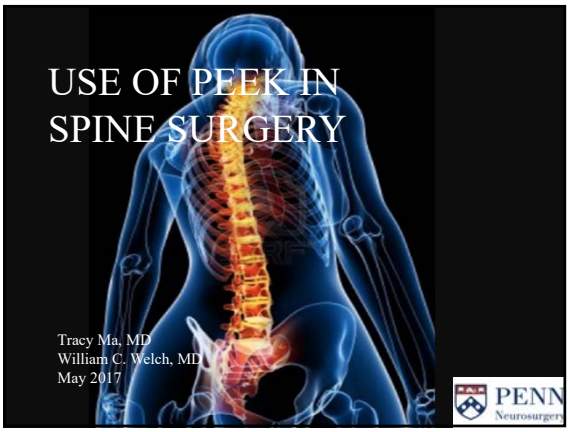
USE OF PEEK IN SPINE SURGERY
Tracy Ma, MD
William C. Welch, MD
May 2017
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Financial Disclosures
Transcendental Spine-stock
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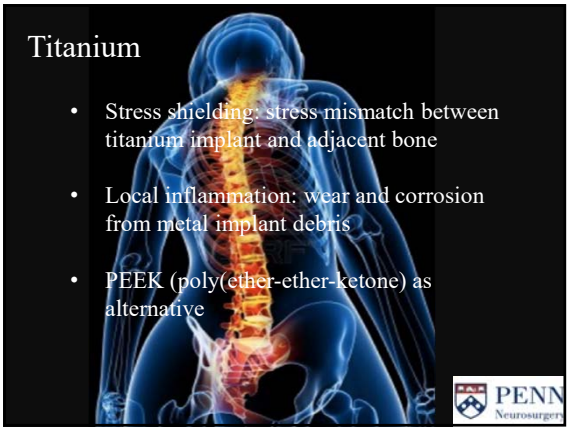
Titanium
• Stress shielding: stress mismatch between titanium implant and adjacent bone
• Local inflammation: wear and corrosion from metal implant debris
• PEEK (poly(ether-ether-ketone) as alternative
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PEEK Advantages

- Biocompatability and biomechanical properties
- Radiolucent
- Elastic modulus close to cancellous bone

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Fusion promotion with PEEK

- Bioinert
- Hydrophobic surface: not conducive to fast bone cell attachment, slow bone fusion
- Bulk modification: bioactive hydroxyapatite, tri-calcium phosphate, and strontium-containing hydroxyapatite → increases elastic modulus
- Surface modification: does not adversely change PEEK's intrinsic properties

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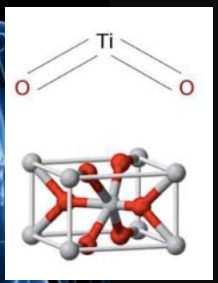
PEEK and TiO2/PEEK

- Protective oxide layer forms rapidly on Ti when exposed to air
- TiO2 binds calcium and phosphate ions → bone-like apatite to induce osteoblast attachment & growth
- TiO2 film on PEEK: significant adhesion, proliferation, differentiation of osteoblast cells



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Osseointegration

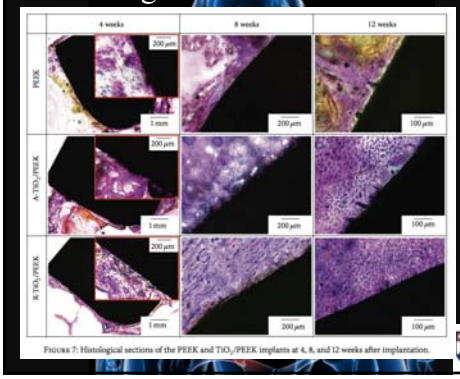

FIGURE 7: Histological sections of the PEEK and TiO_2/PEEK implants at 4, 8, and 12 weeks after implantation.

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TiO2/PEEK in C-spine

- PIERCE-PEEK: large, prospective, multi-center clinical trial, single-level empty PEEK ACDF cage → complete bony fusion of 83% at 18 months
- Kotsias, 2017: prospective, multi-center, single-arm clinical study, single-level PEEK + Ti vs. PEEK only ACDF cage → complete bony fusion of 80% at 18 months but no lasting clinical benefit from Ti coating
- Patients with solid bone fusion did better than patients with non-union

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Review of PEEK cages in C-spine

- 2 randomized controlled trials
- 5 prospective comparative trials
- 3 retrospective comparative trials
- PEEK vs. bone graft: minimal evidence for better clinical and radiographic outcome with PEEK implant
- No differences among PEEK, titanium, carbon fiber cages

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Arthrodesis Rate and Patient Reported Outcomes After Anterior Lumbar Interbody Fusion Utilizing a Plasma-Sprayed Titanium Coated PEEK Interbody Implant: A Retrospective, Observational Analysis.

Joseph A. Sclafani, MD,[1,2] Sophea B. Bergen, PA-C,[1] Miranda Staples, Ph.D.,[2] Kevin Liang, Ph.D.,[2] Ramin Ruiszadeh, MD[1]
[1]Spine Institute of San Diego, Minimally Invasive Spine Center of Excellence, San Diego, CA, [2]Milestone Research Organization, San Diego, CA.

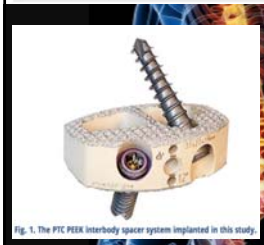

Fig. 1. The PTC PEEK interbody spacer system implanted in this study.

- Titanium coated PEEK spacer in ALIF: 42 of 44 (96%) exhibited solid arthrodesis at 7 months
- Improvement in low back pain and leg pain (using VAS)

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Table 1. Improvement in VAS back and leg scores at 9 months follow-up by subject subgroup.

	N	Improvement (VAS Back)	P (back)	Improvement (VAS Leg)	P (leg)
Overall	43	4.5	0.0001	4.1	0.0001
Age: <55 years	27	4.5	0.98	3.9	0.47
Age: >55 years	16	4.5		4.6	
Female	23	4.4	0.73	4.4	0.54
Male	20	4.7		3.8	
No Tobacco Use	35	4.6	0.62	4.3	0.55
Tobacco Use	8	4.1		3.5	
Metabolic Comorbidity	25	4.4	0.82	4.3	0.68
No Metabolic Comorbidity	18	4.6		3.9	
No Prior Surgery	33	4.7	0.44	4.1	0.78
Prior Surgery	10	4		4.4	
Single-Level Surgery	23	4.5	0.93	3.7	0.35
Multilevel Surgery	20	4.6		4.7	
No Worker's Comp	18	5.3	0.05	4.9	0.21
Worker's Comp	25	3.9		3.6	
Standalone ALIF	11	5.2	0.28	4.8	0.44
ALIF + PSF	32	4.3		3.9	
BMI <30	25	4.1	0.21	4.6	0.33
BMI >30	18	5.1		3.6	
Spondylolisthesis	24	4.4	0.68	3.7	0.34
No Spondylolisthesis	18	4.7		4.7	

Tobacco use, advanced age and DM yielded poorer fusion rates
Time to fusion shorter than comparative ALIF studies

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Lin et al. BMC Musculoskeletal Disorders (2016) 17:374
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BMC Musculoskeletal Disorders

RESEARCH ARTICLE Open Access

Comparison of the PEEK cage and an autologous cage made from the lumbar spinous process and laminae in posterior lumbar interbody fusion

Bin Lin*, Hui Yu, Zhida Chen, Zhuanzhi Huang and Wenbin Zhang

- PEEK vs. autologous cage with spinous processes and laminae: no significant difference in functional outcomes and fusion rates at 2 years in single-level PLIF

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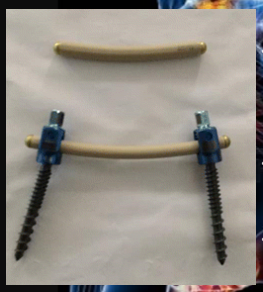
PEEK rods



- Titanium rods: over-stabilization, stress shielding, adjacent segment degeneration
- Systematic review: 8 clinical studies, 15 biomechanical studies
- PEEK rods in biomechanical studies: superior load-sharing distribution, larger adjacent segment range of motion, reduced stress at rod-screw/screw-bone interface
- PEEK rod construct: simple in assembly, reliable in vivo performance when compared to dynamic devices
- However, no evidence to confirm better outcomes with PEEK rods when compared to titanium rods

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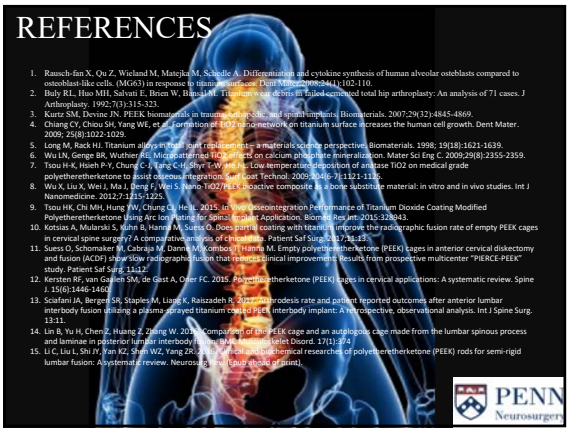
Conclusions/Future of PEEK

- PEEK has visualization and modulus of elasticity benefits
- Poor osseous integration unless surface treated
- Possible use in motion-preservation devices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