

Chapter 5

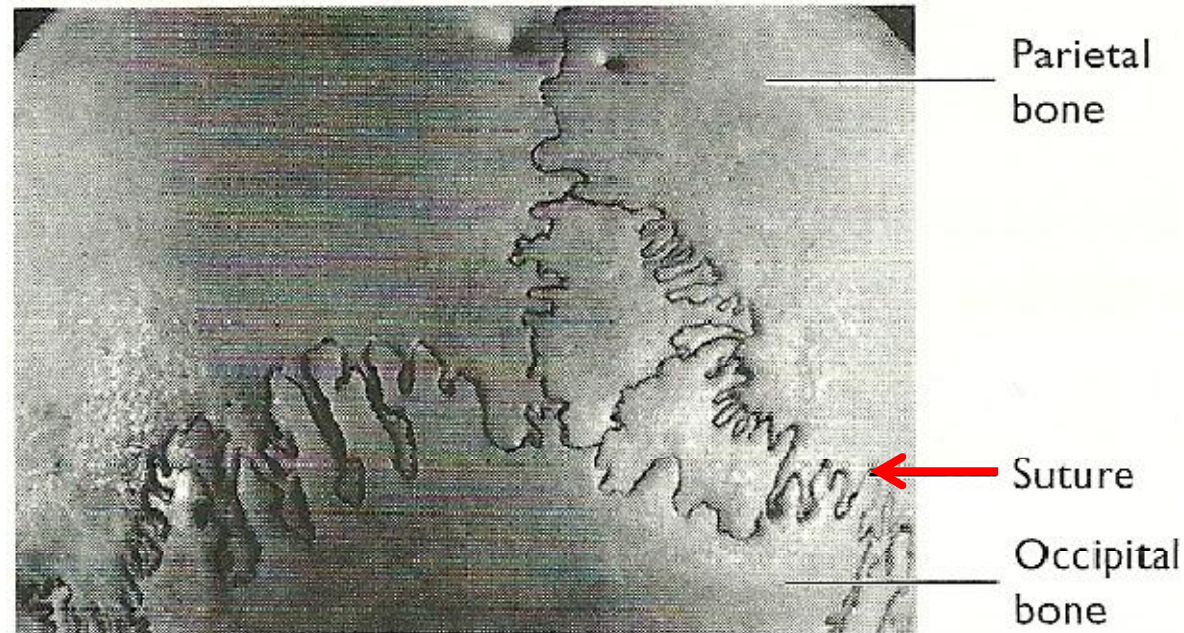
The Biomechanics of Human Skeletal Articulations

Basic Biomechanics, 6th edition
By Susan J. Hall, Ph.D.

Joint Architecture

Classification of Joints:

“ synarthroses: (immovable)
“ sutures



Sutures of the skull.

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Joint Architecture

Classification of Joints:

“synarthroses: (immovable)

“syndesmoses

The mid-radioulnar joint
is an example of a
syndesmosis, where
fibrous tissue binds the
bones together.



Joint Architecture

Classification of Joints:

- “ amphiarthroses: (slightly moveable)
- “ synchondroses

The sternocostal joints
are examples of
synchondroses, wherein
the articulating bones are
joined by a thin layer of
hyaline cartilage.

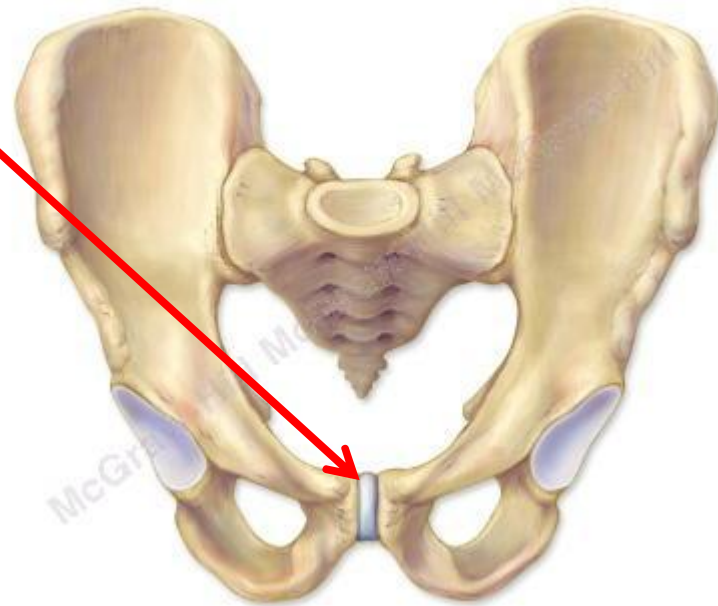


Joint Architecture

Classification of Joints:

- “ amphiarthroses: (slightly moveable)
- “ symphyses

Note the **hyaline cartilage** disc separating the bones of the **pubic symphysis**, typical of a **symphysis** joint.



Joint Architecture

Classification of Joints:

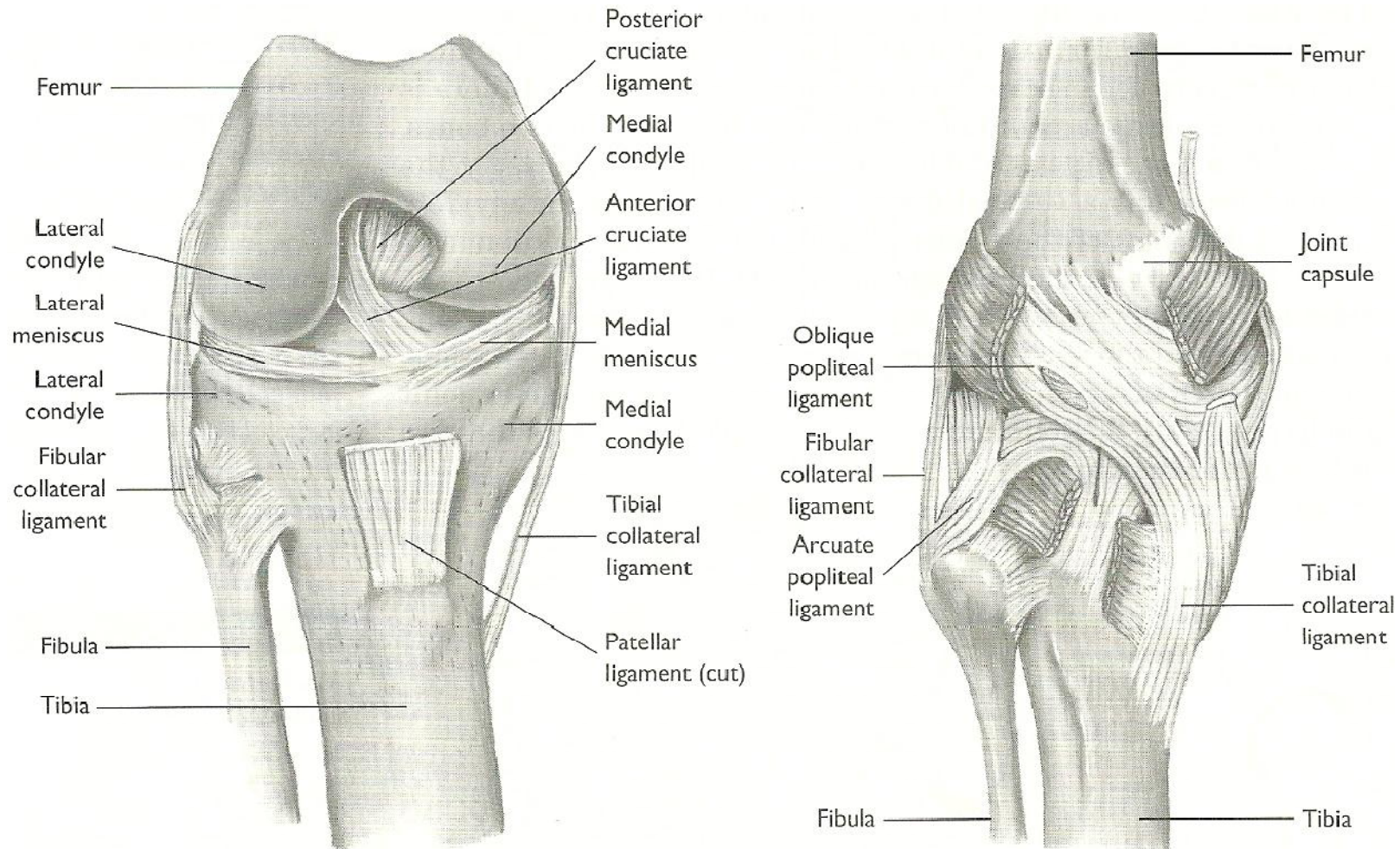
- “ diarthroses or synovial: (freely movable)
characterized by:
 - “ articular cartilage - a protective layer
of dense white connective tissue
covering the articulating bone
surfaces
 - “ articular capsule - a double-layered
membrane that surrounds the joint

Joint Architecture

Classification of Joints:

- “ diarthroses or synovial: (freely movable)
characterized by:
 - “ synovial fluid - a clear, slightly yellow liquid that provides lubrication inside the articular capsule
 - “ associated bursae - small capsules filled with synovial fluid that cushion the structures they separate

Joint Architecture



The knee is an example of a synovial joint, with a ligamentous capsule, an articular cavity, and articular cartilage.

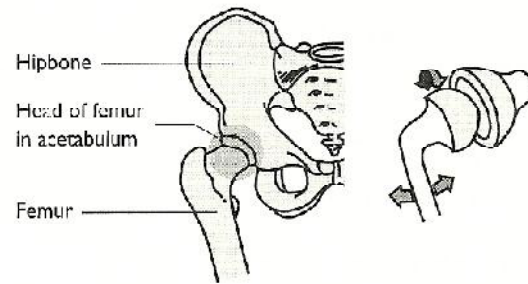
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Joint Architecture

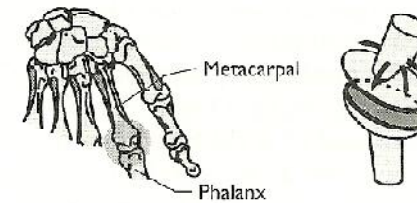
Classification of Joints:

- “ diarthroses or synovial: (freely movable)
 - “ gliding
 - “ hinge
 - “ pivot
 - “ condyloid
 - “ saddle
 - “ ball and socket

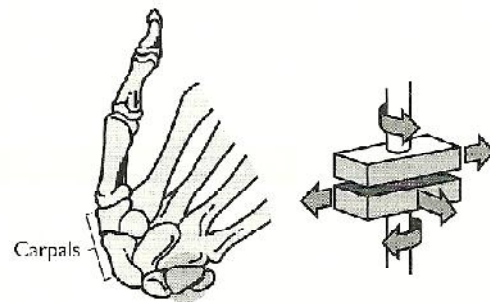
Joint Architecture



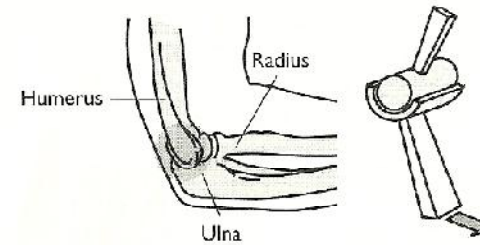
A Ball-and-socket joint



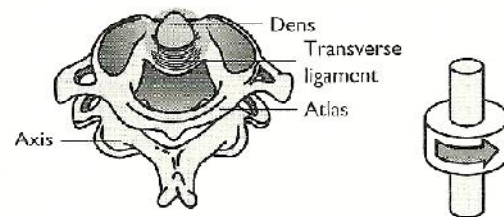
B Condyloid joint



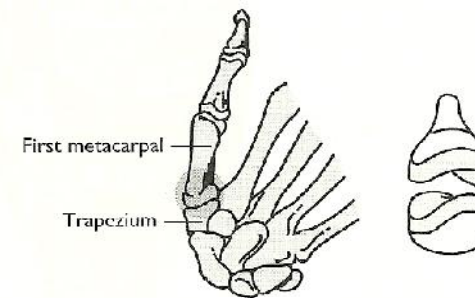
C Gliding joint



D Hinge joint



E Pivot joint



F Saddle joint

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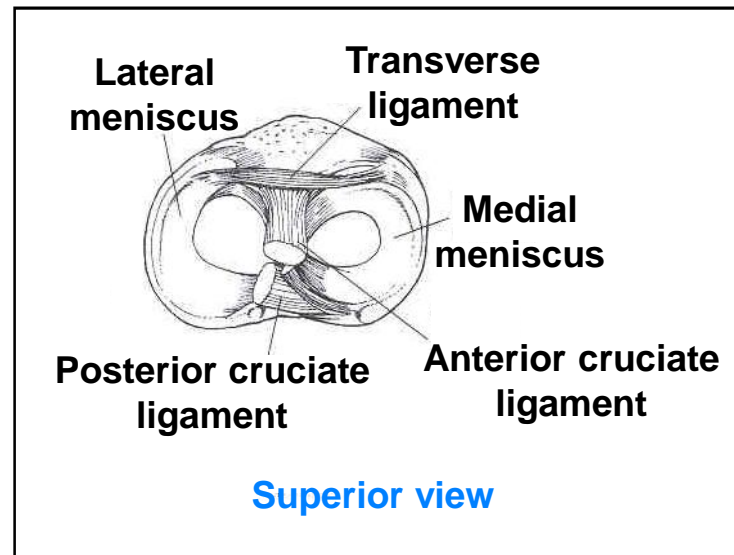
Joint Architecture

What are the functions of articular cartilage?

- “ it spreads loads over a wide area, thereby reducing contact stress
- “ it provides a protective lubrication that minimizes friction and mechanical wear at the joint

Joint Architecture

What is **articular fibrocartilage**?



(soft-tissue **discs** or **menisci** that intervene between articulating bones, as exemplified by the menisci of the knee above)

Joint Architecture

What are the possible functions of
articular fibrocartilage?

- “ distributing loads over joint surfaces
- “ improving the fit of articulations
- “ limiting slip between articulating bones
- “ protecting the joint periphery
- “ lubricating the joint
- “ absorbing shock at the joint

Joint Architecture

What are articular connective tissues?

“ tendons - connect muscles to bones

“ ligaments -connect bones to other bones

Joint Stability

What is joint stability?

(ability of a joint to resist abnormal displacement of the articulating bones)

Joint Stability

What factors increase joint stability?

- “ a closely reciprocating match of the articulating bone surfaces (stability is maximal when joints are in the close-packed position)
- “ a strong array of ligaments and muscle tendons crossing the joint
- “ absence of muscle fatigue

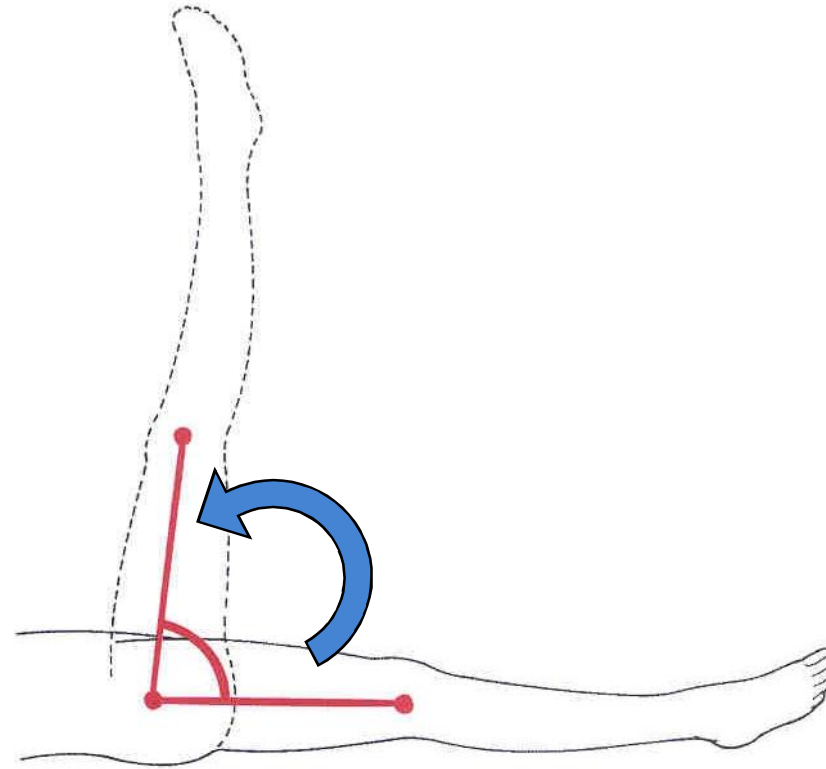
Joint Flexibility

What is **joint flexibility**?

(a description of the **relative ranges of motion** allowed at a joint in different directions)

Range of motion (ROM): the angle through which a joint moves from anatomical position to the extreme limit of segment motion in a particular direction

Joint Flexibility



Range of motion is measured directionally from anatomical position (zero).

Techniques for Increasing Joint Flexibility

What **sensory receptors** influence the extensibility of the musculotendinous unit?

- “ **Golgi tendon organs** - inhibit tension in muscle & initiate tension development in antagonists
- “ **muscle spindles** - provoke reflex contraction in stretched muscle & inhibit tension in antagonists

Golgi Tendon Organs and Muscle Spindles: How do they Compare?

	Golgi Tendon Organs	Muscle Spindles
Location	Within tendons near the muscle-tendon junction in series with muscle fibers	Interspersed among muscle fibers in parallel with the fibers
Stimulus	Increase in muscle tension	Increase in muscle length
Response	1) inhibit tension development in stretched muscle, 2) initiate tension development in stretched muscle	1) initiate rapid contraction of stretched muscle, 2) inhibit tension development in antagonist muscles
Overall Effect	Promote stretch in muscle being stretched	Inhibit stretch in muscle being stretched

Techniques for Increasing Joint Flexibility

What are active and passive stretching?

- “ active stretching- produced by active development of tension in the antagonist muscles
- “ passive stretching - produced by a force other than tension in the antagonist muscles

Techniques for Increasing Joint Flexibility

What are ballistic and static stretching?

- “ballistic stretching- a series of quick, bouncing-type stretches
- “static stretching - maintaining a slow, controlled, sustained stretch over time (usually about 30 seconds)

Techniques for Increasing Joint Flexibility



Active static stretching involves holding a position near the extreme of joint range of motion, usually for about 30 seconds.

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Techniques for Increasing Joint Flexibility

What is PNF?

(Proprioceptive neuromuscular facilitation is a group of stretching procedures involving alternating contraction and relaxation of the muscles being stretched)

Techniques for Increasing Joint Flexibility



PNF techniques require the assistance of a partner.

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Osteoarthritis

What is osteoarthritis?

- “ a common, degenerative disease of articular cartilage
- “ symptoms include pain, swelling, ROM restriction, and stiffness
- “ cause is unknown
- “ both too little and too much mechanical stress seem to promote development