Orthopaedic Trauma Institute Bones & Joints: Keeping Them Healthy & Healing Them When Injured

UCSF Osher Mini Medical School for the Public Department of Orthopaedic Surgery, Orthopaedic Trauma Institute Course Chair: Theodore Miclau III, M.D.

Orthopaedic Trauma Institute

"Our mission: to mend the injured, inspire innovators, and empower leaders to restore lives."



Engineering the Skeleton

Dr. Nathan Young, Ph.D. Assistant Professor UCSF Orthopaedic Surgery Orthopaedic Trauma Institute Introduction / Moderator

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The Body as Machine



Structural Support

 A. Framework for the body
 B. Attachment point for muscles





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 Protection of vital structures

 A. Brain
 B. Spinal cord
 C. Thoracic organs
 D. Internal reproductive organs



Leonardo de Vinci



Mike Tyson

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 Facilitating Movement

 A. Levers for muscles
 B. Moveable joints act as fulcrums



NEWTON'S THREE LAWS

1. Inertia: a body stays at rest unless acted upon by a force

2. Acceleration: F/ mass (or F=ma)

3. Reaction: For every action there is an equal and opposite reaction





Part 1: Bone Biomechanics

Dr. Safa Herfat, Ph.D.

Orthopaedic Trauma Institute Director, Biomechanics Laboratory





What is this guy doing? How is he moving his arm? How are the forces affecting his bones?



Something to think about...



Form = Function?

Part 1: Bone Biomechanics

Dr. Safa Herfat, Ph.D.

Orthopaedic Trauma Institute Director, Biomechanics Laboratory







What happened to this guy? How did the forces affect his bones? How can we repair them?

Bone: Material Properties



How can we leverage the properties of bone to better engineer skeletal repair?







Engineering the Skeleton







Amazing system!



Permits function during growth

BioEngineering Challenges



Every bone in your body took many years to achieve their current shape and size!

BioEngineering Challenges



We're not quite here yet (thankfully?)

FOLLOWED BY...Part 2: Regrowing the Skeleton

Dr. Chelsea Bahney, Ph.D. Orthopaedic Trauma Institute Co-Director, Laboratory for Skeletal Regeneration







Developmental Engineering: How can we make bones? How can we heal them quicker?

Instructive Cues in the Microenvironment



Same developmental signals are disrupted in disease



Understanding the instructive cues in skeletal development provides insight into skeletal disease and therapies to treat it

These signals are recapitulated during skeletal repair

How can we leverage & augment the bodies innate capacity to heal?