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Polyetheretherketone (PEEK) in Oral Rehabilitation of Sarcopenic Patients: A Muscle-Preserving Prosthodontic Approach

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Abstract

Sarcopenia, a progressive decline in skeletal muscle mass and function, has profound implications for oral health, reducing masticatory strength, adaptation to prostheses, and nutritional intake. Polyetheretherketone (PEEK) is a high-performance polymer with favourable biomechanical, biocompatible, and digital-workflow properties. Although PEEK is increasingly used in prosthodontics, its role in preserving or enhancing orofacial muscle function in sarcopenic patients has not been systematically explored. This manuscript reviews the advantages of PEEK over traditional materials, analyses its biomechanical relevance to sarcopenia, and proposes a clinical rationale for adopting PEEK as a therapeutic material in this context. The discussion evaluates current evidence of PEEK's application in dentures, frameworks, and implant prostheses, noting its potential to reduce muscular load, cushion occlusal forces, and improve patient comfort. Finally, this manuscript calls for targeted clinical trials focusing on sarcopenic populations to validate PEEK's long-term efficacy in mitigating oral frailty and promoting healthy aging.

Keywords: Geriatric dentistry, Sarcopenia, PEEK, Masticatory muscles.

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1. Introduction

The global demographic shift towards an aging population has elevated sarcopenia, a progressive loss of muscle mass and function [1]. While much attention has focused on limb musculature, orofacial muscles such as the masseter, temporalis, and tongue are equally susceptible, with sarcopenia impairing chewing efficiency, swallow safety, and prosthesis adaptation [2]. These impairments fuel a vicious cycle; poor oral function leads to a limited diet, malnutrition, and further muscle decline [3]. These functional consequences highlight the need to reconsider whether conventional prosthodontic materials adequately support the compromised oral musculature of sarcopenic patients.

Traditional prosthodontic materials such as cobalt-chromium alloys, titanium, and conventional acrylics were designed for durability, aesthetics, and cost-effectiveness, but not specifically to minimize biomechanical strain on weakened musculature. PEEK, a semi-crystalline, high-performance polymer, offers a compelling alternative. It combines low density, a modulus of elasticity closer to bone, excellent fatigue resistance, and compatibility with CAD/CAM technology [4-8]. Together, these attributes suggest that PEEK could reduce the muscular effort required by sarcopenic patients to stabilize and operate prostheses. Despite growing use in general prosthodontic applications, PEEK has not been specifically evaluated for its "muscle-preserving" potential in sarcopenic patients. Therefore, this narrative review provides an insight into the synthesis of PEEK's properties, clinical applications, and biomechanical advantages, culminating in a clinical rationale for its targeted use in sarcopenia-relevant oral rehabilitation.

2. Properties of PEEK material and prosthodontic advantages

PEEK is a thermoplastic from the polyaryletherketone family, known for its strength, chemical stability, and excellent biocompatibility [4]. Its low mass relative to metal frameworks can translate into reduced prosthesis weight and less demand on weakened orofacial musculature during handling and chewing, a practical advantage in sarcopenia where sustained stabilization is fatiguing [5].

The elastic modulus of PEEK is 8.3 GPa, which is closer to that of cortical bone than that of cobalt-chromium or titanium, promoting more physiologic distribution of load and potentially reducing peak stress at biological interfaces [6]. For sarcopenic patients, this can mean less compensatory muscle activity to control prosthesis micromovements during mastication.

PEEK is a white, radiolucent, tough polymer with outstanding thermal stability up to 335.8°C. It possesses one of the best biocompatibilities, is non-toxic, and resists hydrolysis. PEEK has a low affinity for plaque and is non-allergenic [9]. PEEK has a density of 1300 kg/m^3, a flexural modulus of 140–170 MPa, and a thermal conductivity of 0.29 W/mK. Steam, gamma, and ethylene oxide sterilization do not alter the mechanical characteristics of PEEK. PEEK has an elastic Young's modulus of 3–4 GPa. Young's modulus and tensile characteristics are similar to those of human dentin, enamel, and bone [10,11].

The fracture resistance of CAD-CAM milled PEEK fixed prosthesis is 2354 N. It is more resistant than zirconia (981-1331 N), aluminium (851 N), or lithium disilicate ceramic (950 N). Since PEEK can withstand high fracture loads, it is appropriate for designing a partial denture framework [11].

PEEK also demonstrates favourable fatigue behaviour and wear performance under repetitive loading [4,7]. Relative to brittle ceramics and very rigid metals, the slight resilience of PEEK can cushion occlusal impacts and dampen peak forces transmitted to residual ridges. In older adults with fragile mucosa or resorbed ridges, this resilience is clinically relevant.

From a digital dentistry perspective, PEEK is well-suited to CAD/CAM milling and can be polished to a high gloss, supporting accurate fit and hygiene maintenance [10]. Reported clinical applications include removable partial denture frameworks, complete denture bases, implant abutments, fixed dental prostheses, and overdenture bars. Reviews and case-based series consistently highlight PEEK's light weight, patient comfort, and acceptable mechanical performance as a framework material compared with conventional metals [12-14].

3. PEEK's relevance to Sarcopenia-related oral rehabilitation

Sarcopenic patients commonly present with reduced bite force, slower chewing cycles, and greater neuromuscular fatigue. They often struggle to adapt to prostheses that demand sustained stabilizing activity, precise retention, and low friction to minimize muscular effort [3].

PEEK's lightness reduces gravitational and functional burdens on weakened muscles, making prosthesis manipulation and day-long wear less taxing. Its bone-proximate modulus may improve sensory feedback and reduce micromotion, facilitating more natural masticatory patterns with lower perceived effort. Smooth, CAD/CAM-finished PEEK surfaces reduce friction during tongue and lip movements, aiding bolus manipulation and swallowing—tasks that become disproportionately difficult as orofacial strength and coordination decline. Precise, repeatable digital manufacturing also supports faster adaptation, particularly important for patients with limited neuromuscular reserve [15].

Although these mechanisms align with sarcopenic needs, specific trials in diagnosed sarcopenic cohorts are lacking. Evidence to date comes largely from general prosthodontic populations, finite-element analyses, and case-level or randomized data where muscle outcomes were not primary endpoints. Comparative and modelling studies in non-sarcopenic or mixed adult cohorts offer useful signals.

A randomized crossover clinical study comparing chewing with cobalt-chromium versus PEEK removable partial denture frameworks reported broadly similar bite force but indicated nuanced differences in chewing-related performance measures; importantly, the trial did not quantify muscular workload or fatigue variables central to sarcopenia [14].

A pilot randomized controlled crossover trial evaluating early oral-health-related quality of life found comparable or improved patient-reported

outcomes with PEEK frameworks in the short term versus cobalt-chromium, again without direct electromyographic endpoints [16].

Three-dimensional finite-element analyses suggest that PEEK frameworks can reduce peak stress on abutments and alter load distribution to mucosal support compared with cobalt-chromium or titanium designs, underscoring the need for considered design in distal-extension cases [17].

In full-arch implant-supported PEEK rehabilitations, a randomized clinical trial comparing immediate versus conventional loading reported improvements in patient-centred outcomes and included electromyography of the masseter to characterize neuromuscular behaviour after rehabilitation; while promising, the findings were not designed to show reduced muscular demand and did not enrol participants based on sarcopenia [18]. A study found that fixed PEEK hybrid prostheses enhance occlusal pattern, biting force, mastication, and improve Oral Health-related Quality of Life [19].

Collectively, these data indicate that PEEK frameworks are feasible and acceptable, with mechanical plausibility for gentler force transmission. However, direct evidence that PEEK reduces neuromuscular load or fatigue in sarcopenic patients remains an open question.

4. Discussion

Oral frailty is now widely acknowledged as a critical component of the broader physical frailty spectrum, but the specific intersection between sarcopenia and prosthodontics remains underexplored. Sarcopenic patients need denture frameworks and bases that respect limited muscular capacity, support efficient mastication, and minimize adaptive strain. PEEK's profile aligns well with these goals. PEEK is a useful, biocompatible material that shows good wear resistance, attracts less plaque, and bonds well with veneering composites and cements [20]. The main advantage of PEEK is that it has a lower Young's modulus and is as elastic as bone, which provides a cushioning effect and reduces the stress imparted to abutment teeth [9].

The material's light weight decreases the burden on the elevator and perioral musculature during speech and chewing, which can extend wear time and improve comfort. Its bone-proximate stiffness and fatigue resistance offer a middle path between overly rigid metals and more compliant polymers, potentially smoothing force peaks and protecting oral tissues when muscle control is inconsistent. It has good electrical and mechanical properties, which include resistance to high temperatures and hydrolysis [21]. Digital precision further reduces compensatory muscle activity triggered by rocking, edge pressure, or overextension.

A study compared PEEK and Nickel-Chromium as a post-core material. It was found that PEEK has a lower elastic modulus than root dentin and showed comparably high failure resistance and exhibited a favourable stress distribution at the intra-radicular, indicating a lower possibility of root fracture than conventional post-core materials [19]. According to Montero *et al*. a balance in muscle activity could be a sign that the masticatory system is functioning better, they found that fixed PEEK hybrid prostheses enhance occlusal pattern, biting force, and mastication and also following treatment with prostheses, patients felt they could chew more effectively, which led to increased satisfaction with chewing which aids in food intake and improved Oral Health-related Quality of Life [19].

PEEK can be used as a clasp in a cast partial denture; however, the retentive behaviour of PEEK clasps may be lower than cobalt-chromium equivalents, requiring thoughtful clasp design, reinforcement, or alternative retention strategies. Finite-element work suggests that in distal-extension designs, mucosal stress can increase if base geometry and support are not optimized, resilient liners and broadened stress-bearing areas may be prudent in fragile ridges.

Most importantly, dedicated evidence in sarcopenic populations is still missing. Future studies should treat neuromuscular endpoints as primary outcomes, integrating electromyography of the masseter and temporalis, tongue pressure, maximum voluntary bite force, standardized masticatory performance tests, fatigue scales, wear time, adjustment frequency, and nutritional measures. Design-level analyses should be paired with finite-element models reflecting low-force chewing profiles characteristic of sarcopenia, to clarify how PEEK's modulus and resilience interact with different occlusal schemes and support strategies. Until such data exist, the "muscle-preserving" hypothesis is biologically plausible but not yet proven in the target population.

However, only a few studies have evaluated PEEK material in clinical settings for CAD-CAM prosthesis.

Compared to traditional metal-ceramic or monolithic zirconia restorations, this material is less expensive and would be appropriate for patients with metal or acrylic allergies [19].

From a prosthodontic and geriatric oral rehabilitation perspective, PEEK can be positioned as a strategically relevant material for sarcopenic patients, not only because of its favourable mechanical and biological properties but also due to its potential compatibility with reduced neuromuscular reserve. Sarcopenia is characterized by progressive loss of muscle mass, strength, and endurance, which directly compromises masticatory efficiency, prosthesis tolerance, and ultimately nutritional intake. In this context, the lightweight nature of PEEK reduces functional load on weakened elevator and perioral muscles, while its bone-mimetic elasticity and fatigue resistance may help attenuate stress transmission to oral tissues during low-force, inconsistent chewing patterns typical of sarcopenic individuals. When fabricated using CAD–CAM technology, improved fit and stability may further limit compensatory muscle activity, enhancing comfort and wear time. Although existing evidence is largely derived from general prosthodontic applications rather than sarcopenia-specific populations, the convergence of oral frailty concepts, material biomechanics, and patient-reported functional outcomes supports the biological plausibility of PEEK as a muscle-preserving prosthodontic material. Its potential to positively influence functional performance, nutritional adequacy, and oral health–related quality of life across the geriatric population warrants targeted clinical investigation. Until such evidence is available, PEEK should be regarded as a promising, patient-centred alternative for oral rehabilitation in sarcopenic and frail elders rather than a routine replacement for conventional prosthodontic materials.

5. Conclusion

Sarcopenia presents distinct challenges for oral rehabilitation. Materials should not only restore form and function but also minimize neuromuscular demand on compromised orofacial systems. PEEK, a lightweight, bone-mimetic, digitally compatible polymer, offers a credible path toward that goal. Evidence from general prosthodontic cohorts suggests that PEEK frameworks are clinically acceptable and mechanically reasonable, with potential advantages in terms of comfort and load distribution. The question now is empirical: Does PEEK reduce muscular workload, fatigue, and functional decline compared with conventional materials when used in thoughtfully designed prostheses? Answering it will require targeted trials with neuromuscular and nutritional endpoints. If validated, PEEK could help reframe prosthodontic care for older adults by aligning material science with the functional realities of geriatric physiology.

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References

1. Larsson L, Degens H, Li M, Salviati L, Lee YI, Thompson W, Kirkland JL, Sandri M. Sarcopenia: aging-related loss of muscle mass and function. Physiol Rev. 2019;99(1):427-511. https://doi.org/10.1152/physrev.00061.2017
2. Umeki K, Watanabe Y, Hirano H, Edahiro A, Ohara Y, Yoshida H, Obuchi S, Kawai H, Murakami M, Takagi D, Ihara K. The relationship between masseter muscle thickness and appendicular skeletal muscle mass in Japanese community-dwelling elders: A cross-sectional study. Arch Gerontol Geriatr. 2018;78:18-22. https://doi.org/10.1016/j.archger.2018.05.014
3. Azzolino D, Passarelli PC, De Angelis P, Piccirillo GB, D'Addona A, Cesari M. Poor oral health as a determinant of malnutrition and sarcopenia. Nutrients. 2019;11(12):2898. https://doi.org/10.3390/nu11122898
4. Kurtz SM, Devine JN. PEEK biomaterials in trauma, orthopedic, and spinal implants. Biomater. 2007;28(32):4845–4869. https://doi.org/10.1016/j.biomaterials.2007.07.013
5. Ma R, Tang T. Current strategies to improve the bioactivity of PEEK. Int J Mol Sci. 2014;15(4):5426–5445. https://doi.org/10.3390/ijms15045426
6. Toth JM, Wang M, Estes BT, Scifert JL, Seim HB, Turner AS. Polyetheretherketone as a biomaterial for spinal applications. Biomater. 2006;27(3):324–334. https://doi.org/10.1016/j.biomaterials.2005.07.011
7. Sagomonyants KB, Jarman-Smith ML, Devine JN, Aronow MS, Gronowicz GA. PEEK polymers promote bone cell proliferation and differentiation in vitro. J Biomed Mater Res A. 2009;91(2):408–416. https://doi.org/10.1002/jbm.a.32229
8. Schwitalla A, Müller WD. PEEK dental implants: a review of the literature. J Oral Implantol. 2013;39(6):743–749. https://doi.org/10.1563/AAID-JOI-D-11-00002
9. Ashraf MC, Sujesh M, Ravikumar C, Rajanikanth A, Duggineni CR, Sunitha K. An overview of applications of PEEK polymer in prosthodontics. Int J Dent Mater. 2022;4(2):42-5. https://doi.org/10.37983/IJDM.2022.4204
10. Najeeb S, Zafar MS, Khurshid Z, Siddiqui F. Applications of polyetheretherketone (PEEK) in oral implantology and prosthodontics. J Prosthod Res 2016;60:12-9. https://doi.org/10.1016/j.jpor.2015.10.001
11. Stawarczyk B, Eichberger M, Uhrenbacher J, Wimmer T, Edelhoff D, Schmidlin PR. Three-unit reinforced polyetheretherketone composite FDPs: influence of fabrication method on load-bearing capacity and failure types. Dent Mater J. 2015;34(1):7-12. https://doi.org/10.4012/dmj.2013-345
12. Stawarczyk B, Jordan P, Schmidlin PR, Roos M, Eichberger M, Gernet W. PEEK surface treatment effects on tensile bond strength to veneering resins. J Prosthet Dent.

2014;112(5):1278–1288. https://doi.org/10.1016/j.prosdent.2014.05.014
13. Zoidis P, Papathanasiou I, Polyzois G. The use of PEEK in fixed and removable prosthodontics: A systematic review. Eur J Prosthodont Restor Dent. 2016;24(1):19–24.
14. Skirbutis G, Dzingutė A, Masiliūnaitė V, Šulcaitė G, Žilinskas J. PEEK polymer's properties and its use in prosthodontics. Stomatologija. 2017;19(1):19–23.
15. de Oliveira PHB, Ferreira GF, Gama LT, Carletti TM, Rodrigues Garcia RCM. Chewing with Co-Cr or PEEK denture frameworks: A randomized crossover clinical study. J Prosthodont. 2025;34(7):686-694. https://doi.org/10.1111/jopr.14039
16. Ali KA, Bateson SR, Jury RM, Ellakwa AF, Pearson GJ, Martin N. A pilot randomized controlled crossover trial comparing early OHRQoL outcomes of cobalt-chromium versus PEEK removable partial denture frameworks. J Dent. 2020;102:103473. https://doi.org/10.1016/j.jdent.2020.103473
17. Chen Y-T, Lee H-E, Lin C-L. A three-dimensional finite element analysis of mechanical function for four removable partial denture designs with three framework materials: Co-Cr, Ti-6Al-4V, and PEEK. Sci Rep. 2019;9:1336. https://doi.org/10.1038/s41598-019-50363-1
18. Montero J, Guadilla Y, Flores J, Pardal-Peláez B, Quispe-López N, Gómez-Polo C, Dib A. Patient-Centered Treatment Outcomes with Full-Arch PEEK Rehabilitation Supported on Four Immediate or Conventionally Loaded Implants. A Randomized Clinical Trial. J Clin Med. 2021 Oct 5;10(19):4589. https://doi.org/10.3390/jcm10194589
19. Montero J, Dib A, Guadilla Y, Flores J, Pardal-Peláez B, Quispe-López N, Gómez-Polo C. Functional and patient-centered treatment outcomes with mandibular overdentures retained by two immediate or conventionally loaded implants: A randomized clinical trial. Journal of Clinical Medicine. 2021 Aug 6;10(16):3477. https://doi.org/10.3390/jcm10163477
20. Pavan DSSV, Sampathi NLR, Reddy UN, Neshaneni SK, Medum SSK, Meenakshi CM. Evaluation of stress distribution in an endodontically treated tooth restored with two different post and core systems in a maxillary central incisor: A finite element analysis study. Int J Dent Mater. 2024;6(4):87-93. https://doi.org/10.37983/IJDM.2024.6402
21. Sreenivasulu D, Sowjanya JL. Exploring the Potential of PEEK in Prosthetic Dentistry: A Contemporary Perspective. Int J Dent Mater. 2024;6(2):41-4. https://doi.org/10.37983/IJDM.2024.6203