# POLYETHER-ETHER-KETONE (PEEK) WITH REINFORCED, EFFICACY OF MATERIALS AND ITS APPLICATIONS IN PROSTHODONTICS: A REVIEW

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**Abstract**
Polyetheretherketone (PEEK), meets all the requirements and has proven its versatility in a very short period of time, over the last developed premises. PEEK CAD-CAM software is widely used in the preparation of dental implants, abutments, implant-supported sticks, removable dentures, clamping and non-removable dentures. Look at materials that have high mechanical characteristics, for example. Also, non-allergenic materials and down, proximity to plaque. This article discusses the dental material, its properties and application during teeth-prosthetics.
**Key Words**: PEEK, modification of peek, Bio-HPP.

## INTRODUCTION

PEEK is a member of the family, poly-aryl-ether-ketones (PAEK).Poly-ether-ketone (PEEK) is a high-temperature thermoplastik material. It has three consecutive viscosity classes (high, medium and low) based on the basic formula: (C6 H4 OC6 H4-O-O-C6 H4-CO -) n. It has very high mechanical strength, due to its aromatic chain, ring structure, extremely slow, hence their strong resistance to chemical erosion. See how to withstand high temperature1. It can be sterilized by radiation and heat, from 2 to 5 years. It is accepted that the materials are available, and a great substitute for leg and applied medical science in the field of artificial skull, tiles, components, finger and knee joints, and spine implants. The aesthetic properties are also excellent.

## PEEK HISTORY[7]

The SWING was designed in 1978. It is a semi-crystalline linear polycyclic aromatic polymer. It was first commercialized in the 1980s for industrial applications in the industry and as aircraft, turbine blades etc. In 1992 were incorporated into the dental office.

## PEEK PROPERTIES

1. Semi-crystalline with a melting point of about 335 °[8]
2. The modulus of elasticity (3-4 GPa) is close to the human cortical bone.[10]
3. In hot weather up to 335.8° C9.[3]
4. Radio transparency.[3]
5. Radiation resistance.[3]
6. Wear resistance.[10,11]
7. Biocompatibility and non-toxicity.[10,11]
8. According to different reinforcing agents, such as glass and carbon fiber.[11]

## MODIFICATION OF PEEK DENTAL IMPLANTS

### 1. NANO STRUCTURED SURFACES [13]

Nano-GAP Spin Coverage

- Plasma Gas Processing (O2 / Ar/Nh4)
- Plasma-electron-beam deposition
- Plasma immersion ion implantation

### 2. BIOACTIVE NANOCOMPOSITES [13]

• TIO2/PEEK
• MOPCKOЙ/PEEKUSES OF PEEK[9,10,11]

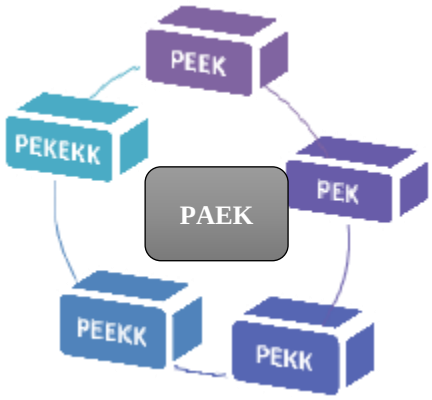


Fig 1: Family Structure of Poly-ether-ether-ketone.

Fig 2: Chemical Structure of Poly-ether-ether-ketone.

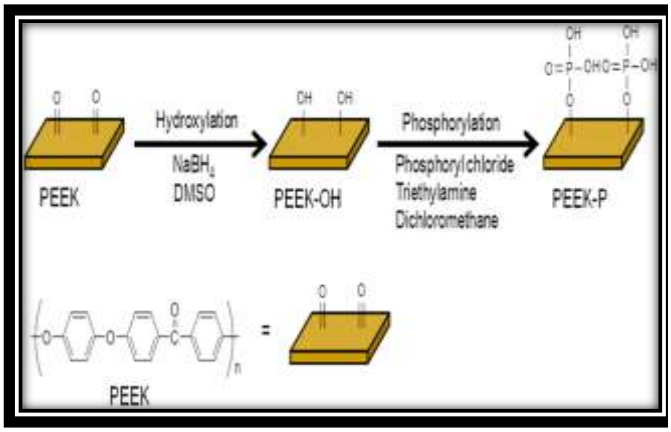


Fig 3: Properties of Poly-ether-ether-ketone**.**

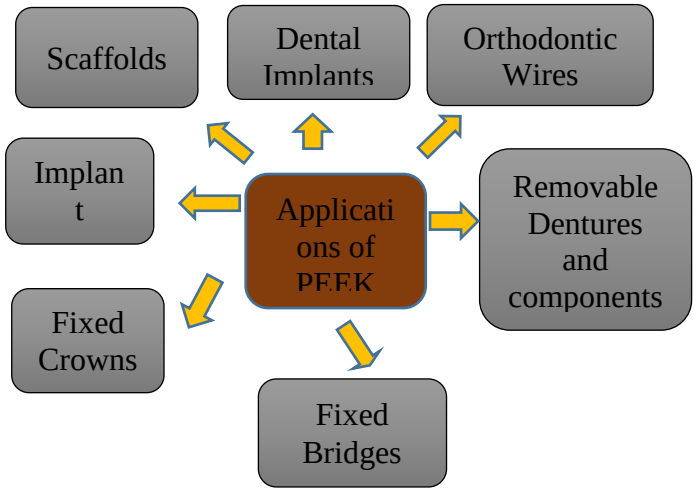


Fig 4: Uses of Poly-ether-ether-ketone.

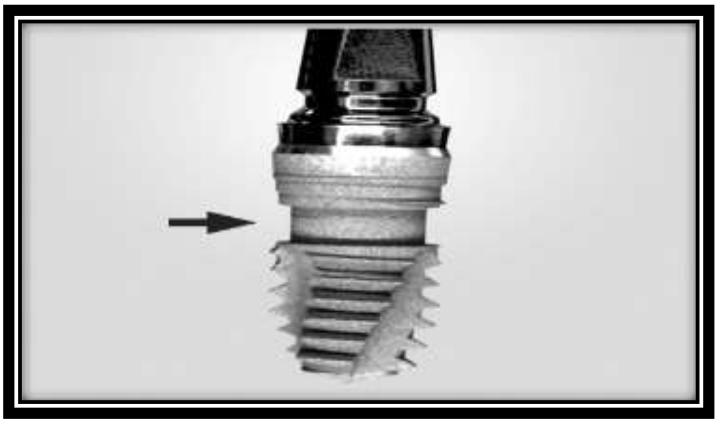

Fig 5: Implant design (grit-blasted/ acid –etched surface). But received 4 different surface coatings performed in the indentation placed 2.3mm from top of the implant with 0.18 mm depth and 1.5 mm height (arrow).

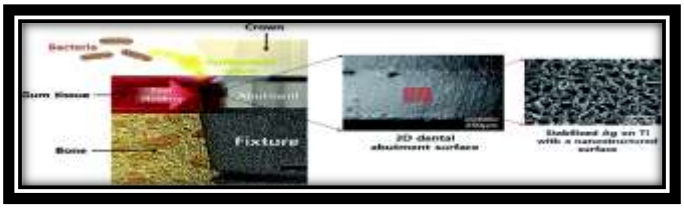


Fig 6: Bio-active PEEK implant.

## PEEK AS AN IMPLANT MATERIAL

PEEK was introduced in 1992, the first method for aesthetic abutments and implants.15 most durable materials to replace missing teeth. This was a great advantage for the property of LOOKING for a material like a dental implant: its low Young's modulus (elasticity) (3-4 GPa) is close to human bone (14 GPa), while the elastic modulus of titanium is close (102 - 110 GPa).[10,1] It has the ability to create, positive, liberating effects of stress. On the contrary, titanium has a very limited number of inherent bone-conducting properties.

## BIO-VZGLYAD NANOCOMPOSITES OF DENTAL IMPLANTS

To increase the bioactivity of the material, integrate with bio-inorganic-based methods, using melt mixing and compression. You can use Nano-Hydroxyapatite, Nano-Hydroxyfluorapatite, and Nano-Titanium Oxide particles.

## PEEK AS DENTAL IMPLANT ABUTMENTS

Unmodified PEEK is used as a provisional abutment, as this material has been shown to reduce the risk of possible stress around the implant.[1] but it is not used as

the final distance material, because its fracture resistance is lower than that of titanium.[18] and now ceramics that PEEK (Bio-HPP) is used as a permanent support based on the advantages it offers.[20]

**PEEK AS REMOVABLE PARTIAL DENTURE**

The mechanical and physical properties of recently developed polymers, such as the aryl-ketone polymers, are similar to those of bone and dentin.[9]

**ADVANTAGES OF PEEK RPD**

1. High biocompatibility, Good mechanical properties, High temperature resistance, Chemical stability [3,8,9]

2. Mainly 4 - (HPa) modulus of elasticity of the skin, it is as elastic as the bone, and can reduce the tension issued by the supporting teeth.
3. The restraining force of cinema and clasps may be a cause for concern. Locks Take a PEEK provides not very tenacious metal locks. But the law is designed to be viewed with a 0.5 mm slash buckle that provides sufficient care for clinical use.
4. Bio-HPP -team is not destructive to enamel and Chinese repair materials, very ordinary Cr-Co-team.[23,24] and Buckles made by Bio-a very sincere person, which will lead to a healthy periodontium and, in particular, in this case part of the conclusion, in the lower part of its proximity to the plaque function. [24]

**PEEK IN FIXED PARTIAL DENTURES (FPD)**

Vacuum press and CAD-CAM, there are two ways to recycle a look at the operation of the FPD[25]. Take a look and granulate for the last two methods used here for long-dimensional FPDs, which finally represents a layer of nanocomposite materials.[2] veneering should be done based on their low translucency and it comes down to the leather. It can still be the full path. [26]

**METHODS FOR REINFORCEMENT OF PEEK MATERIAL**

PEEK is a very low modulus of elasticity compared to the set you have with cortical bone shapes and ceramic materials. On-the-go high tensile strength, essential materials for dental implants, especially those used for abutments and padding.[28]

- Carbon-reinforced PEEK hose for this garden (CFR-PEEK)[29]
- Glass fiber that is PEEKABLE (GFR-PEEK)[28]
- Ceramic-reinforced PEEK (Bio IN)[27]
- Hydroxyapatite-enhanced PEEK [30]
- Нано-TiO2/PEEK (n)-TiO2/PEEK)[31]
- Nano-fluoroapatite TWO n FS/PEEK)[32]

**CONCLUSION**

The following are promising polymer-based materials that can replace metal and ceramic materials in dentistry. In studies, it has been shown to work well as dental implants and enhances osseo-integration.
It can also be used as dental implants, abutments and removable partial denture frames. Its grayish color, it still needs to be veneered with composite resin and when used as teeth and bridges. Excellent physical, mechanical, aesthetic qualities and dental biomaterials, if you consider that this is still a new material. Look at the polymers of the earth. Particles that cause an unfavorable biological reaction of the material. Use different types of look in medical and dental equipment, includes spacers, cannot be dental prostheses and removable, partially framed dentures, including precisely, attachments. When it comes to versatility, there should be more research.

**CONFLICTS OF INTEREST**

The authors state that they have no conflict of interest related to this article.

**REFERENCES**

1. Yang J, Tyberg CS, Gibson HW. Synthesis of aromatic polyketones via soluble precursors derived from bis (α-amino nitrile) s. Macromolecules 1999; 32:8259-8268.

2. Rust-Dawicki, A.M.; Cook, S.D. Preliminary evaluation of titanium-coated PEEK implants. J. Oral Implantol.**1995**, 21, 75–77.

3. Kurtz SM, Devine JN. PEEK biomaterials in trauma, orthopaedic and Spinal implants. Biomaterials 2007;28:4845-4869.

4. Toth JM, Wang M, Estes BT, Scifert JL, Seim HB 3rd, Turner AS. Polyetheretherketone as a biomaterial for spinal applications. Biomaterials 2006; 27:324- 334.

5. Tetelman ED, Babbush CA. A new transitional abutment for immediate aesthetics and function. Implant Dent 2008; 17:51-58.

6. 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.

7. Semadeni M., *Process Development and Materials Optimisation of Injection Moulded*

*Anisotropic(CF/PEEK) Hip Joint Endoprosthesis Stems*. PhDThesis, ETH No 13177, submitted to the SwissFederal Institute of Technology, Zurich. 1999.

8. 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 fi bers for biomedical applications. Mater SciEng C Mater BiolAppl 2017;79:354-62.

9. Najeeb S, Zafar MS, Khurshid Z, Siddiqui F. Applications of polyetheretherketone (PEEK) in oral implantology and prosthodontics. J Prosthod Res 2016; 60:12-9.
10. Xin H, Shepherd D, Dearn K. Strength of poly-etherether- ketone: effects of sterilisation and thermal ageing. Polym Test 2013; 32:1001-5.

11. Kurtz SM. PEEK biomaterials handbook. William Andrew; 2011. 16. 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:e209-151415

12. Santing HJ, Meijer HJ, Raghoebar GM, Ozcan M. Fracture strength and failure mode of maxillary implant supported provisional single crowns: a comparison of composite resin crowns fabricated directly over PEEK Abutments and solid titanium abutments. Clin Implant Dent Relat Res 2012; 14:882- 889

13. Bonding of the Polymer Polyetheretherketone (PEEK) to Human Dentin: Effect of Surface Treatments Brazilian Dental Journal (2016) 27(6): 693-699

14. Stawarczyk B, Bahr N, Beuer F, Wimmer T, Eichberger M, GernetW,et al.. Influence of plasma pretreatment on shear bond strength ofself-adhesive resin cements to polyetheretherketone. Clin Oral Investig2014;18:163-170.

15. Bayer S, Komor N, Kramer A, Albrecht D, Mericske-Stern R, Enkling N. Retention force of plastic clips on implant bars: a randomized controlled trial. Clin Oral Implants Res 2012; 23:1377-1384.

16. Tannous F, Steiner M, Shahin R, Kern M. Retentive forces and fatigue resistance of thermoplastic resin clasps. Dent Mater 2012; 28:273-278.

17. Uhrenbacher J, Schmidlin PR, Keul C, Eichberger M, Roos M, GernetW,et al.. The effect of surface modification on the retention strength of polyetheretherketone crowns adhesively bonded to dentin abutments.JProsthet Dent 2014; 112:1489- 1497.

18. 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 ApplBiomater 2013;101:1209-1216.

19. Behr et al. 2001, Clinical Oral Implants Research 12:174-178.

20. Stawarczyk B, Jordan P, Schmidlin PR, Roos M, Eichberger M, Gernet W, et al.. PEEK surface treatment effects on tensile bond strength to veneering resins. J Prosthet Dent 2014; 112:1278-1288.

21. Lapa VMC. Optimizacao da maquinagem do PEEK e seuscompositos PEEK/CF30 e PEEK/GF30. (Tese). Aveiro (BaixoVouga): Universidade de Aveiro. 2008.

22. Mata F, Gaitonde VN, Karnik SR, Davim JP. Influence of cutting conditions on machinability aspects of PEEK, PEEK CF 30 and PEEK GF 30 composites using PCD tools. J Mater Process Technol 2008; 209:1980–1987.

23. HANCU, V., COMANEANU, R.M., COMAN, C., FILIPESCU, A.G.,GHERGIC, D.L., COTRUT, M.C., In vitro Studies Regarding the Corrosion Resistance of NiCr and CoCr Types Dental Alloys, Rev. Chim. (Bucharest), **65**, no. 6, 2014, p. 706

24. ARDELEAN, L., BORTUN C., MOTOC, M., Metal-free removable partial dentures made of a thermoplastic acetal resin and two polyamide resins, Mat. Plast., **44**, no. 4, 2007, 345-348
25. KOLBECK C, ROSENTRITT M. Munich: Int. Sky-Meeting, 2012

26. VOSSHANS J, SCHELHOVE M, SCHNIEDER F, BioHPP - A metal-free material for prosthetic restorations, Zahntech. Mag., 17, 3, 138– 143 (2013)

27. EDWIN SEVER BECHIR1, ANAMARIA BECHIR2, CHERANA GIOGA2*, ROXANA MANU2, ALEXANDRU BURCEA2,IONELA TEODORA DASCALU3The Advantages of BioHPP Polymer as SuperstructureMaterial in Oral ImplantologyMATERIALE PLASTICE 53No.32016)

28. Lee, W.T.; Koak, J.Y.; Lim, Y.J.; Kim, S.K.; Kwon, H.B.; Kim, M.J. Stress shielding and fatigue limits of poly-ether-ether-ketone dental implants. J. Biomed. Mater. Res. B Appl. Biomater. **2012**, 100, 1044–1052.

29. Green S, Schlegel J. A polyarylketone biomaterial for use in medical Implant applications. Retrieved online June 26, 2014

30. Wu, X.; Liu, X.;Wei, J.; Ma, J.; Deng, F.;Wei, S. Nano-TiO2/PEEK bioactive composite as a bone

substitute material: In vitro and in vivo studies. Int. J. Nanomed. **2012**, 7, 1215–1225.

31. Wang, L.; He, S.; Wu, X.; Liang, S.; Mu, Z.; Wei, J.; Deng, F.; Deng, Y.; Wei, S. Polyether ether ketone-nanofluoro hydroxyapatite composite with antimicrobial activity and osseointegration properties. Biomaterials **2014**, 35, 6758–6775.

32. Schwitalla, A.D.; Emara, M.A.; Spintig, T.; Lackmann, J.; Müller, W.D. Finite element analysis of the biomechanical effects of PEEK dental implants on the peri-implant bone. J. Biomech. **2015**, 48, 1–7.

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