GOALS OF TREATMENT

- Clinical Improvement
- Functional Improvement
- Functional Restoration
- Restoration of Anatomy
- Anatomic Stability
Polyether ether ketone

- Easy to fabricate
- Appropriate modulus
- Adequate strength characteristics
- Inert
- Water absorption @24 hours = 0.1%
- Resists biodegradation
- Radiolucent
- MRI compatible

Osseointegration

- Protein adsorption
- Biologic integration/communication
- Cellular signaling
- Cell stimulation
- Bone formation
ARNOLD CAPLAN, PhD

MEDICINAL SIGNALLY CELLS--MSC

- MSC PERICYTES
- MSC IMMUNO-PRIVILEGED
- MSC IS NOT A MSC IS NOT A MSC - LOCATION MATTERS
- HOMING PROPERTIES
- MSC SIGNALS
- PARACRINE ACTIVITY
- ACTIVATE LOCAL STEM CELLS
- SENECE

Define nano-scale

- NIH: “Control of matter at a length scale of approximately 1-100 nanometers, where novel properties and functions occur because of the size.”
Surface energy

\[ \gamma \approx \frac{(x_\alpha - x_\beta)(-\Delta_{\alpha\beta}H)}{a_0 N_{\Delta x_\beta}} \]
Implant Osseointegration and the Role of Microroughness and Nanostructures: Lessons for Spine Implants
Rolando A. Gittens, Rene Olivares-Navarete, Zvi Schwartz, and Barbara D. Boyan
Acta Biomater. 2014 August; 10(8): 3363–3371

- Bioactive PEEK
  - Eliminated smooth surfaces
  - Plasma surface treatment
  - Chemical surface treatment
  - Composite materials e.g., HA/PEEK, PEEK/n-HA/CF
  - Surface addition e.g., Titanium
Bressan et al. NanoMedicine 2013
Nanotech to Drive Stem Cell Commitment

- Cellular adhesion
- Cellular spreading
- Intracellular signaling

Thank you
BONE GRAFT SUBSTITUTES

SYNTHETICS
- CORAL
- CERAMICS
- CaPO4
- BIOGLASS
- BIO-RESORBABLE
- TANTALUM

PROTEINS
- BMP-2
- BMP-7
- BMP-4
- IGF-1
SELF-ASSEMBLING NANO-STRUCTURE WITH DOMAINS FOR BMP-2
BINDS EXOGENOUS AND ENDOGENOUS BMP-2
REDUCED THE DOSE OF BMP-2 BY TEN FOLD TO ACHIEVE SPINAL FUSION

Bone Graft---

Wang, H et al Tissue Engineering 2012

Combining scaffolds with growth factors and cells
Nanospheres contribute many properties to enhance biologic properties of the scaffolds
TITANIUM NANO TUBULES

- NANO TUBULES FORMED ON SURFACE
- NO EFFECT ON BIO-MECHANICS
- IMPROVES BONE TO METAL AND SOFT TISSUE TO METAL HEALING


- Ti with anodization yields TiO2 Nano tubules
- TNT WITH ZnO (TNT-Zn) nano particles
- Increase osteoblastic activity
- Improved MSC morphology
- Decreased colonization with bacteria

CELLULAR THERAPY

- iPS
- BONE MARROW DERIVED CONCENTRATE MSC
- ADIPOSE DERIVED CELLS (SVF)
- PRP
- AUTOLOGOUS
- ALLOGENIC LIMITED DONOR
- ALLOGENIC PHARMACEUTICAL MODEL
Bone Allograft
CaPO4 autograft
DBM
Bone Allograft
Growth factors
CaPO4
autograft
DBM
Bone Allograft
Growth factors
CaPO4
autograft
DBM
Bone Allograft
Growth factors
CaPO4
autograft
DBM

TRANSITION
- BONE GROWTH
- TISSUE GROWTH
- TISSUE ENGINEERING
BONE GRAFT

- Iliac Crest
- Local Autograft
- Allograft Fresh / Frozen / Freeze Dried
- DBM
- Allograft with Cells

BONE HEALING AND FUSION
HISTORIC / GOLD STANDARD

Growth factors
- PRP / PPP
- Small Molecules
- Scaffolds

BMP