.*, 2022)
	Year	2022
	Country	Indonesia
	Objectives	To evaluate the effect of incorporating nano TiO_2 particles (1% and 5%) on the flexural strength of thermoplastic nylon denture base material.
	Conclusion	Addition of 1% and 5% TiO_2 did not significantly affect flexural strength compared to control, although 1% TiO_2 showed the highest mean value.
12	Title	Tensile Bond Strength between Different Denture Base Materials and Soft Denture Liners

No	Item	Description
	Journal	Materials (MDPI)
	Author(s)	Vuksic J, Pilipovic A, Poklepovic Pericic T, Kranjcic J (Vuksic, Josip, 2023)
	Year	2023
	Country	Croatia
	Objectives	To compare tensile bond strength between various denture base materials (including polyamide and CAD-CAM materials) and soft denture liners.
	Conclusion	Significant differences were observed with silicone-based liners; additive-manufactured and polyamide bases showed lower bond strength than heat-cured PMMA.
13	Title	Comparison between Retention of Maxillary Acrylic and Nylon Denture Base Materials
	Journal	Polytechnic Journal
	Author(s)	Abdulkareem HS, Salem SA (Abdulkareem H S, 2020)
	Year	2020
	Country	Iraq
	Objectives	To compare retention of maxillary complete dentures fabricated from acrylic resin and nylon denture base materials.
	Conclusion	Differences in retention were observed between acrylic and nylon denture bases, influenced by material properties and adaptation.
14	Title	The Effect of Silica Dioxide (SiO_2) Nanoparticle Coating and Duration of Coffee Immersion on Discoloration of Thermoplastic Nylon Denture Base
	Journal	Denta Jurnal Kedokteran Gigi
	Author(s)	Hidayat R, Fatchurrahman H(Hidayat and Fatchurrahman, 2020)
	Year	2020
	Country	Indonesia
	Objectives	To evaluate the effect of SiO_2 nanoparticle coating and coffee immersion duration on discoloration of thermoplastic nylon denture base.
	Conclusion	SiO_2 coating significantly reduced discoloration after coffee immersion.
15	Title	Effect of Immersion of Denture Base Thermoplastic Nylon in Alkaline Peroxide and 10% Castor Oil on Color Stability and Flexural Strength
	Journal	Asian Journal of Engineering, Social and Health
	Author(s)	Utami PW, Lubis HAN, Marbun AH(Yuliharsini *et al.*, 2019)
	Year	2024
	Country	Indonesia
	Objectives	To determine the effect of immersion in alkaline peroxide and 10% castor oil on color stability and flexural strength of thermoplastic nylon denture base.
	Conclusion	Immersion in alkaline peroxide and castor oil did not significantly affect color stability or flexural strength.
16	Title	Impact of Flexible Material and Processing Techniques on the Tensile Strength of Repaired Polyamide Denture Base Material
	Journal	Iraqi Journal of Medical and Health Sciences
	Author(s)	Khaleel HI, Rashid AAL, Alhamoudi FH (Khaleel *et al.*, 2024)
	Year	2024
	Country	Iraq
	Objectives	To evaluate tensile strength of repaired polyamide denture base using different processing techniques.
	Conclusion	Reinjection technique showed higher tensile strength compared to other repair methods.
17	Title	Mechanical Properties of Nylon Denture Base Materials: A Literature Review
	Journal	Problems of Dental Medicine

No	Item	Description
	Author(s)	Radev R, Todorov R, Apostolov N (Radev *et al.*, 2023)
	Year	2023
	Country	Bulgaria
	Objectives	To review mechanical properties of thermoplastic polyamide denture base materials compared to PMMA.
	Conclusion	Polyamide offers aesthetic and functional advantages but mechanical longevity remains under discussion.
18	Title	Evaluation of Some Physical and Mechanical Properties of Chitosan Modified Thermoplastic Denture Base Resin
	Journal	Al-Azhar Journal of Dental Science
	Author(s)	Abdellah M, Ali MS, Abdelrahim RA (Abdellah, Ali and Abdelrahim, 2020)
	Year	2020
	Country	Egypt
	Objectives	To assess the effect of chitosan nanoparticles incorporation on mechanical and physical properties of thermoplastic resin.
	Conclusion	Incorporation of chitosan nanoparticles reduced flexural strength and increased water sorption.

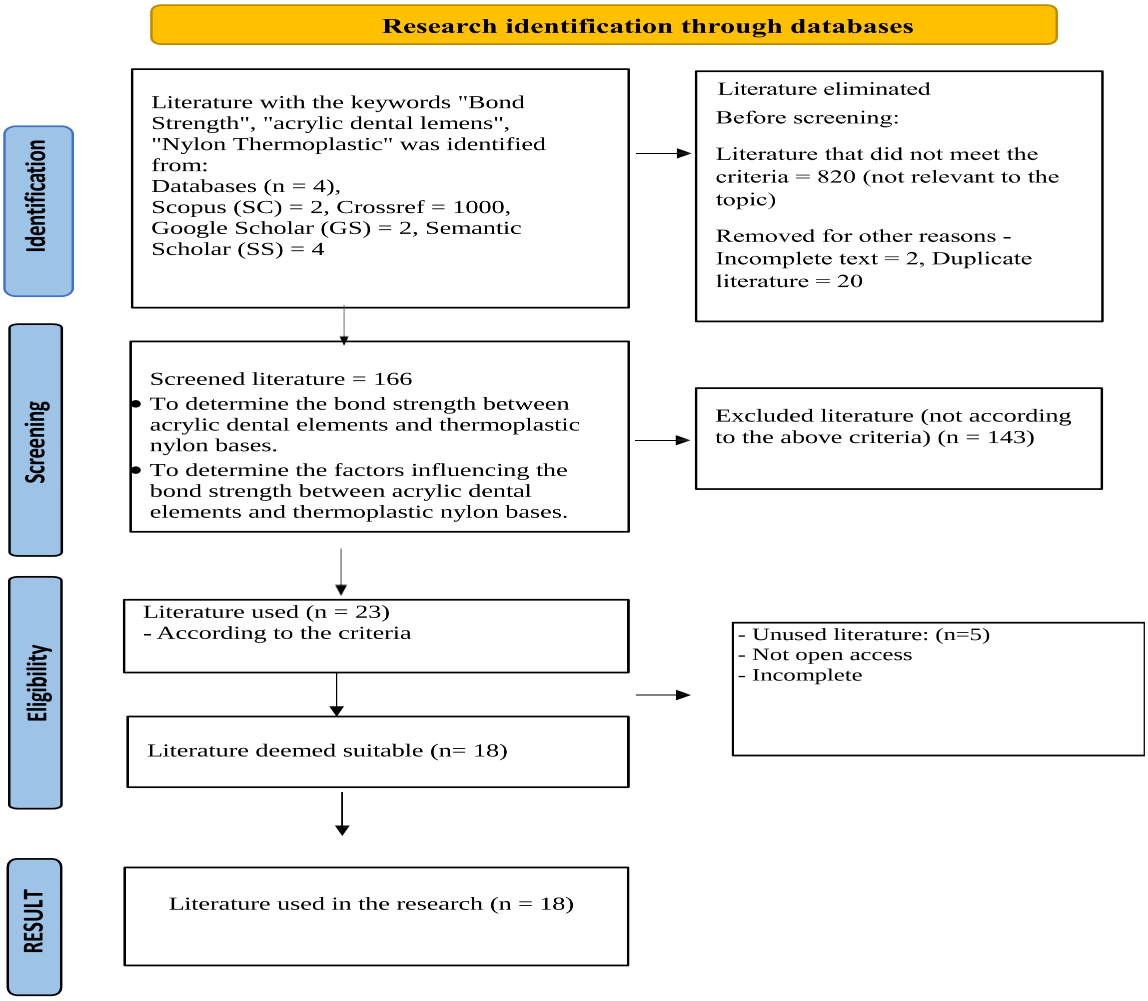

Figure 1. PRISMA Search process diagram (PRISMAStatement, 2020)

1. Factors Affecting Bond Strength Between Acrylic Dental Elements and Thermoplastic Nylon Bases

The qualitative synthesis of 18 included studies revealed that bond strength between acrylic dental elements and thermoplastic nylon denture bases is influenced by four principal categories of factors: (1) the role of surface treatment in enhaching bond strenght, (2) material composition and brand variation, (3) processing and repair techniques, and (4) artificial tooth design and mechanical retention configuration.

a. The role of surface treatment in enhancing bond strength

Surface modification was the most consistently reported determinant of improved bond strength. Mechanical surface treatments, particularly aluminum oxide sandblasting, significantly increased shear bond strength compared to untreated controls (Barus, Köseoğlu, and Nasution, 2024). Larger particle sizes (250 μm) demonstrated the highest bond values, suggesting that micromechanical interlocking plays a critical role in adhesion. Similarly, [Tashiro et al. (2021) reported that mechanical preparation in the form of a T-shaped tunnel significantly enhanced bond strength compared to chemical treatment with ethyl acetate, which showed no significant improvement. Chemical surface treatments such as monomer conditioning, acetone, ethyl acetate, and isopropanol have also been investigated, with monomer treatment demonstrating superior performance compared to other solvents (Naji, 2020). Laser surface treatment using Nd: YAG significantly increased surface roughness and tensile bond strength (Alabady and Khalaf, 2023). Indicating that energy-based surface modification may enhance interfacial adhesion. Collectively, these findings indicate that bond strength in polyamide systems relies predominantly on mechanical retention rather than chemical bonding due to the crystalline and chemically inert structure of polyamid (Fueki K, Ohkubo C, Yatabe M, Arakawa I, Arita M, Ino S, 2014; Radev *et al.*, 2023).

b. Material Composition and Brand Variation

Significant variability in bond strength was observed among different thermoplastic nylon brands. Rizani and Nasution (2019) demonstrated that Valplast™ exhibited significantly higher shear bond strength compared to TCS™ and Biotone™, indicating that intrinsic material composition influences interfacial performance.(Rizani and Nasution, 2019) Mechanical properties of polyamide materials vary considerably depending on formulation, crystallinity, and processing conditions (Radev *et al.*, 2023). Abdellah et al. (2020) further showed that incorporation of chitosan nanoparticles adversely affected mechanical properties, including flexural strength, potentially compromising structural integrity at the tooth–base interface.

Additionally, Vuksic et al. (2023) reported that polyamide denture bases generally demonstrated lower tensile bond strength compared to conventional heat-polymerized PMMA, reinforcing the inherent bonding limitation of thermoplastic nylon systems.

These findings suggest that bond strength is partially material-dependent, with variations in polymer structure, filler incorporation, and degree of crystallinity contributing to interfacial performance differences.

c. Processing and Repair Techniques

The processing technique significantly influenced bond performance. Microwave polymerization demonstrated higher transverse strength compared to autopolymerization and light-cured repair systems(Naji, 2020). Likewise, reinjection repair techniques yielded significantly higher tensile strength compared to manual heating methods (Khaleel *et al.*, 2024).

Injection-molding techniques used for thermoplastic nylon fabrication contribute to dimensional stability but may limit chemical diffusion between acrylic teeth and the base material(Fueki K, Ohkubo C, Yatabe M, Arakawa I, Arita M, Ino S, 2014). Furthermore, thermocycling and aging procedures were shown to reduce bond stability in some fabrication systems (Sarikaya and Terzioglu, no date). Highlighting the influence of artificial aging on interfacial durability. Thus, both initial processing and subsequent repair techniques play a substantial role in determining the mechanical integrity of the tooth–base interface.

d. Artificial Tooth Design and Mechanical Retention

Tooth retention form and design modifications were also evaluated as contributing factors. reported that the acrylic resin brand significantly influenced tensile bond strength, whereas the retention form did not demonstrate a statistically significant effect. In contrast, Tashiro et al. (2021) demonstrated that specific mechanical modifications, such as tunnel preparation, significantly enhanced bond strength. These findings indicate that mechanical interlocking geometry may be more influential than superficial retention features alone.

DISCUSSION

The following systematic literature review indicates that the bond strength between acrylic dental elements and thermoplastic nylon denture bases is primarily governed by mechanical retention mechanisms rather than chemical adhesion. The inherent crystalline structure and low chemical reactivity of polyamide materials hinder interfacial monomer diffusion, making surface modification and mechanical locking the primary determinants of bond performance.

Among the factors evaluated, the role of surface treatment in enhancing bond strength, particularly controlled sandblasting and macro-retentive preparation, consistently improve bond strength. Material composition and brand variability significantly influence interfacial bonding, indicating that not all thermoplastic nylon systems exhibit equivalent bonding behavior. Processing and repair techniques, particularly reinjection methods and microwave polymerization, further contribute to improving interfacial integrity, while certain modified materials can negatively affect mechanical stability.

CONCLUSION

Optimal bonding to thermoplastic nylon dentures requires an integrated approach involving appropriate material selection, standardized surface treatments, and controlled processing protocols. However, substantial methodological heterogeneity and the predominance of in vitro evidence limit definitive clinical generalizations. Future research should prioritize standardized testing methods and long-term research simulations to establish evidence-based clinical guidelines for improving the basic adhesion of dental elements to thermoplastic nylon prostheses.

Authors' Contribution

It is hereby acknowledged that all authors have accepted responsibility for the manuscript's content and consented to itssubmission. They have meticulously reviewed all results and unanimously approved the final version of the manuscript.

Avaialability of Data and Materials

All the data and supportive information are provided within the article.

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Conflict of Interest

The authors declared no conflict of interest, financial or otherwise.

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Supplementary Material

The PRISMA checklist is available as supplementary material on the publisher's website along with the published article. Supplementary material is available on the publisher's website along with the published article.

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