ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, S Iss 4 ,2022

Characteristics of Peek Polymer and Its Application in Dentistry: A Review

Akshay Bhargav[1]*, Puja Malhotra[2], Sumita Giri[3], Parvinder Kaur[4], Amit B Lall[5], Aruna Nautiyal[6]

[1] Professor & Dean, Department of Prosthodontics and Crown & Bridge, Santosh Dental College & Hospital, Santosh Deemed to be University, Ghaziabad, Delhi NCR, India

[2] Professor & HOD, Department of Prosthodontics and Crown & Bridge, Santosh Dental College & Hospital, Santosh Deemed to be University, Ghaziabad, Delhi NCR, India

[3] Professor & HOD, Department of Conservative Dentistry and Endodontics, Santosh Dental College & Hospital, Santosh Deemed to be University, Ghaziabad, Delhi NCR, India

[4] Professor, Department of Orthodontics and Dentofacial Orthopedics, Santosh Dental College & Hospital, Santosh Deemed to be University, Ghaziabad, Delhi NCR, India

[5] Professor & HOD, Department of Oral and Maxillofacial Surgery, Santosh Dental College & Hospital, Santosh Deemed to be University, Ghaziabad, Delhi NCR, India

[6] Senior Lecturer, Department of Periodontics and Oral Implantology, Santosh Dental College & Hospital, Santosh Deemed to be University, Ghaziabad, Delhi NCR, India

ABSTRACT:

The purpose of this study is to review polyether ether ketone (PEEK), its properties, and its application in prosthodontics. Information about PEEK and its use in prosthodontics was searched for in Medline using PubMed, Science Direct, Wiley Online Library, and Google Scholar sources. For this review, 10 full-text articles were chosen and utilised. 140 articles matching the keywords PEEK, prosthodontics, and dentistry were located in the database. Organizing the information on PEEK polymer compatibility by mechanical, chemical, physical, and PEEK surface preparation. PEEK polymer is appropriate for prosthodontic application. There aren't enough claims about difficulties, the growth of biofilm on PEEK surfaces, or its resistance to compression, though. To learn the outcomes, more study should be conducted.

Keywords*:* PEEK, Prosthodontics, Dentistry

INTRODUCTION:

By making materials better, dentistry can advance and technologies can flourish. Modern materials utilized in advanced dentistry must have properties close to dental structure, low plaque affinity, good aesthetics, and biocompatibility. It satisfies picky patients and aids in reconstructing tooth and dentition problems.

Dental cavities and periodontal issues increase due to poor oral hygiene and a lack of preventive. 60–90% of schoolchildren and nearly 100% of adults, according to World Health Organization (WHO) 2012 figures, have dental caries that, if left untreated, might destroy

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dental tissues (1). Fixed or detachable restorations can be used to treat dental flaws. It is advised to use products that have been scientifically approved as being safe for the optimal rehabilitation of masticatory function. This article examines the properties and applications of polyether ether ketone (PEEK), one of the newest dental materials.

PEEK is a stiff, radiolucent polymer that is white and has excellent heat stability up to 335.8° C. (2). It has a modest affinity for plaque and is not allergenic (3-5). PEEK has a thermal conductivity of 0.29 W/mK, a density of 1300 kg/m3, and a flexural modulus of 140–170 MPa (6, 7). Using steam, gamma radiation, and ethylene oxide throughout the sterilizing process, PEEK's mechanical characteristics remain unchanged (8). PEEK has the lowest solubility and water absorption values when compared to composite resin, poly methyl methacrylate (PMMA), and PEEK, according to in vitro studies by Lieberman et al. (9) Comparing PEEK to composite, ceramics, or zirconia, a more established dental material, it is crucial to identify and list its features. This review's objective is to assess PEEK polymer's application in dentistry.

MATERIAL AND METHODS:

The following databases were used in the literature search: Medline, PubMed, Science Direct, Wiley Online Library, and Google Scholar sources on the Internet. The abstracts and titles were examined. Other study subjects were mentioned in various databases while others were not appropriate for this review. Ten full text articles ultimately met the requirements for admission.

There were only English-language papers about dental prosthesis made of PEEK or modified PEEK included, regardless of the manufacturing processes, surface modifications, types of in vitro or in vivo experiments, or the genre of scientific studies (case reports, original researches, review articles). We excluded articles that did not deal with prosthodontics, were not written in English, or were older than seven years.

RESULTS:

PEEK, prosthodontics, and dentistry were used as keywords to find 140 articles in the database. Studies older than seven years were excluded. Read the titles and abstracts of 20 studies. For this review, ten full-text articles were chosen and used. The studies that were chosen were categorized into two groups based on the study's type: surface conditioning of PEEK using various adhesive systems and PEEK's characteristics and appropriateness in prosthodontics. The examination of the articles reveals PEEK's qualities and its use in prosthodontic care. Systematically collected data were used to evaluate various mechanical, chemical, and biological aspects. Information on how the shear bond strength of PEEK to oral tissues was evaluated utilizing different surface preparation and adhesive techniques.

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DISCUSSION

PEEK is a relatively novel substance in prosthodontics. PEEK is more aesthetically pleasing, stable, biocompatible, lighter, and has less discolouration than the metals used in dentistry (10,11). Patients with strict aesthetic standards will find it more alluring as a result. PEEK, however, is not appropriate for monolithic cosmetic restorations of anterior teeth due to its grayish-brown tint (12). To achieve an appealing finish, coating should be done using a more aesthetically pleasing substance, like composite. Many surface conditioning techniques for PEEK are suggested in the literature to enhance adhesion with resin composite crowns. While sulfuric acid etching produces a rough and chemically treated surface, air abrasion with or without silica coating yields a surface that is wettable (13). PEEK's low energy surface produces chemical processing resistance.

According to study by Hallmann et al., using Heliobond as an adhesive and abrading the PEEK surface with 50 m alumina particles, then etching it with piranha solution, produced the maximum tensile bond strength (14). However, using strong sulfuric acid in a therapeutic setting is risky.

PEEK has mechanical qualities that are comparable to those of enamel and dentin. It is hence preferable to ceramic restorations and metal alloys. The fracture resistance of PEEK fixed prosthesis machined by CAD-CAM is 2354N. It has more resistivity than zirconia (981-1331N), aluminum (851N), and lithium disilicate ceramic (950N) (15). Clinical information on PEEK's abrasion with other materials, such as metal alloys, ceramics, dentin, or enamel, is lacking. A 400 N force is cyclically applied to the teeth during mastication.

PEEK has a good fracture resistance but is mechanically somewhat weak in homogenic state. PEEK clasps had lower resistance forces than cobalt-chrome ones, according to in vitro studies by Tannous et al. (16).

PEEK is frequently combined with other materials nowadays, such as fibers, carbon, or ceramics. It is challenging to prepare the surface of PEEK in order to improve bond strength and bonding with composites because of its complex chemical structure and poor wetting properties. The surface of PEEK restorations must be coated with another substance, such as lithium disilicate or resin composites, for proper functionality.

Sadly, insufficient clinical research was conducted to demonstrate PEEK's superiority over other materials. Complications, biofilm growth on the PEEK surface, and its resistance to compression are yet not sufficiently covered. Even yet, PEEK is used to create dental implants, fixed restorations (17), detachable prostheses and their components (4), even maxillary obturator prostheses (18).

CONCLUSIONS:

PEEK is a beautiful contemporary material that can be used in prosthodontics. It is utilized to create both fixed and removably attached prostheses because of its advantageous chemical,

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mechanical, and physical qualities. However, as the majority of the studies have been conducted in vitro, further clinical research is required to understand the situation.

REFERENCE:

1. Ma R, Tang T. Current strategies to improve the bioactiv- ity of PEEK. *Int J Mol Sci* 2014;15:5426-45.
2. Monich PR, Berti FV, Porto LM, Henriques B, de Oliveira APN, Fredel MC, et al. Physicochemical and biological assessment of PEEK composites embedding natural amorphous silica fibers for biomedical applica- tions. *Mater Sci Eng C Mater Biol Appl* 2017;79:354-62.
3. Najeeb S, Zafar MS, Khurshid Z, Siddiqui F. Applica- tions of polyetheretherketone (PEEK) in oral implantol- ogy and prosthodontics. *J Prosthod Res* 2016;60:12-9.
4. Vaezi M, Yang S. A novel bioactive PEEK/HA composite with controlled 3D interconnected HA network. *Int J Bioprint* 2015;1:66-76.
5. Zoidis P, Papathanasiou I, Polyzois G. The Use of a modified poly ether ether ketone (PEEK) as an alternative framework material for removable dental prostheses. A clinical report. *J Prosthet Dent* 2015;25:580-84.
6. Xin H, Shepherd D, Dearn K. Strength of poly-ether- ether-ketone: effects of sterilisation and thermal ageing. *Polym Test* 2013;32:1001-5.
7. Sheiko N, Kekicheff P, Marie P, Schmutz M, Jacomine L, Perrin-Schmitt F. PEEK (polyether-ether-ketone)- coated nitinol wire: Film stability for biocompatibility applications. *Appl Surf Sci* 2016;389:651-65.
8. Schwitalla A, Muller WD. PEEK dental implants: a re- view of the literature. *J Oral Implantol* 2013;39:743-9.
9. Garcia-Gonzalez D, Rusinek A, Jankowiak T, Arias A. Mechanical impact behavior of polyether-ether-ketone (PEEK). *Compos Struct* 2015;124:88-99.
10. Kurtz SM. PEEK biomaterials handbook. William An- drew; 2011.
11. Zhou L, Qia Y, Zhu Y, Liu H, Gan K, Guo J. The effect of different surface treatments on the bond strength of PEEK composite materials. Dent Mater 2014;30: e209-15.
12. Liebermann A, Wimmer T, Schmidlin PR, Scherer H, Löffler P, Roos M, et al. Physicomechanical characteriza- tion of polyetheretherketone and current esthetic dental CAD/CAM polymers after aging in different storage media. J Prosthet Dent 2016;115:321-8.
13. Tannous F, Steiner M, Shahin R, Kern M. Retentive forces and fatigue resistance of thermoplastic resin clasps. Dent Mater 2012;28:273-8.
14. Hallmann L, Mehl A, Sereno N, Hämmerle CH. The improvement of adhesive properties of PEEK through different pre-treatments. Appl Surf Sci 2012;258;7213-8.

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, S Iss 4 ,2022

15. Stawarczyk B, Beuer F, Wimmer T, Jahn D, Sener B, Roos M, et al. Polyetheretherketone - a suitable material for fixed dental prostheses? J Biomed Mater Res B Appl Biomater 2013;101:1209-16.

16. Schmidlin PR, Stawarczyk B, Wieland M, Attin T, Hammerle CH, Fischer J. Effect of different surface pre- treatments and luting materials on shear bond strength to PEEK. Dent Mater J 2010;26:553-9.

17. Uhrenbacher J, Schmidlin PR, Keul C, Eichberger M, Roos M, Gernet W. The effect of surface modification on the retention strength of polyetheretherketone crowns adhesively bonded to dentin abutments. J Prosthet Dent 2014;112:1489-97.

18. 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;34:7-12.