

Advantages of PEEK Dental Prosthetic Frameworks over Metal

A Clinical Case Review

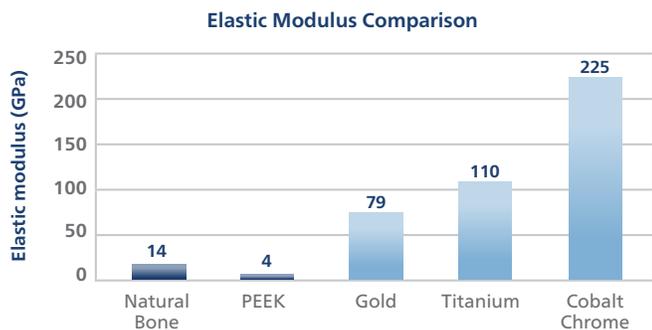
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Since 1978, Polyetheretherketone (PEEK) high performance polymer has been a dependable metal alternative across many industries. For medical applications, PEEK is valued for its strength, corrosion resistance, radiolucency and bone-like modulus of elasticity. InVibio Biomaterial Solutions pioneered many of the medical market applications with PEEK-OPTIMA™, a proven medical-grade polymer that has been used in approximately nine million implanted devices worldwide.

The dental industry has taken note. First used in temporary abutments and healing caps, PEEK-OPTIMA polymer usage has been extended to other dental applications including long-term fixed and removable prosthetic frameworks via the JUVORA™ dental disc.

The Benefits of PEEK (PAEK) Prosthetic Frameworks

The high-performance polymer offers several mechanical benefits over metal frameworks – namely, a more favorable strength-to-weight ratio and the potential for shock absorption¹ (Ref. Figure 1). Metal prosthetics are naturally stronger and exhibit higher compressive strengths than PEEK, however resilience and patient comfort are also clinically significant.²



Rho, JY (1993). "Young's modulus of trabecular and cortical bone material". Journal of Biomechanics 26 (2): 111-119.

Figure 1: PEEK has a bone-like elastic modulus of 4-5GPa, considerably less stiff than metal. As a result, PEEK prosthetic frameworks provide the potential for added shock absorption.³

Just as the physical properties of PEEK are attractive, so is its flexibility in fabrication. CAD/CAM PEEK milling has been used as an alternative to injection-molding since 2012. CAD/CAM milled implant prosthetics are fabricated more quickly, and in a reproducible, highly precise, lower cost fabrication process without compromising material composition, shape or quality.⁴



JUVORA Dental Disc

Made from PEEK-OPTIMA, a high performance polymer solution for long-term¹ fixed and removable prosthetic frameworks, provides 26x more shock absorption³ than titanium for superior comfort.

PEEK Case Studies

Professor Paul Tipton and Dr Bernd Siewert have practiced, taught and authored papers on dental implants and prosthetics for 60-plus years combined. They have experienced considerable success using non-metal, PEEK high performance polymers in fixed and removable prosthetics.

Tipton and Siewert have conducted case studies to test PEEK fabrication methods, CAD/CAM milling versus traditional injection-molding pressing, and their effects on material structure and long-term clinical reliability. They have also tested PEEK's clinical outcomes in patients with bruxism and as long-term, complex and semi-removable prosthetic frameworks. The following summarizes two published case studies.

Professor Paul Tipton, BDS MSc DGDP RCS

is an internationally renowned Prosthodontic Specialist. Now Professor of Restorative and Cosmetic Dentistry at the City of London Dental School, he has over 30 years experience in private practice, founded Tipton Training, Ltd. dental training academy, and has authored over 100 scientific articles.⁵

Dr Bernd Siewert has been in private practice for over 20 years. Since 2007, he's been an instructor at Germany's International Training Center for Dental Implantology (IFZI), and authored and spoken internationally about his speciality, implantology.⁶

Case 1⁴

A 55-year-old female presented with severe bruxism and heavily damaged bar-supported overdenture over four implants (Ref. Figure 2). The initial prosthetic restoration included a fixed, removable and horizontally screw-retained bridge, accompanied by four implant crowns and two molars with PEEK bridge framework (Bio XS, Bredent). After 3 years in situ, the patient's bruxism had first abraded, and then split the posterior occlusal acrylic

veneers. Despite the undamaged PEEK frameworks, a complete prosthetic remake was necessary.



**Figure 2:
Severe bruxism
and heavily damaged
bar-supported
overdenture over
four implants.⁴*

The second prosthetic restoration included four adhesively retained implants fitted with a fully anatomical CAD/CAM fabricated, screw-retained PEEK prosthetic framework, JUVORA Dental Disc by Invibio (Ref. Figure 3).



**Figure 3:
The bridge in the
patient's mouth after
ten months in situ.*

The secondary telescope UL6 and bridge pontic UL5 have been designed fully anatomically. The shade of the non-veneered PEEK (JUVORA Dental Disc) is acceptable for the occlusal surface in the posterior region. The gingival conditions are excellent.⁴

In conclusion, where bruxism is a problem the focus is on producing a durable, functioning restoration. The shock absorbing properties of JUVORA Dental Disc should protect the implants and the patient's natural teeth against the destructive forces of bruxism.

Case 2⁷

A 67-year-old female presented with jaw pain, asymmetric occlusion and advanced periodontitis. The patient had a combined fixed, removable restoration consisting of cemented, metal-ceramic bridge and clasp-retained partial denture.

The restoration included a fixed denture on four implants utilizing the ALL-ON-4³ treatment concept. 3D planning software determined ideal implant placement and the most precise, comfortable prosthetic framework. After a four-month healing period, the temporary restoration model was digitally mastered and a PEEK framework CAD/CAM designed using JUVORA Dental Disc. Veneer fit, basal area shape and gingival pressure, screw canal design, connector positioning and milling path calculations were determined.

The resulting precise, full contour design was then milled immediately and successfully placed on the four implants. The patient reported comfortable chewing and high aesthetic satisfaction (Ref. Figure 4).



**Figure 4:
Occlusal view of the
bridge after placement
and before closure of
the screw holes.*

Conclusions

JUVORA Dental Discs by Invibio have been ANVISA, CE and FDA-cleared for long-term implant borne, fixed and removable prosthetic frameworks made with precision through CAD/CAM workflows. PEEK-OPTIMA's physical properties and benefits including shock-absorption, bone-like modulus, resilience, and CAD/CAM fabrication are not only recommended by Professor Tipton and Dr Siewert, but make it and other PEEK-based prosthetic frameworks ideally suited for modern, prosthetic dentistry. ▲

ABOUT THE AUTHOR

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Dr Marcus Jarman-Smith is a Strategic Marketing Manager with Invibio Biomaterial Solutions. He has worked specifically on medical applications for the high performance polymer PEEK (polyetheretherketone) for dental applications, for over a decade. In 2001, he received a PhD in chemical engineering, tissue engineering and biomaterials from the University of Bath, in the United Kingdom.



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2. Industry testing in-mouth simulation measured JUVORA™ at 1,300N force.
3. Based on the tendency of a material to deform when opposing forces are applied as expressed by the avg. elastic (Young's) modulus values of the two materials (Titanium 110 GPa or PEEK 4GPa).
4. Tipton, P. and Siewert, B. (November 2015) High-performance polymers – part two. *Private Dentistry*, 68-75.
5. Since 2011, Professor Paul Tipton, BDS MSc DGDGP RCS has provided ad hoc consultancy services to Juvora Ltd, an Invibio Company.
6. Since 2012, Dr. Siewert has provided ad hoc consultancy services to Juvora Ltd, an Invibio Company.
7. Tipton, P. and Siewert, B. (September 2016) High-performance polymers – part 3. *Private Dentistry*, 66-72.

*Images, Figures 2-4, provided courtesy by Dr. Bernd Siewert.

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