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RESEARCH ARTICLE

THE PLACE OF PEEK IN DENTISTRY AND IMPLANTOLOGY: *A.MOUHIBI, A.CHAFII, A. ANDOH* PROSTHODONTIC-OCCLUSODONTIE DEPARTEMENT-CCTD- CH CASABLANCA

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ABSTRACT

The PEEK Medical Polyetheretherketone is a high performance polymer. The materials in this group combine excellent mechanical properties with the highest biological compatibility. PEEK is used in aircraft construction for heavy parts and for medical applications. He has experienced an evolution in the field, especially for the manufacture of dental prosthesis frameworks. The elasticity of the material that is the same as the bone tissue makes it similar to nature since it can compensate for bone torsion, especially in the presence of major implantation work. He replaced titanium because of its properties and qualities. This work to demystify this material in its advantages and limitations as well as its place in the current dentistry.

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INTRODUCTION

PEEK Medical Polyetheretherketone is a high performance polymer. The materials in this group combine excellent mechanical properties with the highest biological compatibility. PEEK is also used in aircraft construction for heavy parts and for medical applications. It has experienced an evolution in the dental field, especially for the manufacture of dental prosthesis frameworks. The elasticity of the material, which is similar to that of bone tissue, makes it a material similar to nature since it can compensate for bone torsion, especially in case of major implantation work. It replaced titanium because of its properties and qualities. This work aims to demystify this material by demonstrating its advantages and limitations as well as its place in current dentistry.

Definition

PEEK appears in the medical literature as a non-metallic alternative to Titanium. It has mechanical properties close to those of the bone that allow it to be perfectly integrated on a biological level. Nevertheless, PEEK biointeresis is the main limitation of this material. Surface treatment or hybridization (PEEK-ceramics and CFR-PEEK) overcome this problem by giving it a bioactive character 1.

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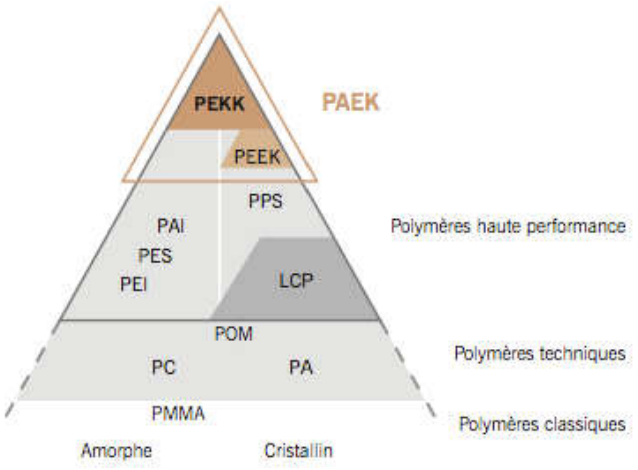


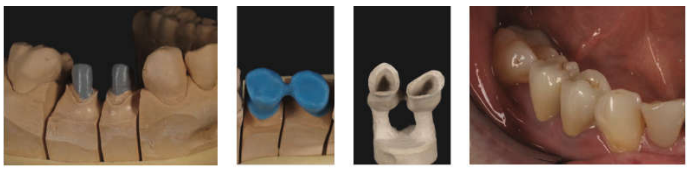
Fig. 1. The high performance polymerisat the top of the quality pyramid2

PolyEtherEtherKétone admits for acronymPEEK, or Oxy-1,4-Phenylene-Oxy-1,4-Phenyl-Carbonyl-1,4-Phenylene. Polyetheretherketone or Oxy-1,4-Phenylene-Oxy-1,4-Phenomenon-Carbonyl-1,4-Phenylene is a ketone belonging to the family of PolyArylEtherKetones (PAEK). PAEKs also include PolyEtherketone (PEK), PolyEtherketone Ketone (PEKK), Poly Ether Ether Ketone Ketone (PEEKK), and PolyEtherketone Etherketone-Ketone (PEKEKK). This family of semi-crystalline thermoplastic materials includes composite materials consisting of a series of very stable phenyl compounds and aromatic rings joined by an oxygen atom: the

Ether group, expressed as ROR and the ketone group, R-CO-R, R representing the carbon chain. PEEK, synthetic polymer, appears under the flat semi-developed formula (-C6H4-O-C6H4-O-C6H4-CO-) n, where n is the repetition number of the motif2. High performance polymers (PHP) are high quality plastics: they have better thermal and chemical stability as well as better mechanical properties than commodity plastics. But generalythey are manufactured in smaller quantities and cost more. The family of PHP who has entered the dental sector is called polyaryletherketones (PAEK). This family has several members with various chemical structures. In the dental sector, many of us have been involuntarily acquainted with the member of this family called PEEK (polyetheretherketone), because it is used in healing caps, temporary abutments and scan equipment. But PEAKs have attracted so much attention lately because of the possibility of using them as an alternative to metal in a wider range of indications such as Removable Dentures and Implanted Prostheses 3.

PEEK in prosthesis

The use of Pekkton® ivory as framworkmaterial resulted in a frank reduction of the mechanical stresses on the framwork while the stresses on the coating increased. The changes in mechanical behavior of the bridge had no influence on the loading of the surrounding hard and soft tissuesT



A 60-year-old female patient who has chosen Pekktonivoryrestorations for theirshockabsorbency, we are in the presence of a completeantagonist bridge. Fig2

Fig. 2. The laboratory stages until the mouthing (Mode d'emploi, 2013)

more particularly to that of the trabecular bone estimated at 1 GPa.

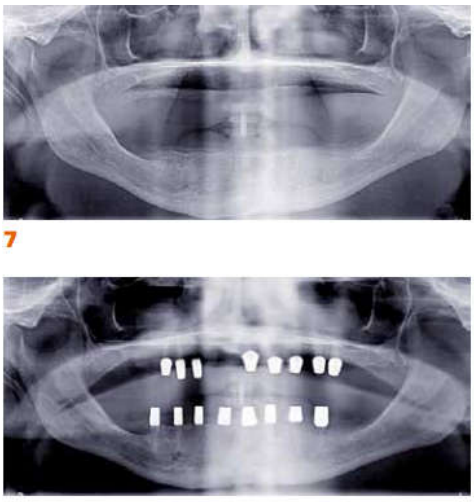


Fig 3. Total toothless patient: X-ray, Fig. 4. Implementationproject

Fig 6. Implant retro alveolar (Le matériau, 2015)

Thickness of frame material

Tableau 1. Thickness of the frame materialaccording to the situation (Mode d'emploi, 2013)

Sealing :

Sealing mode	Classical CVI	self adhesive	adhesive
Stump	Stumplengh>4mm Angle of préparation :4''- 8''	Stumplengh>4mm Angle of préparation : 4''-8''	Stumplengh< 4mm Angle of préparation : >8mm

PEEK in Implantology:

Tableau 2. Parameter of the moigondepending on the nature of the product (Mode d'emploi, 2013)

PekktonIvory	crown anterior tooth	Posteriortooth	anteriortooth bridge	Posteriortooth
Modelage type	Based on the shape of the tooth	Based on cusps	Based on the shape of the tooth	Based on cusps
minimum thickness of the circularwall	> 0,6mm	> 0,6mm	> 0,6mm	> 0,6mm
minimal thickness of the occlusal wall	> 0,8mm	> 0,8mm	> 0,8mm	> 0,8mm
section of the connectingelement	-	-	> 12mm^2	> 14mm^2

PEEK in Implantology

Just like the bone that incorporates an organic phase and a mineral phase, PEEK is a composite material (crystalline phases included in a rubbery amorphous matrix). Its modulus of elasticity (3 to 4 GPa, against 110 GPa for Titanium) is closely related to that of the cortical bone which is 20 GPa, and Its low modulus of elasticity gives it a moderate rigidity, favorable to the bone because it does not exert any notable stress on the latter 15,18. This parameter allows a good integration of the PEEK implantby the bone, due to a better distribution of the stresses exerted during the solicitation of the implant. Thus the PEEK abstains from the phenomenon of stress shielding reproached to Titanium and Zirconia. The

clinical experience of the material is more of its use in other medical fields than in dentistry, its use being widespread and confirmed with a significant clinicalexperience in medical branches such as orthopedics and trauma. Studies indicate that this polymer has been used for nearly 30 years in orthopedic and traumatological surgery, and attest to a very successful clinical follow-up and level of success (Nandi and Biswas, 2013; Knebel, 2010; Morrison *et al*., 1995; Cho *et al*., 2002; Horák *et al*., 2010; Schwitalla and Müller, 2013; Li *et al*., 2015). However, its application to the dental field is relatively recent; as a result, there are only a small number of studies on the subject and a relatively small clinical follow-up 5, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21.22. Nevertheless, its proven value in other areas, medical and non-medical, has left us predicting that PEEK could prove to be a significant alternative to Titanium in dental implantology as well. The clinical decline of the material is more related to its use in other medical fields than in dentistry, its use being widespread and confirmed with a significant decline in medical branches such as orthopedics and traumatology. Seven Somestudies indicate that this polymer has been used for nearly 30 years in orthopedic and traumatological surgery, and attest of a clinical experience and a very satisfactory level of success 5,6,7,8 9,10,22. However, its application to the dental field is relatively recent; as a result there is only a small number of studies on the subject and a relatively low clinical follow-up 5, 9 10, 10, 11, 12, 13, 14 15, 16, 17, 18, 19, 20, 21.22. Nevertheless, its proven value in other areas, medical and non-medical, has left us predicting that PEEK could be a significant alternative to Titanium in dental implantology as well.

Conclusion

High performance polymers PEEK and PEKK have interestingpotential in dentistry for the replacement of metal in removable infrastructure and implant Suprastructure. Theirproperties in terms of rigidity are promising for creation infrastructure thatcouldaddadditionalproperty of absorption of shocks. This can have advantages for the comfort of patients, improving the parafunction and to limit the damage. Increasingly used by prosthetic laboratories, the use of Peek in implantology remains rare. Nevertheless, this material has few advantages thatstilllittlediscussedso far addressed to date in implantology. Indeed, the modulus of elasticity of the Peek is four times lower than that of titanium's one. A stress generated on the bone by a titanium implant, following its activation, will be all the more traumatic. Placing the PEEk implant requires an impaction technique that the practitioner must master.

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