


Collaborative Engineering

Project Identification Domain: Orthopedics



- Anatomy and Biomechanics
- Soft and Hard Tissues
- Bones and Joints
- Knee Anatomy and Motions

OrthoCAD Lab, I.I.T. Bombay

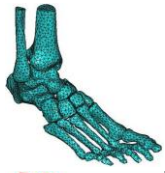
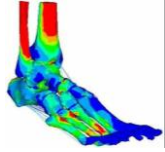
Introduction

Orthopaedics :
(ortho = straight, pais = children)

- study of musculoskeletal system

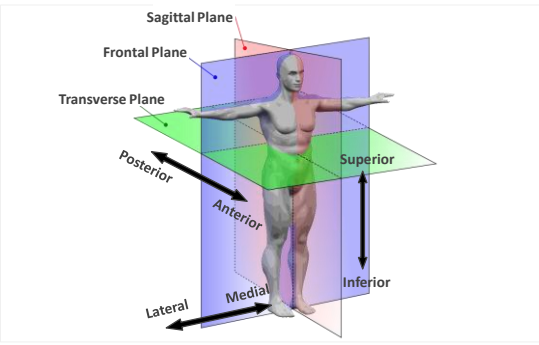
Biomechanics :
(bias = life, mechanics)

- study of the structure and function of biological systems by means of the methods of mechanics

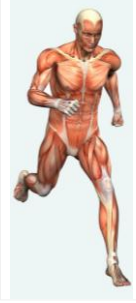
http://www.thesportsphysio.com/contents1a/wp-content/uploads/2011/08/h6_running_skeleton_2_2209.jpg

Anatomical Terminology



Body Tissues

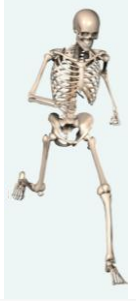
- an organ system that gives humans the ability to move



Musculoskeletal System

SOFT
TISSUES
(musculo...)

HARD
TISSUES
(...skeletal)



<http://www.newmexicoorthopaedics.com/uploads/images/skel.jpg>

Hard Tissues


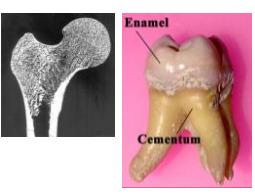
- any mineralized tissue
- having rigid intercellular substance

Bone :

- endoskeleton meant to support and protect the organs

Enamel :

- one of the tissues in the tooth
- hardest tissue in the human body


<http://www.missouristate.edu/assets/HPER/X-ray-arm.jpg>, <http://upload.wikimedia.org/wikipedia/commons/8/8e/Labeledmolar.jpg>

Soft Tissues

- tissues that connect, support or surround organs of the human body

Muscle :

- produce force and cause motion



Soft Tissues

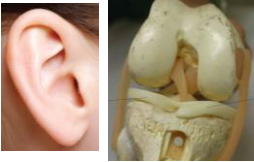
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Muscle :

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Cartilage :

- softer than bone, stiffer than muscle



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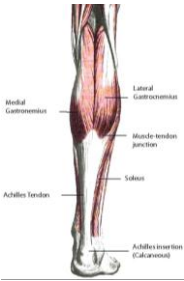
- softer than bone, stiffer than muscle

Ligament :

- connects bone to bone at joints

Tendon :

- connects muscle to bone




Joints

- locations at which two or more bones make contact
- allow movement and/or provide mechanical support

Functional classification :

1. Permit no mobility




<http://us.123rf.com/400wm/400/400/eraxion/eraxion0912/eraxion091200028/6003116-running-skeleton-with-painful-knee-and-hip-joint.jpg>

Joints

- locations at which two or more bones make contact
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Functional classification :

1. Permit no mobility
2. Permit slight mobility




<http://us.123rf.com/400wm/400/400/eraxion/eraxion0912/eraxion091200028/6003116-running-skeleton-with-painful-knee-and-hip-joint.jpg>

Joints

- locations at which two or more bones make contact
- allow movement and/or provide mechanical support

Functional classification :

1. Permit no mobility
2. Permit slight mobility
3. Permit variety of mobility



<http://us.123rf.com/400wm/400/400/eraxion/eraxion0912/eraxion091200028/6003116-running-skeleton-with-painful-knee-and-hip-joint.jpg>

Joints (movable)

JOINT	TYPE	DOF
Head	Pivot joint	1
Shoulder	Ball & Socket joint	5 (3 Rot. + 2 Trans.)
Elbow	Hinge joint	1
Wrist	Gliding joint	2
Hip	Ball & Socket joint	3
Knee	Hinge joint	1
Ankle	Hinge joint	2

Knee Anatomy

- largest hinge joint in the body

Femur (thigh bone):

- longest bone in the body

Patella (knee cap):

- protects the femoral articular surface
- largest sesamoid bone

Tibia (shin bone):

- strongest weight bearing bone

Fibula (calf bone):

- most slender of all long bones

Motion of the Knee

- Major degree of freedom
 - Flexion (hamstrings)
 - Extension (quadriceps)
- Minor degree of freedom
 - Rotation

Knee – Cartilage

- Articular cartilage
 - protects bone surface
 - reduces friction
- Menisci
 - allow rotational freedom
 - shock absorption

<http://meded.uscd.edu/clinicalmed/joints.htm>

Knee – Ligaments

- Cruciate ligaments
 - ACL (prevents anterior motion of tibia)
 - PCL (prevents posterior motion of tibia)
- Collateral ligaments
 - LCL (prevents lateral motion of tibia)
 - MCL (prevents medial motion of tibia)

<http://meded.uscd.edu/clinicalmed/joints.htm>

Summary

BONES: FEMUR, PATELLA, TIBIA

CARTILAGE: LATERAL COLLATERAL, ARTICULAR CARTILAGE, MEDIAL COLLATERAL

LIGAMENTS: ANTERIOR CRUCIATE, MENISCUS, POSTERIOR CRUCIATE

<http://www.joshmyerlaw.com/images/knee-injury.jpg>