TPM Vol. 32, No. S5, 2025
ISSN: 1972-6325
https://www.tpmap.org/

Open Access

PEEK-A-BOON: ROLE OF POLYETHER ETHER KETONE IN PAEDIATRIC DENTISTRY

MEDLYN MARISHA X[1], PONNUDURAI ARANGANNAL[2], JEEVARANTHAN J[3], JANANI VINODHINI[4], MADHUMITHA[5], RAMYA CHELLAMAL[6], ISHWARYA DHEVI G R[7], AARTHI SHREE M[8]

[1]POSTGRADUATE, DEPARTMENT OF PAEDODONTICS &PREVENTIVE DENTISTRY, SREE BALAJI DENTAL COLLEGE AND HOSPITAL, BIHER, PALLIKARANAI, CHENNAI
[2]MDS, PROFESSOR AND HEAD OF THE DEPARTMENT, DEPARTMENT OF PAEDODONTICS &PREVENTIVE DENTISTRY, SREE BALAJI DENTAL COLLEGE AND HOSPITAL, BIHER, PALLIKARANAI, CHENNAI.
[3]MDS, PROFESSOR, DEPARTMENT OF PAEDODONTICS &PREVENTIVE DENTISTRY, SREE BALAJI DENTAL COLLEGE AND HOSPITAL, BIHER, PALLIKARANAI, CHENNAI.
[4]READER, DEPARTMENT OF PAEDODONTICS &PREVENTIVE DENTISTRY, SREE BALAJI DENTAL COLLEGE AND HOSPITAL, BIHER, PALLIKARANAI, CHENNAI.
[5]SENIOR LECTURER, DEPARTMENT OF PAEDODONTICS &PREVENTIVE DENTISTRY, SREE BALAJI DENTAL COLLEGE AND HOSPITAL, BIHER, PALLIKARANAI, CHENNAI.
[6]SENIOR LECTURER, DEPARTMENT OF PAEDODONTICS &PREVENTIVE DENTISTRY, SREE BALAJI DENTAL COLLEGE AND HOSPITAL, BIHER, PALLIKARANAI, CHENNAI.
[7]SENIOR LECTURER, DEPARTMENT OF PAEDODONTICS &PREVENTIVE DENTISTRY, SREE BALAJI DENTAL COLLEGE AND HOSPITAL, BIHER, PALLIKARANAI, CHENNAI.
[8]SAVEETHA MEDICAL COLLEGE, SAVEETHA INSTITUTE OF MEDICAL AND TECHNICAL SCIENCES, SREE BALAJI DENTAL COLLEGE AND HOSPITAL, CHENNAI, INDIA

ABSTRACT
Polyether ether ketone is a high performing polymer gaining attraction in the field of dentistry. PEEK has exceptional properties, including biocompatibility, chemical resistance, and mechanical strength, make it an ideal choice for various dental applications like dental implants, removable dentures, fixed dentures, orthodontic wires etc. With the evolution of science and the advent of new technologies, PEEK is slowly paving way into pedodontics for the fabrication of crowns and space maintainers. This article explores the properties and applications of PEEK in paediatric dentistry.

Key words: PEEK, Polymer, Paediatric dentistry

INTRODUCTION

Polyether ether ketone is a semi crystalline thermoplastic polymer belonging to the family of poly aryl ether ketone. PEEK was developed in 1978 by a team of English researchers initially served industrial purposes in the 1980s, later transitioning to dental applications in 1992 (1). The chemical structure of PEEK consists of repeating units of three phenyl rings, two ester groups and one ketone group (2). The synthesis of Polyetheretherketone (PEEK) involves the condensation reaction between 4,4'-difluorobenzophenone and the disodium salt of hydroquinone in diphenyl sulphone or a similar polar solvent at 300°C, resulting in a thermoplastic with a melting point of 335°C (3). Polyetheretherketone (PEEK) exhibits a distinct set of characteristics, including high impact resistance and shock absorption, enhanced fracture toughness, effective stress distribution, and osseo-integrative capabilities. These attributes contribute to PEEK's expanding market presence in sectors requiring high-performance materials. It is highly biocompatible and does not cause any cytotoxic damage to the living cells thus making it an apt biomaterial (4). The mechanical property of PEEK also adds up to its advantages in the field of dentistry. This material exhibits exceptional strength, stability, and stiffness, while also withstanding elevated temperatures, making it an ideal substitute for metal. Additionally, it boasts outstanding wear resistance and a low friction coefficient (5). The polymer has an elastic modulus of 3-4 GPa which is closer to that of bone (6). Due to these incredible properties, the application of PEEK in paediatric and preventive dentistry has been greatly studied. This article highlights the role of PEEK polymer in paediatric and preventive dentistry.

PEEK CROWNS

The premature loss of aesthetically significant anterior teeth in paediatric patients can have profound psychological implications, potentially affecting self-esteem and personality development, emphasizing the importance of timely intervention (7). Conventional rehabilitation approaches for childhood tooth loss typically involved removable appliances with prosthetic teeth that were difficult for children to manage. Beretta et al reported 2 cases in which metal free PEEK crowns were used to replace missing deciduous teeth due to trauma and concluded that PEEK provides a comfortable and aesthetic solution for restoring smile and chewing function in children (8). PEEK polymer is highly compatible with reinforcing agents which further improved its characteristics like colour match, wear resistance and friction coefficient. A study by Arieira et al evaluated the tribological behaviour of SSC and TiO2 incorporated PEEK crowns which demonstrated that incorporation of TiO2 to PEEK can decrease the friction coefficient thus increasing the wear resistance of the crown (9).

PEEK SPACEMAINTAINERS

Following premature deciduous tooth loss, space retention for successor eruption is crucial in paediatric dentistry. Immediate space maintainer installation is recommended to prevent complications (10). Traditionally, orthodontic space maintainers have been the reliable solution. However, with PEEK's emergence in dentistry, its application in space maintainer fabrication has gained attention. PEEK based space maintainers demonstrated excellent space-maintenance capabilities, exhibiting stability and durability with no instances of dislodgment, fracture, or material failure. Additionally, no allergic reactions were reported in the study by Ierardo et al (11). Another comparative study demonstrated superior patient comfort and pain-free outcomes with CAD/CAM PEEK space maintainers compared to conventional band and loop appliances, which were associated with mild to moderate pain. Moreover, the digital scanning process, clinical procedure, and aesthetic qualities of PEEK maintainers were well-received by paediatric patients (12). The findings demonstrate a significant preference for PEEK space maintainers over traditional band and loop appliances, highlighting their enhanced acceptability.

PEEK IN PEDIATRIC ENDODONTICS

Effective endodontic treatment relies heavily on thorough irrigation with chemical agents, complemented by mechanical preparation, to navigate the complex root canal anatomy and ensure optimal results. The intracanal irrigants are chemical components that must be stored and used in a more appropriate manner to prevent complications. Biomaterials possess the ability to remain unchanged thus making it a suitable material (6). PEEK is one such chemically inert polymer. - PEEK's notable resistance to EDTA, CHX, and NaOCl, combined with its low water absorption and damping characteristics, supports its recommendation for long-term endodontic applications (13).

PEEK IN RESTORATIVE DENTISTRY

An ideal aesthetic restorative material exhibits translucency and a natural tooth-like shade. While PEEK has a white surface, some shading is necessary. However, its hydrophobic properties and low surface energy pose challenges for long-term adhesive bonding. Sulphuric acid etching generates a rough surface topography, facilitating enhanced bonding with moisture-repelling composites. Despite limitations, PEEK's future in restorative dentistry is promising, with surface modifications improving its adhesive capabilities (14).

CONCLUSION

Polyetheretherketone (PEEK) computer-aided design/computer-aided manufacturing (CAD/CAM) crown provide a viable and clinically superior option compared to conventional method. Modern intraoral scanning technology makes dental appointments adventure, enjoyable and stress-free for kids. Like any other material PEEK also has disadvantages. The shear bond strength is still a point of debate. Because it is digitally designed, it is costly. But with the evolution of technology and advancing research, we could expect PEEK to be a promising material in the future of pedodontics

REFERENCE

1. Kurtz SM, Devine JN. PEEK biomaterials in trauma, orthopedic, and spinal implants. Biomaterials. 2007 Nov 1;28(32):4845-69.
2. Qin L, Yao S, Zhao J, Zhou C, Oates TW, Weir MD, Wu J, Xu HH. Review on development and dental applications of polyetheretherketone-based biomaterials and restorations. Materials. 2021 Jan 15;14(2):408.
3. Staniland PA, Wilde CJ, Bottino FA, Di Pasquale G, Pollicino A, Recca A. Synthesis, characterization and study of the thermal properties of new polyarylene ethers. Polymer. 1992 Jan 1;33(9):1976-81.
4. Mrówka M, Machoczek T, Jureczko P, Joszko K, Gzik M, Wolański W, Wilk K. Mechanical, chemical, and processing properties of specimens manufactured from poly-ether-ether-ketone (PEEK) using 3D printing. Materials. 2021 May 21;14(11):2717.
5. Haleem A, Javaid M. Polyether ether ketone (PEEK) and its 3D printed implants applications in medical field: An overview. Clinical Epidemiology and Global Health. 2019 Dec 1;7(4):571-7.

6. Moharil S, Reche A, Durge K. Polyetheretherketone (PEEK) as a biomaterial: an overview. Cureus. 2023 Aug;15(8).
7. Kapur A, Chawla HS, Goyal A, Gaube K. An esthetic point of view in very young children. J Clin Pediatr Dent. 2005 Dec;30(2):99-103.
8. Beretta M, Federici Canova F, Gianolio A, Zaffarano L. Fully digital fixed orthodontic prosthesis: use of PEEK technopolymer in cases of early loss of primary incisors. Eur J Paediatr Dent. 2022Mar1;23(1):51-3.
9. Arieira A, Madeira S, Rodrigues F, Silva F. Tribological Behavior of TiO2 PEEK Composite and Stainless Steel for Pediatric Crowns. Materials. 2023 Mar 17;16(6):2420.
10. Khanna, Puja, Sangeeta Sunda, and Sunny Mittal. ""Keep My Space"-A Review Article. Int J Oral Health Dent.2015: 11-5.
11. Ierardo G, Luzzi V, Lesti M, Vozza I, Brugnoletti O, Polimeni A, Bossù M. Peek polymer in orthodontics: A pilot study on children. Journal of clinical and experimental dentistry. 2017 Oct;9(10):e1271.
12. AboulAzm NS, Sharaf AA, Dowidar KM, AbdelHakim AA. EFFECTIVENESS OF CAD/CAM PEEK FABRICATED SPACE MAINTAINER IN CHILDREN: A RANDOMIZED CONTROLLED CLINICAL TRIAL. Alexandria Dental Journal. 2023 Aug 1;48(2):1-8.
13. Kucher M, Dannemann M, Modler N, Hannig C, Weber MT. Effects of endodontic irrigants on material and surface properties of biocompatible thermoplastics. Dentistry journal. 2019 Mar 6;7(1):26.
14. AC CR, Chaves ET, Susin AH, Valandro LF, Pereira GK, Rippe MP. Surface Treatments and Adhesives Used to Increase the Bond Strength Between Polyetheretherketone and Resin-based Dental Materials: A Scoping Review. The Journal of Adhesive Dentistry. 2022 May 1;24(1):233-45.