

Transdigital[®]

journal



Volume 7, Issue 13: January-June 2026

ISSN: 2683-328X

Sociedad de Investigación sobre Estudios Digitales S. C.



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POLYETHER-ETHER-KETONE FRAMEWORKS IN
IMPLANT-SUPPORTED ALL-ON-X PROSTHESES:
A SYSTEMATIC REVIEW

SUPERVIVENCIA Y COMPLICACIONES DE LOS *FRAMEWORKS*
DE POLIÉTER-ÉTER-CETONA DE ARCO COMPLETO EN
PRÓTESIS IMPLANTOSOPORTADAS TIPO *ALL-ON-X*:
UNA REVISIÓN SISTEMÁTICA

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**SURVIVAL AND COMPLICATIONS OF FULL-ARCH POLYETHER-ETHER-KETONE
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UNA REVISIÓN SISTEMÁTICA**

ABSTRACT

Prosthetic complications in *All-on-X* restorations are related to the material of the *framework*. Polyether ether ketone (PEEK) is an innovative alternative, but its clinical performance has not yet been established. Therefore, the aims of this study was to analyze the clinical survival and prosthetic complications associated with the use of PEEK frameworks in *All-on-X* implant-supported prostheses through a systematic review. The systematic review was conducted in four phases and included scientific publications on this topic that met the established inclusion and exclusion criteria. The results demonstrated that there are few clinical studies on prosthetic or implant follow-up, of which *in vitro* or *Finite Element Analysis* (FEA) studies are the most common. Likewise, most clinical studies showed implant survival rates between 98% and 100%, while prosthetic survival ranged from 93% to 100%. On the other hand, the most common complications were loosening of prosthetic screws, prosthetic fractures, and adhesion failures. In conclusion, it was determined that although PEEK represents a potential alternative for frameworks in implant-supported full-arch restorations, the available evidence is dominated by experimental studies and presents consistent results. More longitudinal clinical studies are needed to establish its actual performance under functional conditions.

Keywords: polyether-ether-ketone, implant-supported prostheses, full arch rehabilitation, All-on-X, prosthetic complications

RESUMEN

Las complicaciones protésicas en rehabilitaciones *All-on-X* están relacionadas con el material del *framework*. El poliéter-éter-cetona (PEEK) es alternativa innovadora, pero su desempeño clínico aún no está establecido. Por lo anterior, el objetivo del trabajo fue analizar la supervivencia clínica y las complicaciones protésicas del uso de *frameworks* de PEEK en prótesis implantosoportadas tipo *All-on-X* mediante una revisión sistemática. La revisión sistemática se llevó a cabo en cuatro fases y estuvo compuesta por publicaciones científicas identificadas sobre esta temática, y que cumplieron con los criterios de inclusión y exclusión establecidos. Los resultados demostraron que existen pocos estudios clínicos de seguimiento protésico o implantario, de los cuales, los *in vitro* o *Finite Element Analysis* (FEA) son los más comunes. Asimismo, la mayoría de los estudios clínicos mostraron tasas de supervivencia implantaria entre 98% y 100%, mientras que la supervivencia protésica estuvo entre 93% y 100%. Por otro lado, las complicaciones más comunes fueron aflojamiento de tornillos protésicos, fracturas protésicas y fallas de adhesión. En conclusión, se determinó que, aunque el PEEK representa una alternativa potencial para frameworks en rehabilitaciones implantosoportadas de arco completo, la evidencia disponible está dominada por estudios experimentales y presenta resultados consistentes. Se requieren más estudios clínicos longitudinales que permitan establecer su desempeño real bajo condiciones funcionales.

Palabras clave: poliéter-éter-cetona, prótesis implantosoportadas, rehabilitación de arco completo, All-on-X, complicaciones protésicas

1. INTRODUCTION

Oral rehabilitation using full-arch implant-supported prostheses is one of the most commonly used treatment options for managing complete edentulism. In this context, the All-on-X concept has gained widespread clinical acceptance by allowing the strategic placement of a small number of implants to support a fixed prosthesis (Nellisser et al., 2022). Despite their high success rates, these restorations can present significant prosthetic complications, such as fractures of the restorative material, *framework* failures, adverse reactions to restorative materials, and screw loosening.

The choice of material for the *framework* is a key factor in the longevity of *All-on-X* restorations. Traditionally, these frameworks have been fabricated from metal alloys, zirconia, or hybrid acrylic restorations due to their high mechanical strength. However, these materials have limitations related to their high rigidity, weight, and biomechanical behavior, which has driven the search for alternatives with properties closer to those of biological tissues (Papathanasiou et al., 2020; Blanch-Martínez et al., 2021). In this context, polyether ether ketone (PEEK) has emerged as a high-performance thermoplastic polymer with growing application in dentistry.

This material offers biocompatibility, chemical stability, and radiolucency, as well as an elastic modulus similar to that of cortical bone, which could promote a more uniform distribution of occlusal loads (Sacks et al., 2024; Wang et al., 2022; Azhar, 2023). However, clinical evidence regarding its performance in *All-on-X*-type implant-supported restorations remains limited, as most available studies are experimental or *in vitro* (Mishra et al., 2023). Consequently, a systematic review of the literature is needed to evaluate the clinical survival and prosthetic complications associated with the use of PEEK *frameworks*.

2. METHOD OF RESEARCH

The objective of this study was to analyze the clinical survival and prosthetic complications associated with the use of PEEK frameworks in implant-supported prostheses of the All-on-X type through a systematic review of the literature, in order to evaluate the available evidence and provide guidance on the selection of this material for full-arch restorations.

This study was conducted as a systematic literature review. It comprised scientific publications on this topic and studies that met the established inclusion and exclusion criteria. The study was a documentary review, as it systematically and reproducibly synthesized the available scientific evidence (Page et al., 2021) using methods that allowed for a reproducible synthesis of the literature (Sánchez-Meca & Botella, 2010).

2.1. Search strategy

A literature search was conducted in the *Dimensions* database using the following search strategy: (“Polyether ether ketone” OR PEEK) AND (“full-arch” OR “All-on-4” OR “All-on-6” OR “All-on-X” OR “complete arch”). This search initially identified 85 potentially relevant publications. Subsequently, a review of titles and abstracts was conducted to assess the relevance of the studies to the research topic. At this stage, 44 publications that did not address the use of PEEK *frameworks* in All-on-X-type full-arch implant-supported restorations were excluded.

The remaining studies were screened using exclusion criteria, which involved discarding literature reviews, duplicate articles, single-case reports, book chapters, conference proceedings, and articles published before 2018. Following this process, a total of 27 studies that met the inclusion criteria were identified and considered for the final review. The selected studies were analyzed using a data table to extract relevant information from the reviewed studies. The analysis was conducted through a qualitative synthesis of the evidence. The process of identifying, selecting, and assessing the eligibility of the studies was represented using a flowchart in accordance with the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) guidelines (Figure 1 y Table 1).

Figure 1
PRISMA Flowchart

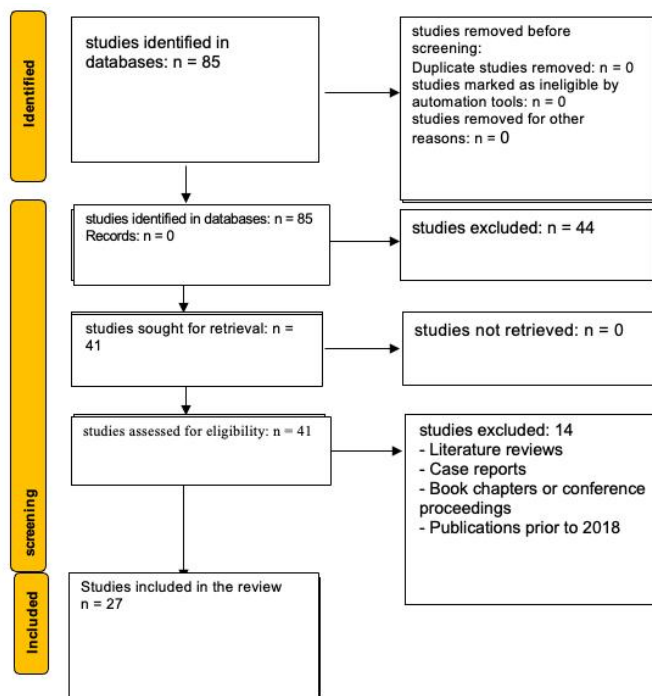


Table 1
Studies selected for the review

Title-Autor	Study type	Main theme
1. <i>Maxillary All-on-6 Treatment Using Zygomatic Implants. Bone Loss Evaluation by CBCT: 3-Year Follow-up</i> (Abouelhuda et al., 2025).	Radiographic follow-up using cone-beam computed tomography (CBCT)	Peri-implant bone changes in All-on-6 with zygomatic implants.
2. <i>Biomechanical analysis of inclined and cantilever design with different implant framework materials in mandibular complete-arch implant-supported prostheses: A 3D finite element analysis</i> (Yu et al., 2022).	Finite Element Analysis in three dimensions (3D)	Tilt and cantilever effects with different materials.
3. <i>In vitro evaluation of wear characteristics in complete arch implant-supported fixed dental prostheses: Impact of framework-veneer material combinations and compatibility</i> (Haji Bakr & Kazazoğlu, 2026).	<i>In vitro</i>	Wear based on combinations <i>framework-veneer</i> .
4. <i>Trueness and marginal fit of implant-supported complete-arch fixed prosthesis frameworks made of high-performance polymers and titanium: An explorative in-vitro study</i> (Abou-Ayash et al., 2021).	<i>In vitro</i>	Milling Accuracy and Marginal Fit in PEEK vs. PEKK vs. Ti.
5. <i>Dynamic finite element analysis of stress distribution in edentulous fixed restorations: Effects of different implant configurations and framework materials</i> (Lan & Su, 2025).	Finite Element Analysis	All-on-4 vs. All-on-6 vs. All-on-6 with short implants under dynamic loading.
6. <i>Biomechanical investigation of maxillary implant-supported full-arch prostheses produced with different</i>	Finite Element Analysis	Stress ranking by material and number of implants.

Table 1*Studies selected for the review*

Title-Autor	Study type	Main theme
<i>framework materials: a finite elements study (Topcu & Mumcu, 2022).</i>		
7. <i>Stress in the bone and prosthetic components due to "All-on-4" system with polyether-ether-ketone screwing prosthesis. Analysis using 3D finite element method (Vaitiekūnas et al., 2020).</i>	Finite Element Analysis 3D	Effect of the loading point on the All-on-4 cantilever with PEEK.
8. <i>Metal-Ceramic and Polyether Ether Ketone-Composite Maxillary Fixed Prosthesis Supported by Four Implants and Opposed by Removable Distal Extension Partial Dentures: A Comparative Study of Clinical and Prosthetic Outcomes (Kortam et al., 2022).</i>	A three-year comparative clinical study	Metal-ceramic vs. PEEK composite in All-on-4 maxilla.
9. <i>Biomechanical Evaluation of Framework Materials in All-on-Four Versus All-on-Six Prosthesis: A Finite Element Study (Cabbarova et al., 2026).</i>	Finite Element Analysis	Biomechanical comparison of All-on-4 vs. All-on-6 by material.
10. <i>The influence of framework material on stress distribution in maxillary complete-arch fixed prostheses supported by four dental implants: a three-dimensional finite element analysis (Dayan & Geckili, 2021).</i>	Finite Element Analysis 3D	Framework material and stress in the All-on-4 jaw.
11. <i>Short-term report of an ongoing prospective cohort study evaluating the outcome of full-arch implant-supported fixed hybrid polyetheretherketone-acrylic resin</i>	Prospective cohort (short-term)	Preliminary results and complications associated with PEEK-acrylic hybrid prostheses.

Table 1*Studies selected for the review*

Title-Autor	Study type	Main theme
<i>protheses and the All-on-Four concept (Maló et al., 2018).</i>		
12. <i>Mechanical Response of PEKK and PEEK As Frameworks for Implant-Supported Full-Arch Fixed Dental Prosthesis: 3D Finite Element Analysis (Villefort et al., 2021).</i>	Finite Element Analysis 3D	FEA Comparison of PEEK vs. PEKK as <i>frameworks</i> .
13. <i>Polyetheretherketone computer-aided design and computer-aided manufacturing framework for All-on-Four mandibular full-arch prosthesis: 3 Years' retrospective study of peri-implant soft tissue changes and ridge base relationship (Mourad et al., 2023).</i>	Retrospective, 3 years	Relationship between soft tissue, the margin, and periodontal assessment with PEEK frameworks.
14. <i>Investigation of Stress Distribution Between Two Different Implant Concepts in Implant-Supported Maxillary Protheses with Different Framework Materials: A Finite Element Study (Kilic & Caglar, 2025).</i>	Finite Element Analysis	All-on-4 vs. All-on-6 y ranking por material (CoCr, Zr, Ti, PEEK).
15. <i>Finite element analysis of the effect of framework material and thickness on the biomechanical performance of 'All-on-Four' full-arch prosthesis (Shash et al., 2024).</i>	Finite Element Analysis	Impact of framework thickness and material on biomechanical performance.
16. <i>Finite Element Analysis of Welded Titanium Bar and Poly Ether Ether Ketone Bar in Maxillary Full Arch Splinted Interim Prosthesis (Zaki Mohamed et al., 2025).</i>	Finite Element Analysis	Comparison of welded titanium bars vs. PEEK in full-arch temporary protheses.

Table 1*Studies selected for the review*

Title-Autor	Study type	Main theme
17. <i>Comparative evaluation to study the effect of implant support on complete fixed dental prosthesis fabricated with peek framework when implants placed in all-on-4 and all-on-6 situation, by strain gauge analysis and finite element analysis – An in vitro study</i> (Vinodh et al., 2023).	Experimental Biomechanics + Finite Element Analysis	Effect of the implant abutment and configuration (comparison) with the PEEK framework.
18. <i>Biomechanics of the implant-supported full arch fixed complete denture manufactured by milling and injection techniques: An experimental and FEA study</i> (Gürkan et al., 2025).	<i>In vitro</i>	Effect of manufacturing technique (milling vs. injection molding) on biomechanical response.
19. Biomechanical Properties and Biocompatibility of Implant-Supported Full Arch Fixed Prosthesis Substructural Materials (Eraslan et al., 2021).	<i>In vitro</i> (properties + biocompatibility)	Mechanical properties and biocompatibility of substructural materials.
20. <i>The All-on-4 Concept Using Polyetheretherketone (PEEK) –Acrylic Resin Prostheses: Follow-Up Results of the Development Group at 5 Years and the Routine Group at One Year</i> (De Araújo Nobre et al., 2023).	Cohort (two groups: five years vs. one year)	Long-term vs. short-term outcomes for PEEK–acrylic prostheses.
21. <i>Effect of Different Cantilever Lengths in Polyether Ether Ketone Prosthetic Framework in All-on-Four Technique on Stress Distribution: A Three-Dimensional (3D) Finite Element Analysis</i> (Almjaddr & Saker, 2024).	Finite Element Analysis	Cantilever and stress distribution with a PEEK framework in All-on-4.

Table 1
Studies selected for the review

Title-Autor	Study type	Main theme
22. <i>Influence of Framework Material and Posterior Implant Angulation in Full-Arch All-on-4 Implant-Supported Prosthesis Stress Concentration</i> (Mendes Tribst et al., 2022).	Finite Element Analysis3D	Posterior angulation + framework material in All-on-4.
23. <i>Hybrid Polyetheretherketone (PEEK)–Acrylic Resin Prostheses and the All-on-4 Concept: A Full-Arch Implant-Supported Fixed Solution with 3 Years of Follow-Up</i> (De Araújo Nobre et al., 2020).	Prospective cohort, 3 years	Survival and Complications in PEEK–Acrylic Hybrid Prostheses.
24. <i>Patient-Centered Treatment Outcomes with Full-Arch PEEK Rehabilitation Supported on Four Immediate or Conventionally Loaded Implants. A Randomized Clinical Trial</i> (Montero et al., 2021).	Randomized clinical trial	Patient-Centered Functional and Subjective Outcomes with PEEK.
25. <i>Comparison of Surface Strains of Polymeric Frameworks for Fixed Implant-Supported Prostheses: A Digital Image Correlation Study</i> (Messias et al., 2025).	<i>In vitro</i>	Surface tension in polymeric frameworks via digital correlation.
26. <i>Five years of radiographic evaluation for the peri-implant bone changes of all-on-four Implant prostheses constructed from different framework materials using different digital construction techniques</i> (Mourad et al., 2024).	Prospective longitudinal clinical study	Assessment of changes in peri-implant bone around implants by comparing different materials.
27. <i>Biomechanical analysis of All-on-4 implant supported framework using</i>	Finite Element Analysi	Evaluation of the biomechanical behavior of

Table 1
Studies selected for the review

Title-Autor	Study type	Main theme
<i>different materials across various clinical practice (Chen et al., 2025).</i>		prosthetic structures using different materials.

3. RESULTS

Within the final set of studies (n=27), 51.7% were biomechanical studies and FEA analyses; 13.8% evaluated physical and mechanical properties through experimental studies; 27.6% were clinical studies analyzing prosthetic or implant survival and biological parameters; and 6.9% focused on the bonding interface and adhesive failures. Chronologically, the highest number of publications (27.6%) occurred in 2025. On the other hand, more than 50% of the studies were published between 2023 and 2026. This demonstrated a recent growth in scientific interest in the use of PEEK in implant-supported restorations.

3.1. Biomechanics and finite element analysis

Most of the evidence comes from FEA studies, which evaluated stress distribution in implant-supported restorations using polymeric frameworks. In general, these models agree that the lower stiffness of PEEK causes greater deformation of the framework and redistributes loads toward the prosthetic screws and connecting components. In one FEA study, it was observed that under bilateral vertical loading, both PEEK and titanium transmit forces to the bone in a similar manner. However, under unilateral oblique loading, PEEK exhibited lower stress transmission to the marginal bone, although with higher stresses within the material itself.

In *All-on-4* cases, it was observed that the implants on the loading side can withstand between 66.38% and 74.68% of the total occlusal forces. This means that when force is applied to a specific side of the prosthesis—as occurs during unilateral chewing or in the posterior region—most of the load is concentrated on the implants closest to that loading point and is not distributed evenly (Vaitiekūnas et al., 2020). Similarly, comparative analyses indicated that PEEK frameworks can increase stress on prosthetic screws by 10% to 20% compared to stiffer materials such as zirconia or titanium (Dayan & Geckili, 2021).

The length of the cantilever emerged as one of the most critical biomechanical factors. Some studies reported that when the cantilever exceeds six millimeters (mm), the maximum stress on the implants can increase up to 2.6 times compared to titanium frameworks (Chen et al., 2025). Likewise, studies comparing All-on-4 and All-on-6 configurations demonstrated that increasing the number of implants reduces stress concentrations in the peri-implant bone and prosthetic components (Kilic & Caglar, 2025; Lan & Su, 2025). Along these lines, an in vitro study

using strain analysis and FEA under a load of 100 Newtons (N) showed that the All-on-6 configuration with pterygoid support reduces deformation in the angled implants compared to the All-on-4 system, due to better stress distribution toward the implants located more distally (Vinodh et al., 2023).

It was also observed that the manufacturing technique can influence the mechanical behavior of the material. PEEK *frameworks* produced by milling (CAD-CAM) exhibited a higher elastic modulus and flexural stiffness (4.6 ± 0.9 GPa) compared to those manufactured by injection molding (3.1 ± 0.6 GPa), which translates to lower levels of deformation under functional load (Gürkan et al., 2025).

3.2. Physical properties and strength

In terms of dimensional accuracy, CAD-CAM-milled PEEK *frameworks* showed smaller deviations (0.039 ± 0.01 mm) compared to other materials such as PEKK (0.049 ± 0.009 mm) and titanium (0.074 ± 0.011 mm) (Abou-Ayash et al., 2021). This means that PEEK is more precise in the manufacture of prostheses, as it improves the fit of the implants. On the other hand, wear simulation studies after 1,250,000 masticatory cycles demonstrated that PEKK-based combinations exhibited the lowest volumetric wear ($\Delta V \approx 0.205$ mm³), while metal/resin combinations showed higher values ($\Delta V \approx 1.580$ mm³).

PEEK may exhibit greater wear resistance than traditional materials (Haji Bakr & Kazazoğlu, 2026). Furthermore, studies evaluating deformation using digital image correlation confirmed that PEEK frameworks exhibit greater displacement under load, demonstrating their lower stiffness compared to fiber-reinforced materials (Messias et al., 2025). In other words, PEEK tends to deform more under masticatory forces, which demonstrates its lower elastic modulus compared to stiffer materials.

On the other hand, in some comparative studies of substructure materials, PEEK demonstrated high biocompatibility, similar to zirconia in terms of how cells grow on its surface. Despite this, it exhibited lower fracture resistance and lower hardness compared to zirconia and cobalt-chromium (Cr-Co), which were identified as the most durable materials (Eraslan et al., 2021).

3.3. Clinical survival studies

Overall, these studies reported high implant survival rates, ranging from 98.9% to 100% during the available follow-up periods. In patients treated with mandibular All-on-4 and PEEK frameworks, increases in plaque, gingival, and bleeding indices were observed over time, while probing depth did not show significant changes in the implants. This was significant because, although implant survival remains high, the condition of the peri-implant tissues may be compromised over time if proper monitoring and maintenance are not performed (Mourad et al., 2023).

The literature is limited, and three of the articles are follow-up studies by the same author. Prosthesis survival showed greater variability, with reported values ranging from 93.6% to 100%, depending on the follow-up period and the type of restoration. There is a cohort study initiated in 2018 that has received two updates to date regarding material survival (Maló et al., 2018). In 2020, some authors observed a prosthetic survival rate of 98%, associated with a single case of framework fracture (De Araújo Nobre et al., 2020). These same authors, later in 2023, reported a 93.6% five-year prosthetic survival rate due to prosthetic fractures (De Araújo Nobre et al., 2023).

With regard to biological parameters, marginal bone loss was generally low, with average values of approximately 0.40 ± 0.73 mm over three years (25) and 0.28 and 0.54 mm over five years (De Araújo Nobre et al., 2023). Furthermore, a randomized clinical trial demonstrated significant improvements in patients' masticatory capacity, with increases ranging from 15–31% to 65–71% after one year of rehabilitation (Montero et al., 2021). In a five-year CBCT radiographic evaluation of *All-on-4* mandibular prostheses, significant differences in vertical bone loss were observed between the different materials and techniques, with the group using PEEK-milled frameworks showing the greatest bone loss, while the metal group showed the least (Mourad et al., 2024). In contrast, in a three-year CBCT radiographic follow-up of maxillary *All-on-6* restorations with zygomatic implants, the group with PEEK CAD-CAM frameworks showed less bone loss compared to the group with titanium frameworks across various surfaces, including conventional anterior and zygomatic implants (Abouelhuda et al., 2025).

3.4. Adhesion interface and adhesive complications

Complications related to the interface between the *framework*, the coating material, and the prosthetic components emerged as one of the most consistent findings in the literature. Several clinical studies reported coating material adhesion failures ranging from 14.3% to 15.8% in initial follow-ups, reaching up to 28.6% of prostheses at five years (Maló et al., 2018; De Araújo Nobre et al., 2020). Similarly, loosening of prosthetic screws was observed at rates of approximately 6.1% at the prosthesis level, while comparative studies between metal and polymer frameworks reported rates of up to 12% for screw loosening and approximately 10% for fractures of the aesthetic coating (Kortam et al., 2022).

4. DISCUSSION AND CONCLUSIONS

This review examined a rapidly expanding field of research, with a notable increase in publications between 2022 and 2025. However, the rise in scientific output does not necessarily translate into clinical evidence, as most of the studies involve biomechanical or experimental research. In this context, recent literature appears to address a more complex conceptual issue than the simple evaluation of the material. The debate focused on determining whether PEEK or its derivatives function as prosthetic materials and on identifying under which conditions of design, prosthetic geometry, and cementation protocols they can offer predictable clinical performance.

The contrast between the biomechanical results and the clinical evidence is particularly noteworthy. FEA studies indicated that PEEK frameworks redistribute stresses within the implant/prosthesis assembly due to their lower elastic modulus. While rigid materials tend to concentrate loads within the framework itself, polymers exhibited greater structural deformation and transferred part of the stresses to the prosthetic screws, the implants, and, to a lesser extent, the peri-implant bone. This pattern has been observed in multiple loading scenarios and implant configurations (Dayan & Geckili, 2021; Lan & Su, 2025; Almjaddr & Saker, 2024; Shash et al., 2024; Mendes Tribst et al., 2022). However, these models have limitations, as they are based on computational simulations that do not fully replicate real clinical conditions.

Experimental studies bridge the gap between simulation and clinical practice by analyzing the physical properties and mechanical behavior of materials under controlled conditions. The available evidence showed that polymeric frameworks can offer advantages related to digital manufacturing and dimensional accuracy. For example, it has been reported that CAD-CAM-milled PEEK can exhibit favorable levels of marginal fit (Abou-Ayash et al., 2021). This supports its potential reproducibility in full-arch restorations. However, these benefits do not in themselves guarantee better long-term clinical outcomes. Studies on deformation and stress distribution showed that the mechanical behavior pattern of high-performance polymers differs significantly from that of traditional metallic or ceramic materials (Messias et al., 2025).

Within this group, PEEK belongs to the polyaryletherketone (PAEK) family of polymers, a category of high-performance thermoplastics. PEEK is the most widely used material in this family. However, other materials such as PEKK have modifications in their chemical structure that directly impact their behavior. Compared to PEEK, PEKK exhibited 80% greater compressive strength and a higher melting point, which increases the material's stiffness, thermal stability, and mechanical strength. In practical terms, this means that PEEK tends to behave like a more flexible material, while PEKK exhibits stiffer and more resistant behavior, more closely resembling the performance of traditional, harder materials (Jung et al., 2023). Further research is needed on this variant to determine whether it is a better option.

Furthermore, research on wear has shown that the performance of the prosthesis depends, to a large extent, on the compatibility between the framework, the material used for the coating, and the antagonist (Haji Bakr & Kazazoğlu, 2026). This material interaction explains why, clinically, the prosthetic coating is one of the main sources of technical complications. That is, the material chosen to be placed over the PEEK.

The clinical evidence revealed a relatively consistent pattern. Full-arch restorations using polymeric frameworks can achieve high implant survival rates and functional improvements when the treatment is performed properly (Maló et al., 2018; De Araújo Nobre et al., 2020; De Araújo Nobre et al., 2023). Nevertheless, it is important to note that there are few clinical follow-up studies, so it is not possible to generalize based on these studies, which are by the same author in a specific population. Furthermore, some studies have shown that clinical parameters

such as plaque, bleeding, and gingival inflammation increase over time, indicating that the performance of the restoration depends not only on the material but also on hygiene control and maintenance during clinical follow-up (Mourad et al., 2024).

On the other hand, in a five-year radiographic follow-up of mandibular All-on-4 restorations, greater vertical bone loss was observed in PEEK frameworks compared to metal structures, suggesting less favorable outcomes with this type of combination (Mourad et al., 2024). In contrast, another study on maxillary All-on-6 restorations with zygomatic implants reported less bone loss around the implants when PEEK frameworks were used compared to titanium ones (Abouelhuda et al., 2025).

On the other hand, the longevity of the prosthesis does not depend solely on the implants remaining in the mouth, but also on the occurrence of technical complications, primarily related to cementation. Various studies report recurring problems such as veneer adhesion failure, veneer fractures, and screw loosening (Kortam et al., 2022; Mendes Tribst et al., 2022; Yu et al., 2022; Almjaddr & Saker, 2024). This has important clinical implications, as the focus shifts from implant survival alone to include prosthesis maintenance, long-term occlusal control, and a more meticulous cementation protocol. Furthermore, because it is a less rigid material, PEEK tends to deform under load, which can contribute to screw loosening when the prosthesis is directly screw-retained.

Taken together, the biomechanical, experimental, and clinical evidence showed that the connection zone is the most critical point. Both computational models and clinical studies identify this area—where the screws and prosthetic cylinders are located—as the primary site of technical complications. This indicated that the selection of the framework material should not be evaluated in isolation, but rather in conjunction with other factors such as prosthetic design, cantilever length, coating material, and bonding protocols. In this regard, several studies agreed that reducing the cantilever and increasing the number of implants can decrease stresses on the most vulnerable components (Almjaddr & Saker, 2024; Cabbarova et al., 2026; Kilic & Caglar, 2025; Lan & Su, 2025; Shash et al., 2024; Mendes Tribst et al., 2022).

From a clinical perspective, the available evidence allowed for the formulation of several relevant recommendations. In All-on-X restorations using PEEK, it is essential to control design variables that influence stress distribution, such as cantilever length and implant configuration. Likewise, the selection of the abutment material and bonding protocols should be considered central elements of the treatment plan, given that the literature has shown that many technical complications originate from cementation. Due to the chemically inert nature of PEEK, direct bonding with resin cements is limited.

For this reason, it has been recommended to perform surface treatment via sandblasting to create micro-retentions, followed by physical retentions to the structure and the application of specific primers such as *Visiolink*, which contain acrylic monomers capable of modifying the polymer surface and improving bonding with resin

cements (Maló et al., 2018). Finally, treatment planning must include strategies for prosthetic maintenance and occlusal control, as the clinical success of these restorations depends on implant survival and the long-term mechanical stability of the prosthetic system.

In conclusion, the evidence suggests that polymeric frameworks (PEEK/PEKK) in full-arch restorations may be clinically viable and functionally beneficial, but their performance depends critically on the biomechanical design. Added to this are the bonding interface and the aesthetic veneer, where many complications arise. Given the recent increase in studies and the relative dominance of FEA, the field urgently needs more in vivo studies, ideally clinical trials and cohort studies, to translate theoretical biomechanics into clinical recommendations with greater certainty..

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