

Cages and Bone Healing


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Disclosures

My department receives research support from:

- DePuy Synthes®; Integra® LifeSciences; Bacterin International, Inc.; NuTech®; Vertical Spine, Alphatec Spine, Nuvasive

I am a consultant to Centinel Spine and Paradigm Spine




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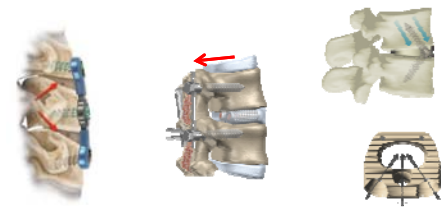
Objectives

...from the aspect of bone healing


<p>1. Stable fixation of motion segment</p> <ul style="list-style-type: none"> ▫ Optimized screw trajectories ▫ Resistance to axial, torsional and bending movement ▫ Eliminate need for fixation outside of load profile 	<p>3. Materials</p> <ul style="list-style-type: none"> ▫ Osteo-Compatiable ▫ Cell-Compatiable
<p>2. Optimal load transfer</p> <ul style="list-style-type: none"> ▫ Footprint contact on cortical rim ▫ 80% of load is transmitted through the anterior column of the spine ▫ Comply with Wolff's law to afford superior fusion outcomes 	<p>4. Bone Graft Choice</p> <ul style="list-style-type: none"> ▫ Direct contact ▫ Conductive over time <p>5. Radiolucency</p> <ul style="list-style-type: none"> ▫ Allows for assessment of fusion



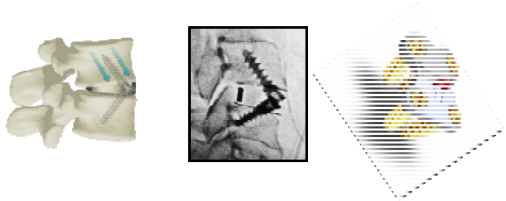
Stable Fixation




- Screw angles direct the spine's axial forces along the long axis of screw.
- Reduces bending moment, preventing de-rotation and screw back-out.
- Converging screws are more resistant to implant pullout.



Optimal Load Transfer




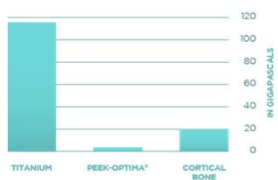
- Lag effect creates **compressive fixation**.
- Provides constant compressive forces enhancing fusion in line with Wolff's Law



Materials


Osteo-Equivalent Modulus

- Exhibits a modulus of elasticity similar to bone.
- Presents a reduced risk of subsidence relative to all-titanium

Material	Modulus of Elasticity (Gigapascals)
Titanium	~110
PEEK-OPTIMA [®]	~10
CORTICAL BONE	~15

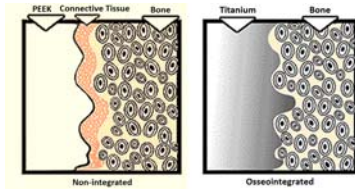
Compared with all-titanium cages, PEEK cages have been shown to be six times less likely to experience subsidence.²



1. Ashwin RB, et al. A contrastless wave technique for the measurement of the elastic properties of cortical bone. J Biomech. 1984; 17(5):349-61.
2. Chen Y, Wang S, Lu S, Yang L, Tang H, Yuan Y, Chen D (2015) Comparison of titanium and polyetheretherketone (PEEK) cages in the surgical treatment of multilevel cervical spondylolisthesis: a prospective, randomized, controlled study with over 7-year follow-up. Eur Spine J. <http://dx.doi.org/10.1007/s00586-015-2772-y>

Introduction – Benefits of CPTi

- CPTi coat creates rough, osteoconductive surface
 - Short-term stability due to increased **friction**
 - Long-term stability due to bone **cell adhesion** to the titanium

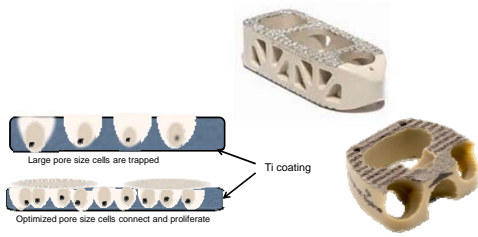


7 Polishing Methods Less a Factor in Cell Adhesion than Surface Characteristics of Titanium Plasma Spray Coatings on PEEK



SIZE DOES MAKE A DIFFERENCE

- Pore depth favorable for cell proliferation by balancing *porosity* and *pore depth*



The Science

Method

- hMSCs placed on CP Ti coated PEEK coupons
- Cultured 24 hrs
- Stained

Images revealed

- Living hSMC cells
- Significant cell count
- Strong adhesion

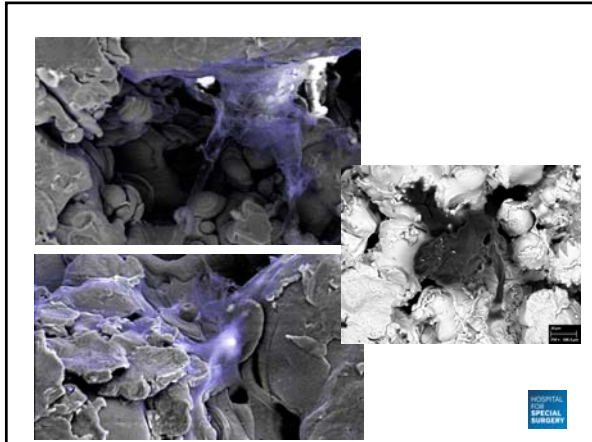
Further analysis showed

- Cell proliferation
- Cell migration

Significance

- Pore depth is physiologically matched providing a surface that facilitates cell attachment, migration and proliferation of bone forming cells





Comparison of Coarse and Fine Topography

Coarse Roughness **Fine Roughness**

11 *Polishing Methods Less a Factor in Cell Adhesion than Surface Characteristics of Titanium Plasma Spray Coatings on PEEK*

Cell Count between Different Roughnesses

Coarse Roughness **Fine Roughness**

28 cells/0.257 mm² 54 cells/0.257 mm²

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Graft Containment Area



Maximize graft area is key

Ease of getting graft well packed

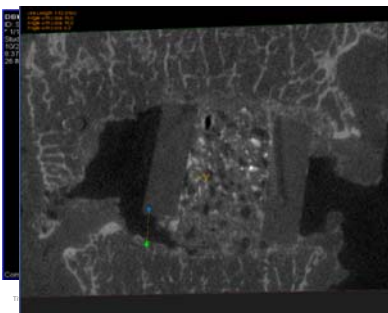
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Bone Graft Choices

...just because you use it in the gutters doesn't make it a good choice for your interbody

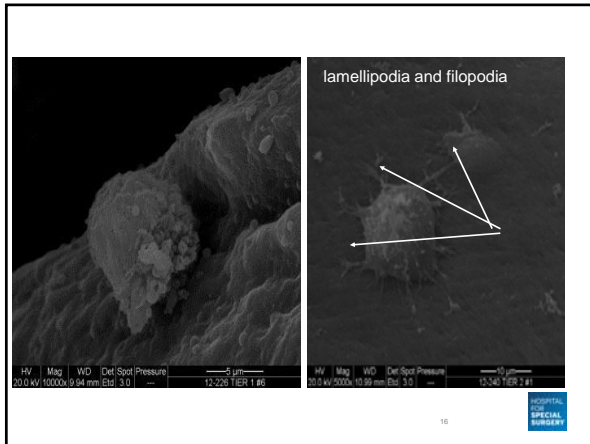


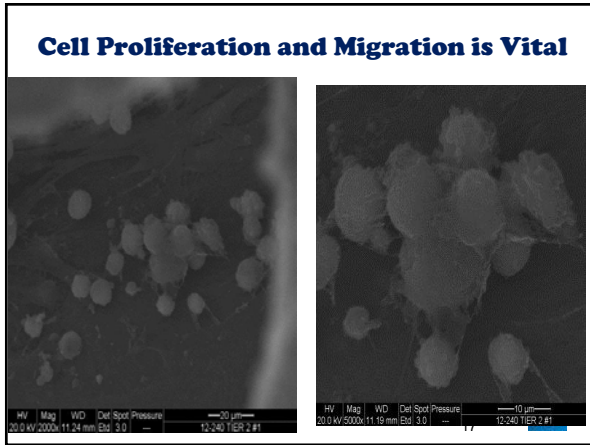
Spacer w/ DBM
(Minimal Endplate Contact)

Spacer w/ Sponge
(Intimate Endplate Contact)

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What is the ideal graft?

A composite of the right components

Cells + Matrix + Signals

Host or Cultured Structure or Void Filler DBM or Growth Factor

Thank You

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