



CELLS, SIGNALS, and SURFACES

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GOALS OF TREATMENT


- ▶ CLINICAL IMPROVEMENT
- ▶ FUNCTIONAL IMPROVEMENT
- ▶ FUNCTIONAL RESTORATION
- ▶ RESTORATION OF ANATOMY
- ▶ ANATOMIC STABILITY





Polyether ether ketone

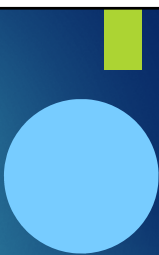
- ▶ Easy to fabricate
- ▶ Appropriate modulus
- ▶ Adequate strength characteristics
- ▶ Inert
- ▶ Water absorption @24hours= 0.1%
- ▶ Resists biodegradation
- ▶ Radiolucent
- ▶ MRI compatible



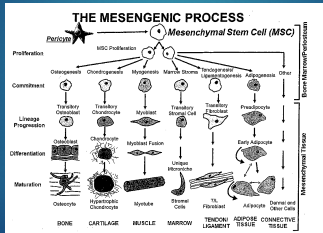


Osseointegration

- ▶ Protein adsorption
- ▶ Biologic integration/communication
- ▶ Cellular signalling
- ▶ Cell stimulation
- ▶ Bone formation



ARNOLD CAPLAN, PhD

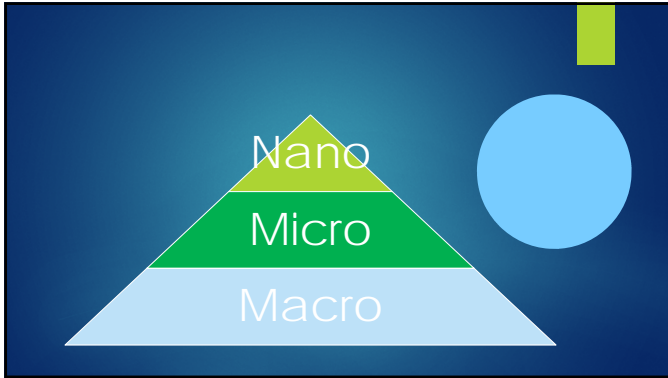


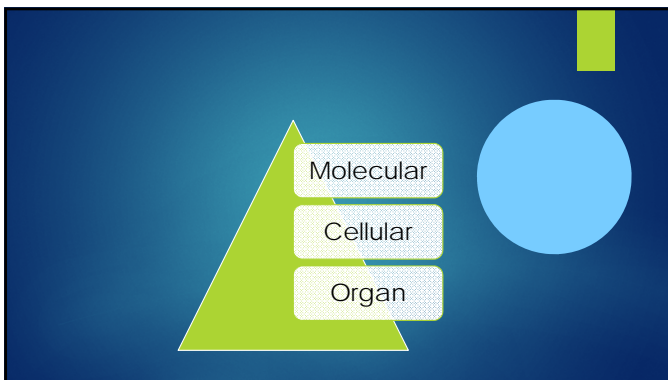
MEDICINAL SIGNALLY CELLS--MSC

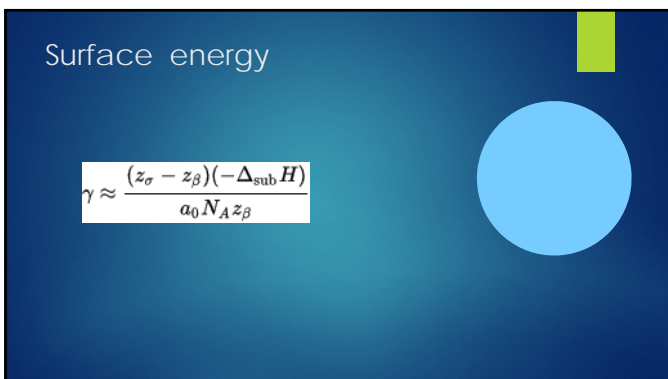
- ▶ MSC-PERICYTES
- ▶ MSC- IMMUNOPRIVILEGED
- ▶ MSC IS NOT A MSC IS NOT A MSC –LOCATION MATTERS
- ▶ HOMING PROPERTIES
- ▶ MSC- SIGNALS
- ▶ PARACRINE ACTIVITY
- ▶ ACTIVATE LOCAL STEM CELLS
- ▶ SENECEENCE

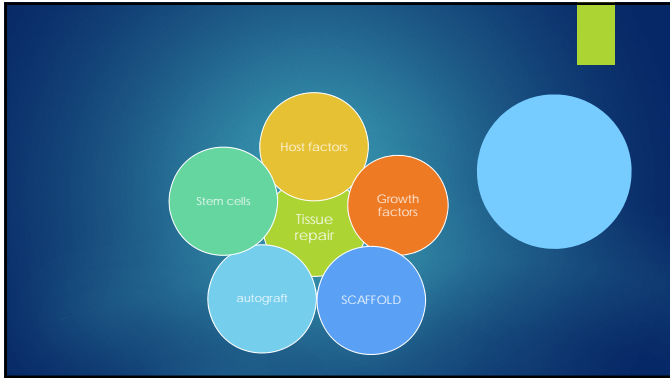
Define nano-scale

- ▶ NIH- "Control of matter at a length scale of approximately 1 - 100 nanometers, where novel properties and functions occur because of the size."





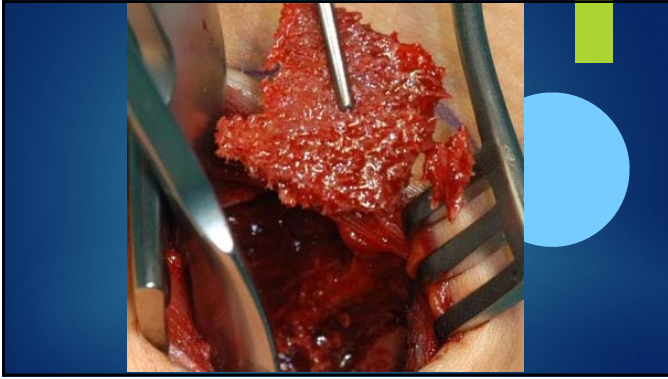




Implant Osseointegration and the Role of Microroughness and Nanostructures: Lessons for Spine Implants
Rolando A. Gittens, Rene Olivares-Navarrete, Zvi Schwartz, and Barbara D. Boyan
Acta Biomater. 2014 August ; 10(8): 3363-3371

Bioactive PEEK

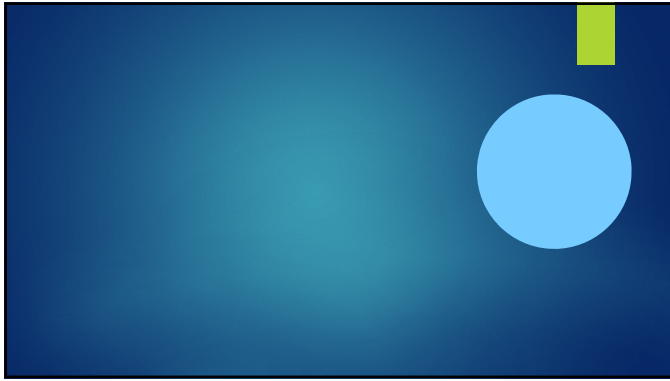
- ▶ Eliminated smooth surfaces
- ▶ Plasma surface treatment
- ▶ Chemical surface treatment
- ▶ Composite materials eg, HA/PEEK, PEEK/n-HA/CF,
- ▶ Surface addition- e.g. Titanium

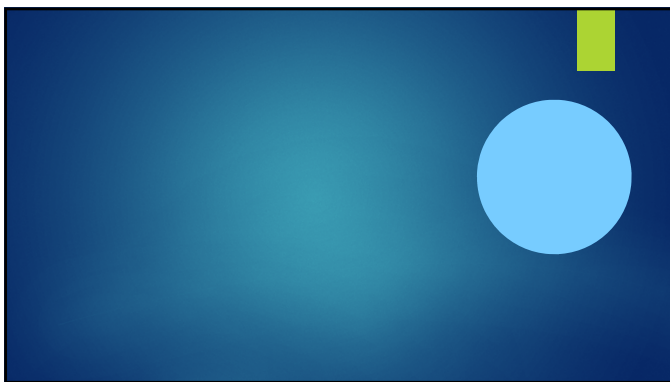


Bressan et al. NanoMedicine 2013
Nanotech to Drive Stem Cell
Commitment

- ▶ Cellular adhesion
- ▶ Cellular spreading
- ▶ Intracellular signaling


Thank you

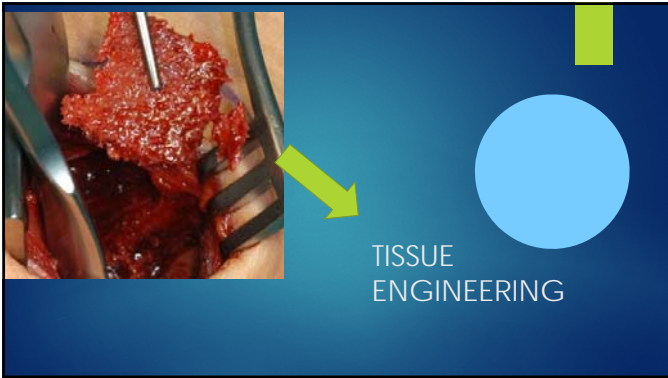


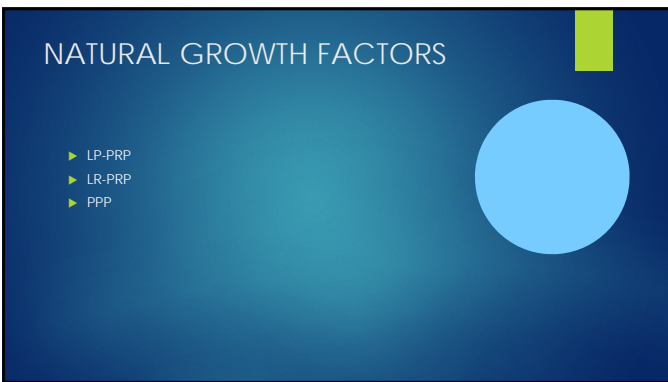


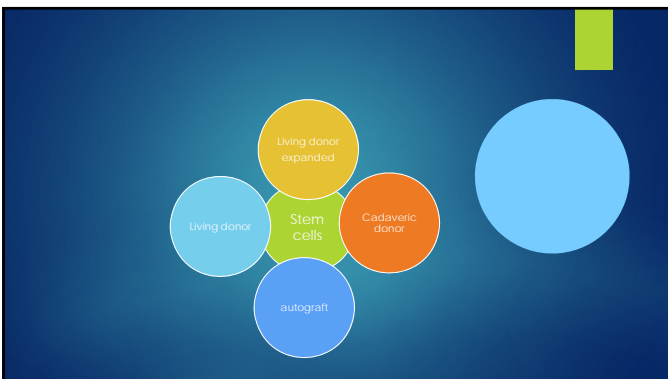
BONE GRAFT SUBSTITUTES

<p>SYNTHETICS</p> <ul style="list-style-type: none">▶ CORAL▶ CERAMICS▶ CaPO4▶ BIOGLASS▶ BIO-RESORBABLE▶ TANTALUM	<p>PROTEINS</p> <ul style="list-style-type: none">▶ BMP-2▶ BMP-7▶ BMP-4▶ IGF-1
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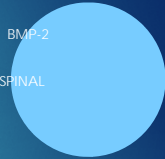




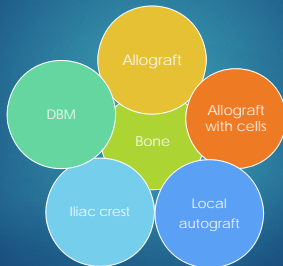


INSITUTE FOR BIONANOTECHNOLOGY –
NORTHWESTERN UNIVERSITY

- ▶ 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




Titanium Nano tubules–Liu,W. et al. International J of Nanomedicine,2015

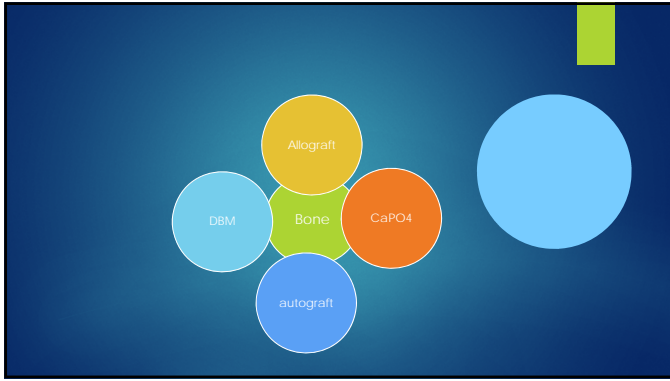
- ▶ Ti with anodization yields TiO₂ Nano tubules
- ▶ TNT WITH ZnO (TNT-Zn) nano particles
- ▶ Increase osteoblastic activity
- ▶ Improved MSC morphology
- ▶ Decreased colonization with bacteria

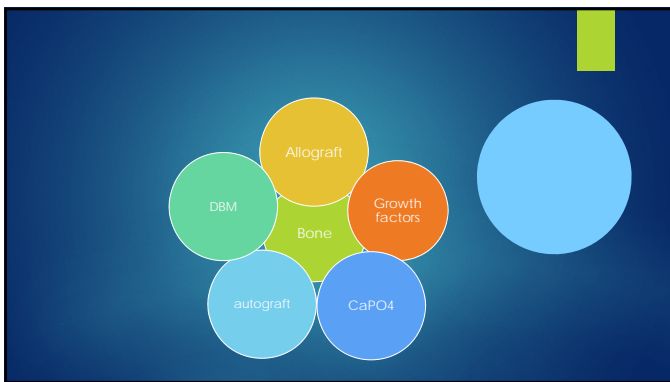


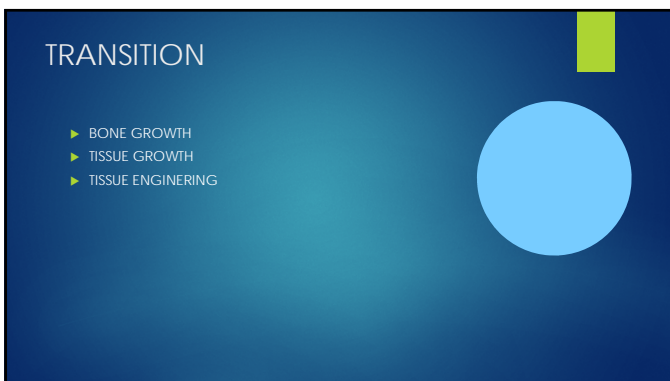
CELLULAR THERAPY

- ▶ IPS
- ▶ BONE MARROW DERIVED CONCENTRATE/ MSC
- ▶ ADIPOSE DERIVED CELLS (SVF)
- ▶ PRP
- ▶ AUTOLOGOUS
- ▶ ALLOGENEIC LIMITED DONOR
- ▶ ALLOGENEIC PHARMACEUTICAL MODEL









BONE GRAFT

- ▶ ILIAC CREST
- ▶ LOCAL AUTOGRAFT
- ▶ ALLOGRAFT FRESH /FROZEN/FREEZE DRIED
- ▶ DBM
- ▶ ALLOGRAFT WITH CELLS



BONE HEALING AND FUSION HISTORIC/GOLD STANDARD



