
Biomechanics – Chapter B: Joint Structure & Function (Puzzle Scenarios)

Puzzle 1: Squat vs. Leg Press

A physiotherapy intern observes two athletes: one doing squats, the other performing leg presses on a machine. Both use similar loads.

Question: Which principle explains why the squat challenges balance more?

Options:

1. Squat is an open chain exercise
2. Squat involves a closed kinematic chain with multiple joints
3. Leg press allows greater torque generation
4. Squat reduces base of support compared to leg press

Answer & Reasoning:

👉 **Option 2.** Squats are **closed-chain**, requiring multiple joints (hip, knee, ankle) to coordinate stability and mobility. Leg press is guided, reducing balance demands.

Puzzle 2: The Tennis Player's Shoulder Pain

During a forehand swing, a tennis player complains of shoulder discomfort. The intern recalls that repetitive overhead movements stress the glenohumeral joint.

Question: Why is this joint prone to injury?

Options:

1. It is a hinge joint with poor blood supply
2. High stability due to congruent surfaces
3. High mobility but low structural stability
4. Excessive joint cartilage thickness

Answer & Reasoning:

👉 **Option 3.** The **glenohumeral joint sacrifices stability for mobility**, making it vulnerable under repetitive stress.

Puzzle 3: Limited Knee ROM After Casting

A child removed from long-leg casting struggles with knee flexion. The intern considers the underlying reason.

Options:

1. Fibrocartilage hypertrophy
2. Capsular tightness limiting mobility
3. Meniscal wedge blocking motion
4. Congruent joint surfaces reduce flexibility

Answer & Reasoning:

👉 **Option 2.** Immobilization leads to **capsular and soft tissue tightness**, restricting ROM.

Puzzle 4: The Push-Up Challenge

A student observes that during push-ups, scapulae “wing out” from the rib cage.

Question: What does this represent in terms of kinematic chains?

Options:

1. Open chain shoulder action
2. Closed chain scapulothoracic motion
3. Failure of bone congruency
4. Increased capsular tightness

Answer & Reasoning:

👉 **Option 2.** Push-ups are **closed-chain** actions, requiring scapulothoracic stability. Winging shows poor stabilization.

Puzzle 5: Elderly Woman with Hip Stiffness

An elderly woman reports difficulty rising from a chair. The intern notes reduced hip mobility.

Question: Which factor mainly restricts her movement?

Options:

1. Fibrocartilage degeneration
2. Loss of capsular elasticity
3. Reduced joint lubrication
4. Reduced femoral length

Answer & Reasoning:

👉 **Option 2.** With aging, **capsular tissue loses elasticity**, limiting hip mobility during sit-to-stand.

Puzzle 6: Runner with Ankle Instability

A physiotherapy student examines a sprinter who rolled his ankle. The intern recalls ligaments' role in joint stability.

Question: Why does the ankle become unstable after ligament injury?

Options:

1. Ligaments only generate torque
2. Ligaments act as passive stabilizers of synovial joints
3. Ligaments increase ROM flexibility
4. Ligaments control muscle contractions directly

Answer & Reasoning:

👉 **Option 2.** Ligaments serve as **passive stabilizers**, resisting excessive motion. Injury reduces mechanical joint stability.

Puzzle 7: Basketball Player's Knee Locking

During practice, a basketball player reports “locking” of the knee joint in extension. The intern considers the joint structure involved.

Options:

1. Menisci contributing to congruency
2. Ligaments tightening during flexion
3. Tibiofemoral capsule limiting stability
4. Joint cartilage hypertrophy

Answer & Reasoning:

👉 **Option 1.** The **menisci improve joint congruency** and help with the locking mechanism during extension.

Puzzle 8: The Typist’s Wrist Strain

A student observes a secretary typing with wrists constantly extended. After prolonged work, pain develops.

Question: Which principle explains the discomfort?

Options:

1. Open chain, increased mobility
2. Closed chain restriction
3. Stress on synovial joint structures from prolonged end-range position
4. High stability of carpal bones

Answer & Reasoning:

👉 **Option 3.** Keeping the joint at **end-range extension stresses synovial tissues** (capsule, cartilage), leading to strain.
