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Poly-Ether-Ether-Ketone (PEEK) Removable Partial Dentures: A Scoping Review

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ABSTRACT

This scoping review aims to comprehensively assess the existing evidence from both clinical and in vitro studies concerning removable partial dentures (RPD) made from poly-ether-ether-ketone (PEEK) to identify current research gaps and enhance the understanding of PEEK's viability as a material for RPD. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) extension for scoping reviews was applied. A search was made using PubMed, Web of Science, Elsevier's Scopus, ProQuest and Springer Link databases for articles in the English language up to November 2023, focusing on case reports, clinical, and in vitro studies. A total of 33 studies were included in the analysis, which consisted of 4 case reports, 6 clinical studies, and 23 in vitro studies. Clinical studies predominantly examined patient satisfaction post-PEEK RPD insertion, framework accuracy, dimensional changes in residual ridges, and fungal/bacterial adhesion to PEEK. In vitro studies emphasised retentive force clasps (12 studies), accuracy and fitness (5 studies), material staining effects (3 studies), and diverse surface treatments (3 studies). The current body of evidence reveals a scarcity of clinical studies investigating PEEK as an RPD framework. In vitro studies primarily focused on assessing material retentive forces, with limited attention given to accuracy, surface treatment, and staining of denture base materials. Future research should address these gaps, exploring aspects such as adhesion and biofilm formation (e.g. *Candida albicans*) on RPD surfaces. Rigorous, well-designed clinical trials and expanded in vitro investigations are essential to establish PEEK RPD as definitive prostheses for partially edentulous patients.

Keywords: *Framework; PEEK; poly-ether-ether-ketone; removable partial denture; scoping review*

INTRODUCTION

The versatility of polymer-based removable partial dentures (RPD), such as poly-ether-ether-ketone (PEEK), in dental applications is continually being explored and studied. PEEK has been used as an implant, a fixed prosthesis, a removable prosthesis, a surgical guide, an occlusal splint, and others (Sinha *et al.*, 2017; Alexakou *et al.*, 2019; Ali *et al.*, 2020; Gomaa *et al.*, 2023). In prosthodontics, the PEEK framework has been introduced to the market to replace the traditional cobalt-chromium (Co-Cr) framework, thanks to the emerging materials available and the present state of technology. It is a member of the poly-aryl-ether-ketone (PAEK) family known for its superior mechanical properties, low water absorption, excellent heat resistance, and biocompatibility (Najeeb *et al.*, 2016; Alexakou *et al.*, 2019; Papathanasiou *et al.*, 2020). The translucent nature of PEEK, eliminating the metal clasps shown, enhances the natural appearance by providing an aesthetically appealing solution for patients (Zoidis *et al.*, 2016; Ichikawa *et al.*, 2019).

It is considered a potential substitute for the prosthodontic framework due to inherent flexibility and its low elastic modulus allows for the absorption of functional stresses, reducing the risk of damage to the abutment teeth and underlying tissue (Papathanasiou *et al.*, 2020; Khurshid *et al.*, 2022). These cushioning effects were stated to enhance patient's comfort during function and the overall longevity of the prosthesis. Additionally, the PEEK RPD framework has also demonstrated favourable biocompatibility in in vitro studies, with minimal adverse tissue reactions reported due to the biologically inert characteristic, which reduces the risk of allergic reactions and inflammatory responses, making it a favourable choice for patients with metal allergies (Najeeb *et al.*, 2016; Papathanasiou *et al.*, 2020; Papathanasiou *et al.*, 2022).

Apart from its unique material properties, it can be fabricated using digital technologies such as computer-aided design and computer-aided manufacturing (CAD/CAM) or additive technologies, enabling the precise customisation for individual patients (Alexakou *et al.*, 2019; Khurshid *et al.*, 2022). The digital workflow allows dental professionals to design and fabricate the framework with greater accuracy and efficiency, ensuring a comfortable fit and optimal function for the patient (Arnold *et al.*, 2018; Pereira *et al.*, 2021). As research and technology continue to evolve, the PEEK RPD framework holds great potential to further revolutionise the field of RPD and enhance the quality of patient care (Ali *et al.*, 2020).

Ultimately, the integration of PEEK into RPD has ushered in a new era of dental prosthetics, offering patients both aesthetic and functional benefits. PEEK's unique material properties, including mechanical strength, low water absorption, biocompatibility, and low elastic modulus ensure optimal patient comfort and prosthesis longevity (Najeeb *et al.*, 2016; Alexakou *et al.*, 2019). Nevertheless, there are additional domains warranting further exploration, including production techniques, extended clinical results, comparative analyses, and the influence of the oral environment. This scoping review aims to comprehensively evaluate the existing evidence from both clinical and in vitro studies on RPD made from PEEK, with the primary objective being to enhance understanding of PEEK's suitability as a material for RPDs, identify research gap and understand the current applications PEEK RPD.

MATERIAL AND METHODS

Search Strategy

A scoping review was conducted using the criteria established by the Joanna Briggs Institute (Peters *et al.*, 2015) and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) (Tricco *et al.*, 2018). The review was structured using a population, concept, and context (PCC) question as recommended for scoping reviews by the Joanna Briggs Institute. The PCC components were defined as follows: Population (P) – Respondents receiving PEEK RPD and materials studied in in vitro research related to PEEK material in RPD; Concept (C) – Utilisation of PEEK material in RPD; and Context (C) – Clinical dental practice and research.

Identification of Relevant Studies

Details search for relevant articles was performed using the search query "polyetheretherketone" OR "poly-etheretherketone" OR "poly-ether-ether-ketone" OR "polyether ether ketone" OR "PEEK" AND "removable prost*" OR "removable partial denture*" using five academic search databases: PubMed; Clarivate Analytics' Web of Science (WOS) Core Collection; Elsevier's Scopus; ProQuest: Dissertation and Theses; and Springer Link Open Access. In addition, reference mining and internet search was performed following a full text article collection. A single author (NFA) compiled information from all studies and organised it in the Microsoft Excel 2019 software (Microsoft Corporation, United States) for data extraction.

Study Selection

The process of study selection involved screening the titles and abstracts, followed by a detail review of the full-text articles using predetermined criteria. All related duplicates were removed, and reference was managed using EndNote® software.

Charting the Evidence

The studies were charted according to study design, material, methods, and conclusion using a predetermined, standardised charting format in Microsoft Excel 2019.

Data Synthesis

Two authors (NFA and FA) conducted a full-text assessment to determine eligibility for the qualitative assessment, concentrating only on case reports, clinical studies, and in vitro studies for PEEK RPD. Studies on characterisation of the materials, finite element analysis, digital technique/workflow, removable complete dentures, overdentures, obturators, double crowns, splints, and implants without any comparison to PEEK RPD and review articles were excluded from analysis. The inclusion and exclusion criteria for this review are summarised in Table 1. The synthesis was performed by a single author (NFA). A second author (FA) examined the data acquired to ensure consistency. RA and SS, serving as the third and fourth authors, resolved any issues that emerged during review process. All data extraction was performed independently by NFA, and the data was transferred to a data extraction form that was designed specifically for the review. The process of study selection is shown in Fig. 1.

Table 1 Eligibility criteria for selecting studies

Inclusion criteria	Exclusion criteria
1. Case reports and clinical studies related to PEEK RPD. 2. In vitro studies on PEEK materials focusing on RPD. 3. English articles.	1. Review article. 2. Studies on characterisation of the materials, finite element analysis, digital technique/workflow of PEEK materials in RPD. 3. Study on removable complete dentures, overdentures, obturators, double crowns, splints, and implants without any comparison to PEEK RPD.

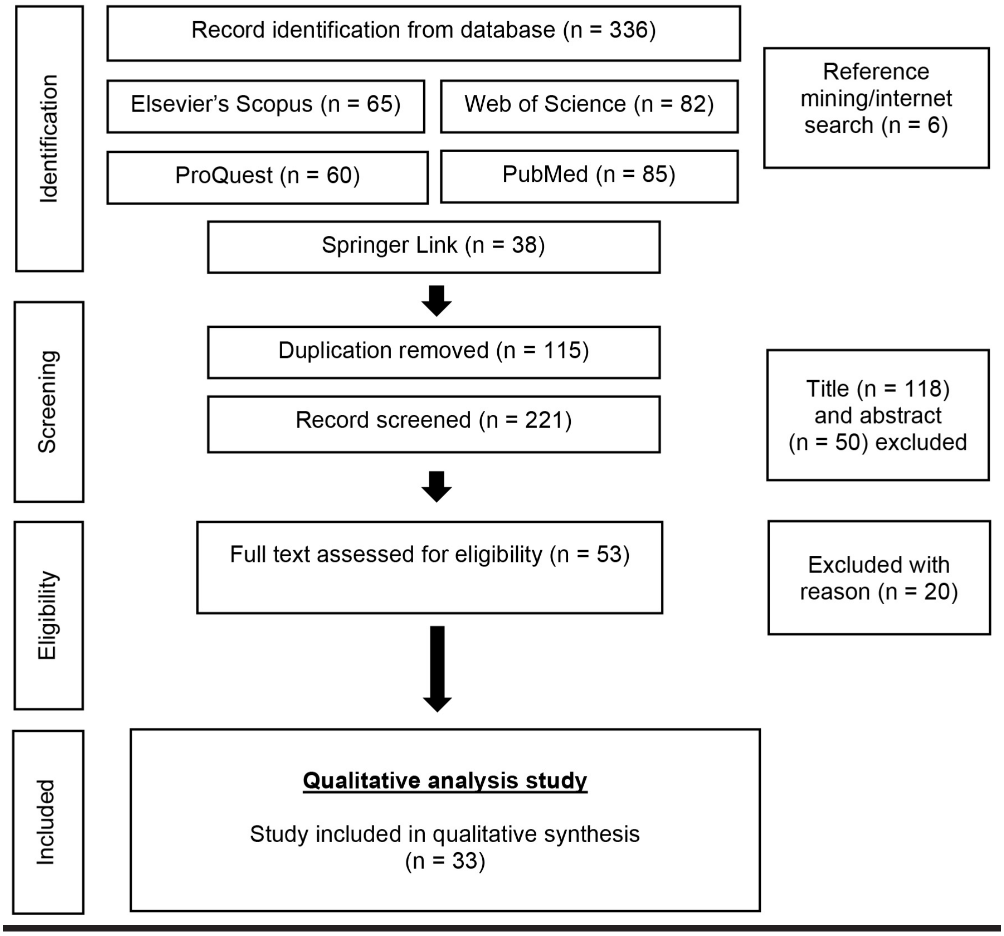

Figure 1. Flowchart of search study included based on PRISMA-ScR flow diagram.

RESULTS

Studies Selection

This scoping study identified a total of 336 potentially suitable articles published from January 2018 to November 2023. The results were obtained from five databases: Scopus (n = 65); PubMed (n=85); WOS (n = 82); Springer Link (n = 38); and ProQuest (n = 60). Further records were identified using alternative sources, including an internet search and reference mining (n = 6). A total of 115 articles were removed due to duplication, leaving 221 articles to be screened. Out of that, 168 articles were further eliminated, after title and abstract screening due to irrelevant topics, which in studies are no comparison to RPD, or review articles. After the full-text screening (n = 53) process was completed, a total of 20 articles were excluded for these reasons: studies focused on characteristics of material; studies involve double crown/intracoronal attachment and finite element analysis (n = 7); studies involve occlusal splint/space maintainer/technical/workflow (n = 10); and studies involve language other than English (n=3). A total of 33 studies met the inclusion criteria following full-text reading for qualitative analysis. This includes case reports (n = 4), clinical studies (n = 6), and in vitro studies (n = 23). From the 23 in vitro studies, 12 focused on the clasp, 5 on the accuracy of the material, 3 on different surface treatments, and 3 on the staining effect on colour stability of the material.

Table 2 Case reports related to PEEK materials in RPD

Author, year, indication	Participant characteristics	Materials/fabrications	Authors' remarks
Wu *et al.* (2022) Framework	53 years old, female, Kennedy Classification IV	Material: PEEK disc (BioPAEK, Sino-dentex Co. Ltd. Changchun, China) Scanner: TRIOS 3, 3Shape A/S, Copenhagen, Denmark Milling machine: Cameo, Aidite (Qinhuang DAO) Technology Co. Ltd. Qinhuangdao, China)	Utilising PEEK as the framework for the RPD. A 3-dimensional printing diagnostic denture (separable into dentition and base with framework) was integrated initially, followed by substituting the remaining detachable part with a milled PEEK framework and thermoplastic using compression molding as definitive RPD.
Ichikawa *et al.* (2019) Clasp	84 years old, female, Kennedy Classification I	Material: PEEK disc (Ceramill PEEK, Juvora Ltd. Lancashire, UK) Scanner: CAD software (Geomagic Freeform, USA) Milling machine: RXP500 DSC	Using non-filler PEEK as clasp material for the RPD, both the remaining part and the clasp arm showed excellent fit and no deformation even after a two-year review.
Harb *et al.* (2019) Framework	56 years old, female, Kennedy Classification I	Material: PEEK discs (Ceramill PEEK, Juvora Ltd. Lancashire, UK) Scanner: 3D scanner (Ceramill Map400) and CAD software (3Shape Dental System, 3Shape) Milling machine: Ceramill Motion 2, Amann Girrbach	Utilising PEEK as the framework for the RPD, strategically designed PEEK clasps with a 0.5 mm undercut and increased bulkiness could significantly enhance retention for practical clinical application.
Zoidis *et al.* (2016) Framework	70 years old, female, Kennedy Classification I	Material: PEEK BioHPP, Bredent GmbH, Senden, Germany Technique: Conventional lost wax technique using a vacuum press device (2 press, Bredent GmbH)	PEEK's as RPD framework material should not replace a well-designed Cr-Co RDP framework due to insufficient robust clinical evidence supporting its efficacy.

Characteristics of Included Studies

Table 2 summarises the case reports related to RPD manufactured with PEEK material. Among the four case reports discussed, three had evaluated PEEK as a framework, while one had the integrated PEEK as a clasp with the Co-Cr framework (Zoidis *et al.*, 2016; Harb *et al.*, 2019; Ichikawa *et al.*, 2019; Wu *et al.*, 2022). All respondents were female, ranging in age from 53 to 84 years old (mean age: 65.75 years old). Three of the prosthesis designs were Kennedy Classification I, with one being Kennedy Classification IV. Only one study by Zoidis *et al.* (2016) utilised a conventional lost wax technique (LWT) with a vacuum press device to fabricate the RPD framework, while the other studies employed digital techniques using different scanners, software, and milling machines to produce the prostheses.

Six clinical studies were evaluated (Medappa, 2018; Mohamed & Rasha, 2019; Ali *et al.*, 2020; Mansour *et al.*, 2020; Maraka *et al.*, 2021; Lo Russo *et al.*, 2022) (Table 3). A total of 89 respondents were involved in the clinical studies, with 64 receiving PEEK RPD. Most of the PEEK RPD were manufactured digitally, with prosthesis designs varying across the included studies. One study evaluated the accuracy of the framework (Maraka *et al.*, 2021), one study assessed the dimensional changes of the residual ridge (Lo Russo *et al.*, 2022), two studies assessed patient satisfaction after weaning PEEK RPD (Mohamed & Rasha, 2019; Ali *et al.*, 2020), one study assessed influence of surface topography on bacterial adhesion (Medappa, 2018) and one study assessed *Candida albicans* adhesion on PEEK (Mansour *et al.*, 2020).

A total of 23 in vitro studies were evaluated. Table 4 summarised characteristics of in vitro studies related to RPD clasp materials manufactured from PEEK material. Twelve studies evaluated PEEK as a new clasp material (Tannous *et al.*, 2012; Muhsin *et al.*, 2018; El-Baz *et al.*, 2020; El Mekawy & Elgamal, 2021; Güleryüz *et al.*, 2021; Mayinger *et al.*, 2021; Micovic *et al.*, 2021; Gentz *et al.*, 2022; Hussein, 2022; Yunisa *et al.*, 2022; Zheng *et al.*, 2022; Vaddamanu *et al.*, 2023), with most study focusing on the retentive force produced with Co-Cr as the control group, while one study used graphene-based polymer (GBP) as a comparison. All studies used different clasp designs (e.g. varying lengths and widths) and different methodologies (e.g. differing fatigue cycles and thermocycling protocols), indicating a lack of standardisation in methodology. The majority of in vitro studies evaluated the retentive force incorporating dimensional changes of material in different thicknesses (either 1.0 mm or 1.5 mm) and different undercuts (0.25, 0.50 or 0.75 mm) using the pull-off test method.

Table 3 Clinical studies related to PEEK materials in RPD

Author, year	Objectives	Subjects	Authors' remarks
Lo Russo *et al.* (2022)	To compare the residual ridge dimensional changes after 1-year of wearing PEEK RPD to a group of untreated patients.	Six untreated patients (Control) 10 received PEEK	No difference in edentulous residual ridge height and overall dimensions between patients wearing PEEK RPD, fabricated with a digital workflow, and controls without an RPD.
Maraka *et al.* (2021)	To evaluate the fit accuracy of the RPD frameworks fabricated by digital and conventional method.	Five patients (conventional Co-Cr-Control) Five patients (milled PEEK)	Accuracy Cr-Co frameworks fabricated using conventional casting were less accurate as compared to PEEK CAD/CAM.
Ali et *al.* (2020)	To investigate differences in the performance of PEEK vs Co-Cr frameworks for RPD in terms of OHRQoL, patient preference, periodontal indices, and denture satisfaction in one year period.	Twenty-six participants received either Co-Cr or PEEK (1-year follow up = 19 patients)	PEEK denture frameworks have similar effect on OHRQoL, patient satisfaction, and periodontal outcomes as Co-Cr denture frameworks.
Mansour *et al.* (2020)	To compare the adhesion of *Candida albicans* to the fitting surface and mucosa underneath of Bre-Flex Versus PEEK RPD.	18 patients (9 Bre Flex: 9 PEEK) Microbiology evaluation at denture insertion, 3-weeks, 4-weeks)	Bre-Flex group shows higher number of *Candida* colonies in comparison to the number of colonies in PEEK group.
Mohamed & Rasha (2019)	To investigate patient satisfaction metal versus PEEK RPD framework in three-month period.	10 participants	Digitally milled PEEK frameworks increase patient satisfaction as compared to conventionally manufactured metal RPD frameworks.
Medappa (2018)	To assess the influence of surface roughness on bacterial adhesion in PEEK.	10 participants (5 control: 5 PEEK) within 24 hours	There is increase in surface irregularities and the presence of microbial colonies, predominantly gram-positive cocci. However, the evaluation timeframe is restricted to a brief 24-hour period, posing a significant limitation for comprehensive assessment.

Note: OHRQoL = Oral Health-related Quality of Life

Table 4 In vitro studies related to RPD clasp materials manufactured by PEEK material

Author, year	Objective	Sample/material tested	Materials and methods	Authors' remarks
Vaddamanu *et al*. (2023)	To examine the retentive forces and the fitting surface (inner surface) deformation of clasps made from PEEK and Co-Cr.	n = 42 (used 0.25 mm and 0.5 mm) with thicknesses of 1 mm and 1.5 mm. Co-Cr (Control) PEEK with different length (long vs short)	a. Used Aker clasp with one conventional (long arm clasp) and one short clasp. b. Employed a fatigue chewing simulator machine tensile tester unit to simulating six months of use (360 cycles).	PEEK clasps had retentive forces quite similar to Co-Cr clasps, yet showed lower deformation in their fitting surface compared to Co-Cr.
Yunisa *et al.* (2022)	To investigate the effect of the dimensions PEEK rods on the force needed to produce 0.5 mm deflection.	n = 32 (8 groups) 2 lengths (9 mm and 15 mm), 2 thicknesses (1.5 mm and 2.5 mm), 2 shapes (taper and rectangular) PEEK only	a. Used a cantilever rod (with different length, thickness and shape). b. Employed a hydraulic universal testing machine with a speed of 5 mm/min.	Enhancing the deflection force on PEEK involves shortening the arm length and increasing arm thickness to ensure clinically viable retention strength.
Gentz *et al.* (2022)	To compare retentive force of Co-Cr clasp and two thermoplastic polymers (PEEK and PEKK).	n = 48 (16 per group) Used 0.25 mm undercut Co-Cr (Control) PEEK PEKK	a. Used Aker clasp. b. Employed masticatory simulator to allow vertical movement of clasp (that mimic insertion and removal of an RPD) to simulate 10 years of use (15,000 cycles).	All groups exhibited an initial increase followed by a gradual decline in retentive force. All thermoplastic clasps showed inferior retentive forces when compared to Co-Cr clasps.
Zheng *et al.* (2022)	To investigate the fatigue behaviour of cast and laser-sintered (LS) Co-Cr and PEEK material for a clasp.	n = 30 (10 per group) 0.25 mm, 0.50 mm and 0.75 mm undercut Cast Co-Cr LS Co-Cr Milled PEEK	a. Used dumbbell-shaped specimens to simulate a typical clasp design and dimensions. b. Used 30,000 fatigue cycles (simulating 21 years) or till specimen failure.	None of clasp on PEEK groups fail during the simulation period. Clasps at 0.25 mm exhibited superior fatigue resistance. Cast and laser-sintered Co-Cr displayed comparable fatigue resistance and behaviour.
Hussein (2022)	To assess the mechanical performance of GBP and PEEK materials.	n = 32 (16 per group) Did not mention the undercut used. GBP PEEK	a. Used Aker clasp. b. Used insertion/removal cyclic pull-off force (10,000 cycles) and effect of oral environment aging 10,000 thermocycle process. c. 3-dimensional deviation of the clasps' arms was also measured.	Both materials exhibited a gradual decrease in retentive force, with PEEK having higher retention compared to GBP. GBP showed greater deformation than PEEK, identified by the difference between initial and final deviation. Maximum principal stress was higher in GBP at the retentive terminal and guiding plane compared to PEEK.

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Table 4 (*continued*)

Author, year	Objective	Sample/material tested	Materials and methods	Authors' remarks
Güleryüz *et al.* (2021)	To evaluate the retentive force and dimensional change of clasps with different thickness and undercut made from PEEK by the thermo-mechanical fatigue.	n = 48 (12 per group) PEEK (at undercuts of 0.25 mm or 0.50 mm) and different thickness (1 mm and 1.5 mm)	a. Used Aker clasp. b. Initial and final retentive force over thermos-mechanical fatigue (7,200 thermocycle to stimulate 5 years' time). c. Microcomputed tomography was utilised to assess dimensional changes between initial and final images, while scanning electron microscopy was employed to examine surface alterations on the clasp.	Thermo-mechanical aging reduces the retentive force in PEEK clasps. Increasing the thickness and undercut of clasps, decreases the amount of dimensional change.
El Mekawy & Elgamal (2021)	To assess the effect of the different processing techniques (injection molding versus milling) on PEEK.	n = 20 (10 per group) 0.50 mm undercut.	a. A PEEK framework with Aker clasp was constructed. b. Removal and insertion were carried out at 120, 720 and 1440 cycles.	PEEK RPD frameworks produced using the injection molding regarded as a viable alternative to CAD/CAM techniques.
Mayinger *et al.* (2021)	To assess retention force of PEEK and Co-Cr after storage in water and artificial aging.	n = 60 (15 per group) Undercut used = 0.75 mm Co-Cr (Control) DentoKepp (PEEKmilled1) BioHPP Blank (PEEK milled2) BioHPP Granulat (PEEK pressed)	a. Used 15 Bonwill clasps. b. Pull-off test (retention force) was examined at different aging levels at 30 days (10,000 thermal cycles) and 60 days (20,000 thermal cycles) c. *20,000 thermal cycles-simulate a clinical period of 2 years	All materials showed sufficient retention for clinical use. PEEKmilled2 outperformed PEEK pressed. Artificial aging notably reduced retention in PEEK materials, while Co-Cr displayed higher values post-aging.
Micovic *et al.* (2021)	To investigate the retention force of PEEK removable dental prosthesis clasps in comparison with a cobalt-chrome-molybdenum control group after storage in artificial saliva.	n = 60 (15 per group) Undercut used= 0.75 mm Co-Cr (Control) DentoKepp (PEEKmilled1) BioHPP Blank (PEEK milled2) BioHPP Granulat (PEEK pressed)	a. Used 15 Bonwill clasps. b. Retention force (pull-out test) was examined using the universal testing machine at initial, 90 days and 180 days of aging time.	The control group had higher retention force values than PEEK. The manufacturing process (milled vs pressed) did not impact retention force for PEEK. Unlike the control group affected by artificial aging, PEEK materials maintained consistent results.

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Table 4 (*continued*)

Author, year	Objective	Sample/material tested	Materials and methods	Authors' remarks
El-Baz *et al.* (2020)	To evaluate the retentive force, fatigue resistance and deformity of clasps made Co-Cr and PEEK	n = 16 Co-Cr (conventional) PEEK (injection moulding)	a. Aker clasp at lower natural mandibular teeth. b. Removal and insertion cycling of clasps was carried out for 360, 730, 1,080, 1,440, 2,116 and 2,880 cycles (corresponding to 3, 6, 9, 12, 18 and 24 months RPD wear).	Retention means for both materials significantly decreased from baseline to 24 months. PEEK clasps with a 1.0 mm cross-section engaging a 0.50 mm undercut offer equivalent retention as Co-Cr clasps. There is comparatively more deformation in Cr-Co compared to PEEK clasps.
Muhsin *et al.* (2018)	To investigate the retentive force of a novel clasp design for PEEK thermoplastic material at three different undercut depths.	n = 90 (10 per group with different undercut 0.25 mm, 0.50 mm and 0.75 mm) Co-Cr Thermo-pressed PEEK Machined PEEK-Juvora™ Optima	a. Used "novel clasp design" i.e. short arm for aesthetic purposes. b. Fatigue cycling equivalent to 6,600 cycles (3 years of use) of insertion/removal and thermocycling was conducted and the retentive force of each clasp was measured.	PEEK clasps showed no tendency to fracture across varied undercut depths during testing. The PEEK-Juvora™ clasps at 0.75 mm undercut depth displayed the highest initial retentive force of 45 N, followed by PEEK-Optima®NI1 at the same depth with 35 N.
Tannous *et al.* (2012)	To evaluate the retentive force of clasps made from 3 thermoplastic resins and Co-Cr alloy by the insertion/removal test simulating 10 years use.	n = 112 (16 per group with different undercut (0.25 mm, 0.50 mm) and different thickness (1.0 mm to 1.5 mm except Co-Cr with only 1.0 mm thickness) Co-Cr (Control) PEEK, PEKK and polyoxymethylene (POM)	a. Used "straight semicircular clasp patterns" resembling Aker clasp design. b. Insertion/removal test simulating 10 years use.	Thermoplastic resin clasps-maintained retention over 15,000 cycles, lower than Co-Cr clasps, yet adequate for clinical application.

Note: PEKK = poly-ether-ketone-ketone.

Five in vitro studies discuss the accuracy and fit of PEEK frameworks, as summarised in Table 5. All studies used different methodologies, manufacturing techniques, and design modifications based on different Kennedy classification cases (Arnold *et al.*, 2018; Ye *et al.*, 2018; Negm *et al.*, 2019; Guo *et al.*, 2022; El Saeedi *et al.*, 2022). Both milling and pressing techniques yielded acceptable clinical fit, with the milling technique demonstrating higher accuracy (El Saeedi *et al.*, 2022). In one study that used the fused deposition modelling (FDM) technique, it was concluded that despite the limitation of using only one model without a control, the RPD's fit met the clinical requirements (Guo *et al.*, 2022). Two studies used Co-Cr as a control (Arnold *et al.*, 2018; Ye *et al.*, 2018) while the other two used PEEK with different manufacturing processes (Negm *et al.*, 2019; El Saeedi *et al.*, 2022). Negm *et al.* (2019) found that direct CAD/CAM milling exhibited superior trueness compared to indirect additive manufacturing, although the latter showed excellent fit in specific areas, whereas Ye *et al.* (2018) observed that CAD/CAM-manufactured PEEK had a better fit than cast RPD. Additionally, Arnold *et al.* (2018) highlighted significant discrepancies in fit between direct CAD/CAM milling, which exhibited superior fit compared to LWT, with rapid prototyping (RP) showing the most discrepancies. All of the studies use 3D digital software to analyse the accuracy of fit, with only one earlier study using light microscopy at 560 magnifications (Arnold *et al.*, 2018).

Table 5 Accuracy of RPD manufacture by PEEK materials

Author, year	Objective	Materials/methods	Authors' remarks
El Saeedi *et al.* (2022)	To evaluate the accuracy and adaptation of BioHPP frameworks constructed from milling vs the pressing technique in three different axis (x, y, z).	n = 40 20 PEEKS pressed: 20 PEEK milling. Using Geomagic Control-X, 3D Systems Design: Single palatal strap Case: Kennedy Class III	Both show acceptable clinical fit but, milling technique show higher accuracy than the pressing technique for PEEK RPD.
Guo *et al.* (2022)	To evaluate fit of the PEEK RPD constructed by FDM using analysis of 3D morphology plotted.	n = 1 (PEEK RPD) Using FDM and Geomagic qualify software Design: Single palatal strap Case: Kennedy Class I	The only study that assesses fitting of PEEK using FDM, however use only one model with no control, yet the RPD's fit satisfied the clinical requirements.
Negm *et al.* (2019)	To compare the accuracy of fit and trueness PEEK fabricated by direct and indirect CAD/CAM techniques.	n = 20 PEEK only (10 direct CAD/CAM, 10 indirect additive manufacturing) Using Geomagic Control-X; 3D Systems Design: Anterior-Posterior (AP) palatal strap Case: Kennedy Class I	Two CAD/CAM approaches used: direct milling and indirect additive manufacturing. Direct technique had superior trueness; indirect showed exceptional fit in specific areas like guiding plates and AP strap. Both are within acceptable fit.
Ye *at al.* (2018)	To evaluate fit of PEEK vs Co-Cr RPD in different area of RPD (rest, major connector, denture base, entirely).	n = 30 15 PEEK, 15 Co-Cr RPD Using silicone and Geomagic Qualify software Design: Lingual palatal bar Case: Kennedy Class 2 Div 1	PEEK manufactured by CAD/CAM had better fit as compare to cast RPD.

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Table 5 (*continued*)

Author, year	Objective	Materials/methods	Authors' remarks
Arnold *et al.* (2018)	To evaluate the fit of RPD clasps fabricated by means of four different CAD-CAM-systems versus conventional LWT as control.	n = 15 (3 each group) Using 5 different fabrication technique; indirect rapid prototyping (IRP), direct rapid prototyping (DRP), selective laser melting (SLM), indirect milling (IM) (wax milling with LWT), direct resin milling (DM) and LWT (Control) Using light microscopy at ×560 magnification Design: Complete palatal strap Case: Class 4 Mod 2	A single investigator conducted the assessment to evaluate fit of the retentive clasps in horizontal and vertical measurement. Direct CAD/CAM milling exhibited notably superior fit compared to LWT. RP showed the most discrepancies. Casting resulted in higher horizontal discrepancies due to greater distortion than vertical ones.

Notes: FDM = fused deposition modelling; LWT = lost wax technique; RP = rapid prototyping

Table 6 summarises three in vitro studies on the effect of staining and colour stability on PEEK material (Polychronakis *et al.*, 2020; Porojan *et al.*, 2021; Papathanasiou *et al.*, 2022). Each study employed different methods and tested different materials (polyamide, acetal resin, polymethyl methacrylate [PMMA], polyoxymethylene [POM]). One study evaluates different aging and staining protocols on optical properties, colour changes, and surface roughness, focusing solely on PEEK materials without any comparisons (Porojan *et al.*, 2021). Another study used different extrinsic staining media (such as coffee, red wine, Coca-Cola, distilled water) and compared PEEK with three other materials (Papathanasiou *et al.*, 2022). The third study incorporated cleansing solutions with the extrinsic staining media and tested both PEEK and POM materials (Polychronakis *et al.*, 2020).

Table 6 In vitro studies on effect of staining in PEEK denture base material

Author, year	Objective	Material tested	Authors' remarks
Papathanasiou *et al.* (2022)	To assess the effect of commonly used solutions (coffee, red wine, coca cola distilled water) on colour stability, gloss, and surface roughness of RPD prostheses polymers.	PEEK Polyamide Acetal resin PMMA	PEEK exhibited minimal colour change but the most significant loss of gloss, while polyamide showed the highest colour alteration. Coffee immersion caused highest colour and gloss changes. Surface roughness remained unaffected by the immersing solutions.
Porojan *et al.* (2021)	To determine the influence of different ageing and staining protocols on optical properties, colour changes, and surface roughness of PEEK.	PEEK only	Glazing PEEK improves surface irregularity and opalescence consistently, regardless of aging or staining protocol. However, artificial aging harms colour stability and roughness, diminishing translucency and opalescence on glazed surfaces.
Polychronakis *et al.* (2020)	To investigate the long-term effect of staining and/or cleansing solutions (water, wine, coffee, cleanser and combo bath) on the colour stability of two RPD polymers. **Combo bath: wine-water-coffee-water-cleanser-water*	PEEK POM	POM exhibited more discolouration than PEEK in coffee and combo baths, but not in cleanser. The combo bath, including a cleanser, resulted in less discolouration, highlighting the cleanser's efficacy in preventing long-term discolouration for both materials.

Table 7 summarises the different surface treatment in PEEK RPD. All studies employed diverse methodologies, including variations in treatment conditions and different methodologies to evaluate the results. One study used different sandblasting techniques (Kurahashi *et al.*, 2019), while the other study used a combination of mechanical and chemical techniques (Jassim & Jaber, 2019). Mechanical technique with air abrasive surface treatment significantly improved bond strength for both Co-Cr and PEEK materials. Meanwhile, chemical treatment with acid etching of Co-Cr alloy surfaces led to a significant decrease in bond strength to acrylic resin, whereas PEEK polymer demonstrated superior bond strength to acrylic resin (Jassim & Jaber, 2019). Additionally, one study included different surface treatments on PEEK to be bonded to maxillofacial silicone elastomers (Cevik *et al.*, 2023). Moreover, some studies employed only scanning electron microscopy (SEM) and profilometer analysis, while others utilised X-ray diffraction analysis, Fourier transforms infrared (FTIR) spectroscopy, bond strength tests, and failure analysis, in addition to SEM.

Table 7 In vitro studies in different surfaces treatment on bond strength of PEEK materials

Author, year	Objective	Methods	Authors' remarks
Cevik *et al.* (2023)	To evaluate the effect of different surface treatments on PEEK to be bonded to maxillofacial silicone elastomers.	Consist of n = 48 specimens (40 PEEK, 8 PMMA) Treatment conditions PEEK prior bonding to silicone: a. Control PMMA (applied platinum primer) b. Control PEEK (applied a platinum primer) c. Silica-coating d. Plasma e. Sandpaper f. Laser Surface topography was analysed using SEM. Surface roughness was measured with profilometer. A peel test was performed to measure the bond strength between PEEK and silicone.	Surface treatments on PEEK did not affect the bonding between PEEK and silicone as applying a platinum primer to PEEK structures resulted in a favourable bonding.
Jassim & Jaber (2019)	To evaluate the bonding strength between heat-cured denture base resin to Co-Cr and PEEK polymer focused on the different surface treatments (acid etch and air abrasive).	Consist of n = 60 (acrylic-Co-Cr and acrylic-PEEK). Surface treatment conditions of PEEK: a. No treatment b. Al_2O_3 sandblasting c. 98% sulfuric acid Evaluations were done in five sections: SEM, X-ray diffraction analysis, FTIR spectroscopy, bond strength test and failure analysis.	Air abrasive surface treatment significantly improved bond strength for both Co-Cr and PEEK. Acid etch surface with Co-Cr alloy show a significant decrease in bond strength to acrylic resin, while PEEK polymer demonstrates superior bond strength to acrylic resin. Heat acrylic resin showed higher bond strength to PEEK polymer than Co-Cr alloy.

(*continued on next page*)

Table 7 (*continued*)

Author, year	Objective	Methods	Authors' remarks
Kurahashi *et al.* (2019)	To investigate the effect of PEEK surface treatments on the shear bond strength to acrylic resin.	Involve Co-Cr and PEEK with two types of resin (Unifast and Palapress Vario). PEEK: No treatment (as positive control) Co-Cr: Metal primer (as negative control) Surface treatment conditions of PEEK a. Ceramic primer application b. Aluminium oxide (Al_2O_3) sandblasting c. Tribochemical silica airborne-particle abrasion (Rocatec) d. Rocatec with ceramic primer application	Rocatec treatment, combined with ceramic primer, showed the highest bond strength of PEEK to acrylic resin (both Unifast II and Palapress Vario).

DISCUSSION

Case Reports Related to RPD Manufactured by PEEK Material

Case reports highlighted the patient satisfaction with PEEK frameworks, citing improved aesthetics and comfort compared to traditional metal frameworks, despite concerns about discolouration over time. All case reports reporting the use of PEEK as an RPD framework involve high aesthetic demand patients who complained of compromised aesthetics due to the display of the metal clasps of the existing Cr-Co denture, with two patients complaining of the metallic taste (Zoidis *et al.*, 2016; Harb *et al.*, 2019; Wu *et al.*, 2022). While PEEK's colour may not perfectly match natural teeth, it is generally more acceptable than metal. PEEK clasps provide gentler retention compared to metal clasps, with suggestions for optimal design to enhance retention (Tannous *et al.*, 2012; Zoidis *et al.*, 2016; Harb *et al.*, 2019). Additionally, the authors highlighted the importance of preoperative design as it is impossible to adjust the retention capacity due to clasp bending at delivery and difficulty in the polishing procedure (Ichikawa *et al.*, 2019). Concerns about PEEK's colour stability and surface gloss over time were noted in the literature. Zoidis *et al.* (2016) reported a loss of shine in the high-gloss surface after one year of clinical follow-up, while Ichikawa *et al.* (2019) observed colour and texture changes in the clasp arm after two years of use. All authors concluded that a PEEK denture should not be considered a substitute framework material for a well-designed Cr-Co RPD due to the lack of clinical evidence on the size and type of RPD frameworks that can be fabricated with PEEK, and no long-term clinical behaviour is yet available to consolidate the scientific evidence (Zoidis *et al.*, 2016; Harb *et al.*, 2019; Wu *et al.*, 2022). Nevertheless, although the use of PEEK as a denture material in the case report demonstrated successful clinical application with favourable outcomes, the positive results observed should warrant further investigation through larger-scale clinical studies to confirm the long-term performance and biocompatibility of PEEK RPD, offering potential advancements in RPD treatments.

Clinical Studies Related to RPD Manufactured by PEEK Material

One clinical study examined the accuracy of PEEK frameworks compared to Co-Cr frameworks, based on the difference in weight of polyvinyl siloxane (PVS), concluding that fabrication techniques affect accuracy, albeit based on a small sample size (Maraka *et al.*, 2021). This study utilised qualitative assessments, including a visual inspection and a pressing test, where gaps were duplicated using a silicone impression material between the RPD framework. Another clinical case-control study focused on dimensional changes in residual ridges of patients wearing PEEK RPD frameworks versus a control group of six untreated patients, suggesting that PEEK RPD may be suitable for ridge preservation. Despite concerns about increased tissue load, the study suggested that PEEK frameworks could be suitable for preserving residual ridges, as they did not significantly affect vertical height or three-dimensional changes over one year period (Lo Russo *et al.*, 2022).

Two studies assessed patient satisfaction with PEEK frameworks compared to metal frameworks, with mixed findings on satisfaction improvement and periodontal variables (Mohamed & Rasha, 2019; Ali *et al.*, 2020). Mohamed & Rasha (2019) found that digitally milled PEEK frameworks led to higher patient satisfaction than conventionally manufactured metal RPD frameworks, using the 19-item Oral Health Impact Profile in Edentulous Patients (OHIP-EDENT) questionnaire. However, their study had limitations such as a small sample size (n = 10) and a short wearing period of three months, affecting the interpretation of causal relationships (Mohamed & Rasha, 2019). In contrast, a more recent study showed significant improvements in oral health-related quality of life (OHQoL) and denture satisfaction scores for both metal and PEEK frameworks, assessed using the 20-item Oral Health Impact Profile (OHIP-20) and McGill Denture Satisfaction Questionnaire (MDSQ) questionnaires. However, no statistically significant differences in periodontal variables were found over one year. The latter study also faced limitations like uneven distribution of dentures in the study group based on Kennedy Classification and a short cross-over period prior to final denture selection, which may have affected the results (Ali *et al.*, 2020). Both studies used different questionnaires and reported varying results, with Mohamed & Rasha (2019) focusing on OHIP-EDENT and indicating higher satisfaction with PEEK frameworks, while Ali *et al.* (2020) used OHIP-20 and MDSQ and found improvements with both metal and PEEK frameworks.

Only two studies addressed the adhesion of microorganisms to PEEK RPD, with mixed findings regarding bacterial colonisation. Medappa (2018) investigated bacterial adhesion on PEEK discs before and after 24 hours of clinical use, where no cleaning was allowed during the duration of the study. It is concluded that there is an increase in surface irregularities and the presence of microbial colonies, predominantly gram-positive cocci. Nevertheless, the small sample size (5 PEEK: 5 control) and short duration of time are the main limitations of this study (Medappa, 2018). Another randomised clinical trial evaluated the adhesion of *Candida albicans* to the fitting surfaces of two different thermoplastic materials (Bre-Flex versus PEEK); concluded that there were more *Candida* colonies on the mucosa in the Bre-Flex group, but more colonies on the denture surface in the PEEK group after a 4-week review (Mansour *et al.*, 2020).

While initial clinical studies have shown promising results, there are currently only six clinical studies in the literature, of which one focuses on accuracy, one on changes in dimensional residual ridge, two on periodontal evaluation and OHQoL, and another two on microorganism adhesion to PEEK. Additionally, the recall review was very short. Thus, there is still a need for further research on the long-term effect and clinical outcome, as currently the follow-up period on research between 24 hours, one month, three months and one year. A well-designed prospective cohort study comparing PEEK RPD with traditional RPD materials is valuable to fully understand the clinical data on the performance, biocompatibility, long-term effects, and potential complications associated with PEEK RPD in dental applications.

In Vitro Studies Focused on PEEK as Clasp Material

Most of in vitro studies focused on PEEK as clasps material employing the pull-off test method. The pull-off test or insertion/removal test is a method for determining the retention force in an in vitro study setup using a masticatory simulator in which specimens are extracted from abrasion-resistant models to allow vertical movement of the clasp (that mimics insertion and removal of an RPD) while measurement conditions are held constant (Tannous *et al.*, 2012). As there is no standard structural design established in relation to its properties, and most of the design recommendations come from the dental supplier, which recommends a clasp undercut of 0.5 mm in the anterior region and 0.5 mm to 0.75 mm in the posterior region (Juvora Ltd., 2021). Muhsin *et al.* (2018) investigated the retentive force of PEEK thermoplastic material at various undercut depths, noting the highest initial retention at 0.75 mm. PEEK demonstrated no tendency to fracture across different depths, showcasing its advantageous properties (Muhsin *et al.*, 2018). Due to material's flexibility and toughness, it allows it to adapt to deeper undercuts in abutment teeth, while its low friction coefficient reduces the risk of irritation (Zheng *et al.*, 2021). Moreover, a study on PEEK's fatigue resistance found it to have the highest fatigue resistance among tested material (Zheng *et al.*, 2022).

Apart from ensuring optimal retention and stability of the new clasp design with the new material, it is important to develop and design more aesthetically pleasing designs while minimising the visibility of clasp components. Our study found that during the experimental study, most of the clasp designs were Aker clasps or Bonwill designs. However, one study went beyond using only the clasp, fabricating the entire RPD framework using PEEK to investigate the retentive force of the clasp. This study compared two different fabrication techniques and concluded that frameworks fabricated by the injection molding technique were considered a promising method over the CAD/CAM technique (El Mekawy & Elgamal, 2021).

To simulate the effects of years of use and ageing in the mouth, it is important to know how a material will work and last over time in the experimental in vitro studies. One way to simulate these effects is to subject the materials through multiple cycles of mechanical, thermal and/or thermomechanical stress. This can help find potential failures that may happen over time. Nevertheless, there is inconsistency in the methodology of the studies, particularly when it comes to the number of cycles to simulate years of use and thermomechanical stimulation to stimulate the effect of oral environment ageing. While some studies may use a specific number of cycles, such as 2,200, 4,400, and 6,600 (Muhsin *et al.*, 2018), others may use different cycles, such as 10,000 or 20,000 (Mayinger *et al.*, 2021), which leads to variability in results and makes it difficult to compare findings across the studies.

In Vitro Studies on Accuracy of RPD Manufactured by PEEK

All studies use different manufacturing techniques and design modifications. Thus, no direct comparison of studies can be done. PEEK RPD can be manufactured either using direct or indirect techniques of additive manufacturing such as FDM, selective laser melting (SLM), or subtractive manufacturing (milling using CAD/CAM). One study found that direct CAD/CAM milling showed better fit than additive manufacturing, which had the highest discrepancies (Arnold *et al.*, 2018). Similarly, another study reported that direct techniques had better overall trueness compared to indirect techniques (Negm *et al.*, 2019). Furthermore, a comparison of milling and pressing techniques revealed that milling showed higher accuracy (El Saeedi *et al.*, 2022). These studies primarily utilised 3D digital software for accuracy analysis, with one earlier study employing light microscopy at 560 magnifications (Arnold *et al.*, 2018). The integration of objective measurements and visualisations offered by current technologies allows for a more comprehensive evaluation of the accuracy of RPD. In addition, a more in-depth study incorporating a clinical study will help validate laboratory findings in terms of the accuracy of the PEEK framework. This will yield more valuable data as the integration of clinical studies adds a layer of complexity that addresses the dynamic oral environment and patient-specific variables such as tissue adaptation, stability, durability, and long-term performance (Ali *et al.*, 2020).

In Vitro Studies on Effect of Staining and Colour Stability on PEEK Denture Base Material

Staining or discolouration is considered an aesthetic failure, which is a relevant clinical problem. Staining can occur when extrinsic substances (such as food, beverages, and tobacco) adhere to or penetrate the surface of denture base material, resulting in visible discolouration (Sepúlveda-Navarro *et al.*, 2011; Ayaz & Ustun, 2020). Apart from that, the discolouration of prostheses may be caused by either intrinsic factors such as chemical reactions within the material in relation to type of resin matrix, percentage, and filler size, or the distribution of the incorporated fillers (Dietschi *et al.*, 1994). In addition, surface irregularity and surface-free energy play a significant role in colour stability during surface processing in which several studies demonstrated a correlation between a rough surface and the discolouration of denture which can be explained by the larger contact area (Gönülol & Yılmaz, 2012; Heimer *et al.*, 2017). Identifying the potential causes that contribute to staining allows the clinician and researcher to establish strategies to reduce or prevent it.

PEEK demonstrates remarkable colour stability when compared to other denture resin materials like polyamide, acetal resin, and PMMA, even after immersion in various staining media such as coffee, red wine, and cola (Papathanasiou *et al.*, 2022). This resilience can be attributed to its inert semicrystalline nature, high chemical stability, low water solubility, and absorption. One study assessing the effects of various ageing and staining protocols on optical properties and colour changes concluded that immersing PEEK in hot coffee results in visible discolouration compared to exposure to a cold juice bath. Additionally, glazing PEEK can further enhance its surface characteristics, reducing the impact of colour changes due to staining (Gönülol & Yılmaz, 2012). Long-term exposure to staining agents may cause linear discolouration in PEEK, but the use of cleansing solutions, particularly in combination baths, can mitigate this effect (Polychronakis *et al.*, 2020). PEEK's hydrophobic properties, originating from its aromatic backbone and nonpolar carbon-carbon bonds, contribute to its resistance to staining. While POM contains more hydrophilic groups (hydroxyl [-OH] groups). This can attract and absorb water, resulting in increased water absorption, which can contribute to the absorption of pigmented substances, thus rendering the material more susceptible to staining (Schierz *et al.*, 2021; Akl & Stendahl, 2022). While PEEK itself is highly resistant to hydrolysis and long-term water exposure, the interface between the polymer and reinforcements, such as carbon fibre, may be susceptible to fluid environments in vivo (Kurtz & Devine, 2007). Compared to other materials like POM and PMMA, PEEK exhibits lower solubility and water absorption rates across various ageing media and durations (Liebermann *et al.*, 2016). However, it is crucial to consider that water absorption and release can potentially lead to molecular instabilities, affecting the material's physical and mechanical properties over time.

In Vitro Studies on Different Surfaces Treatment

The inherent hydrophobicity of PEEK can pose challenges for traditional adhesives in achieving proper bonding with the acrylic denture base or artificial teeth. To address this issue, various surface treatment techniques have been developed to modify the surface properties of PEEK, such as surface conditioning techniques like surface roughening, which are needed for successful bonding on PEEK surfaces. Apart from improving the wettability of the surface, this process simultaneously removes the contaminated layer, debris, and/or metal oxides and achieves an increase in the surface area by producing micromechanical roughness (Nishigawa *et al.*, 2016; Caglar *et al.*, 2019).

Surface treatment investigations revealed promising outcomes, with techniques like sandblasting and acid etching enhancing bonding strength between PEEK and acrylic resin, although variations in outcomes were noted based on the material substrate. Three in vitro studies investigated different surface treatments on the bond strength of PEEK materials, each with diverse methodologies. Kurahashi *et al.* (2019) explored various surface treatments on PEEK, finding that SiO_2-coated aluminium oxide blasting resulted in the highest bond strengths, facilitating mechanical interlocking with acrylic resin. However, it is important to note that this study focused on the surface treatment of PEEK that enables its use as the clasp of RPD to Co-Cr framework and the fixation of PEEK prostheses. Another study that compared acid etch and air abrasive treatments for bonding PEEK to acrylic resin showed that acid etching showing superior bond strength due to physicochemical alterations on the PEEK surface (Jassim & Jaber, 2019). However, acid etching decreased bond strength with Co-Cr alloy, likely due to sulfuric acid's corrosive nature, while air abrasion improved bond strength by promoting micromechanical interlocking sites. SEM revealed that acid-etched PEEK groups displayed a sponge-like and complex fibre network surface with evident pits and porousness, while air abrasives caused pronounced irregularities and a rough texture with peaks and valleys. Chemically, the acid etches treatment attacks functional carbonyl and/or ether groups between the benzene rings of the PEEK polymer, which creates physicochemical alterations on the PEEK surface (Jassim & Jaber, 2019). Furthermore, surface treatments on PEEK did not affect bonding with maxillofacial silicone elastomers, with platinum primer application resulting in favourable bonding (Cevik *et al.*, 2023).

Limitations of Study and Recommendations for Future Study

While our review provides valuable insights into the use of PEEK RPD, several limitations should be acknowledged. Firstly, the scope of this scoping review may have been influenced by publication bias, as only articles available in English were included. The lack of extensive clinical studies with long-term follow-ups limits the ability to conclusively assess the performance and patient satisfaction of PEEK RPD. Moreover, the predominance of in vitro research focusing on specific aspects of PEEK RPD, such as clasps, highlights a gap in comprehensive investigations encompassing accuracy, bond strength, surface treatment, and staining resistance.

To address these limitations and further advance the understanding and application of PEEK RPD, future research should prioritise several areas. Firstly, there is a need for well-designed prospective studies or randomised controlled trials with extended follow-up periods to evaluate the long-term clinical performance, patient satisfaction, and durability of PEEK RPD compared to conventional materials. Comparative studies directly comparing PEEK RPD to traditional frameworks, considering factors such as fit, comfort, and biocompatibility, would provide valuable insights for clinicians and patients in decision-making. Moreover, comprehensive investigations into the adhesion properties and biofilm formation on PEEK RPD surfaces, along with studies assessing the effectiveness of different surface treatments, are essential to mitigate potential concerns regarding plaque accumulation and oral hygiene maintenance. Finally, collaborative efforts between researchers, clinicians, and manufacturers are necessary to standardise design protocols and optimise fabrication techniques to ensure the successful integration of PEEK RPD into routine dental practice.

CONCLUSION

This review, spanning studies from 2018 to 2023 on PEEK RPD, reveals PEEK frameworks as a viable alternative, particularly for metal-allergic patients. While in vitro studies predominantly focus on clasps, limited attention is given to accuracy, surface treatment, and staining of denture base material. Emphasising framework accuracy is crucial for prosthesis stability, and PEEK demonstrates superior bond strength with acrylic resin through specific surface treatments. Despite the reported low plaque affinity, there is a need for thorough investigation into adhesion and biofilm formation on PEEK RPD surfaces, with longer follow-up periods. Clinical research is sparse, consisting of four case reports and six studies with one-year follow-ups. Promising evidence from in vitro experiments and case reports underscores the necessity for well-designed prospective studies or randomised controlled trials, comparing PEEK RPD to conventional materials and assessing long-term clinical efficacy to guide optimal use in dental practice.

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