The Musculoskeletal Examination

The Sports Medicine Core Curriculum Lecture Series
Sponsored by an ACEP Section Grant
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Overview

General Principles of the Orthopaedic Examination

Shoulder
Elbow / Forearm
Hand / Wrist
Knee
Foot / Ankle
Orthopaedic Exam – General Principles

Inspection
Palpation
Range of Motion
Stability
Special Tests
Neurovascular
  Motor / Sensory / Deep Tendon Reflexes
  Distal Pulses / Capillary Refill
Shoulder Examination

Inspection and Palpation
Range of Motion (Active / Passive)
Rotator Cuff
  Impingement
  Strength
Biceps Tendon
Acromioclavicular Joint
Glenohumeral Instability
Labrum
Thoracic Outlet Syndrome
Neurovascular
Shoulder – Inspection / Palpation

Bony Landmarks

Soft Tissue Landmarks

Alignment
  Posture
  Asymmetry
  “Splinting” of Affected Arm
Shoulder – Alignment

Posture

“attention” position (scapula retracted)
round-shouldered (scapula protracted)

Asymmetry

relative prominence of bony landmarks
note spasm, atrophy, or loss of normal muscular contour

“Splinting”

affected arm carried higher due to contraction of shoulder girdle muscles and support of forearm
Shoulder – Range of Motion

Abduction: 0° to 160 – 180°
  observe for “painful arc” at shoulder level and/or
  “shrugging” / “shoulder hiking”
Forward Flexion: 0° to 160 – 180°

Adduction
  at side: 0 – 30°
  cross-body: at minimum should be able to cup hand on
    opposite shoulder

Extension: 0° to 40 – 60°
Shoulder – Range of Motion

External Rotation

at side: 0° to 45 – 90° (performed w/ elbow at 90°)

at 90° abduction: should be > 90°

• more functionally important motion
• may be > 20° difference side to side, esp. in throwing athletes, with greater motion in dominant arm
Shoulder – Range of Motion

Internal Rotation

at side (Apley Scratch test):

T7 (women), T9 (men)

- identify spinous process of highest vertebra reached
- usually 2 levels higher in non-dominant arm
- more functionally important motion

at 90° abduction: 0° to 30 – 45°
Shoulder – Rotator Cuff

Impingement

“painful arc” of abduction and/or shoulder hiking

Neer impingement sign

- performed by passively bringing the shoulder to maximum forward flexion while stabilizing the acromion/scapula with the other hand

Hawkin’s impingement sign

- performed by forward flexing to 90° with the elbow flexed and forearm parallel to the floor, then internally rotating the arm with the acromion/scapula stabilized using the other hand
Shoulder – Rotator Cuff

Jobe test (Empty Can test)
- isolates supraspinatus
- resisted elevation with the arm at 90° abduction, 30° anterior, and elbows fully extended with thumbs down

Resisted External Rotation
- isolates infraspinatus / teres minor
- resisted ER with the arms at sides and elbows flexed to 90°
Shoulder – Rotator Cuff

Lift-off test
isolates subscapularis
performed by internally rotating arm behind the back, then asking patient to lift the hand off the back against resistance

Belly Press test
isolates subscapularis
same as liftoff test except hand is placed against the abdomen with examiner’s hand between
useful in patients with limited IR
Shoulder – Rotator Cuff

Drop Arm sign
indicative of massive rotator cuff tear

passively abduct arm to maximal degree, then release and ask patient to slowly lower to side

inability to perform controlled lowering is a positive test
  • usually lose control around 100°
  • note that pain can cause a false positive result
Shoulder – Rotator Cuff

Weakness may be due to pain and/or muscle tear

Subacromial injection with local anesthetic may help to distinguish pain-related weakness from a true tear of the rotator cuff

Repeat exam after injection to assess response
Shoulder – Biceps Tendon

**Speed’s test**

performed by having patient resist downward push with
the arm forward flexed to 90° and the elbow fully extended

highly sensitive but not specific

**Yergason’s test**

performed by having patient supinate/flex against resistance with the elbow flexed to 90°

less sensitive than Speed’s test
Shoulder – Acromioclavicular Joint

Passive Cross-Chest Adduction test

bring the patient’s arm to maximum cross-body adduction

• positive test is tenderness in the AC joint
• must carefully localize pain as may also exacerbate rotator cuff pain in setting of impingement/tear

may also palpate AC joint for crepitus
Shoulder – Instability

Anterior

**Apprehension test**

- have patient relax, place shoulder in 90° abduction and slight extension, with elbow flexed – then externally rotate the arm (easiest to perform with patient supine)
  - simulates most common position of subluxation/dislocation
- positive test is sensation of impending dislocation
Shoulder – Instability

Anterior

Relocation test

- increases specificity of Apprehension test
- repeat Apprehension test while placing hand over anterior shoulder for support, which should alleviate sensation of impending dislocation
Shoulder – Instability

Inferior

Sulcus sign

- performed by placing axial traction inferiorly with the arm at the patient’s side
- positive test is presence of a hollow between the lateral edge of the acromion and the humeral head
- is an indication of risk for multidirectional instability
- may be symmetric bilaterally, but significance increases if greater sulcus on symptomatic side
Shoulder - Instability

Anterior-Posterior

**Drawer test**

- performed by stabilizing the acromion with one hand while grasping the humeral head with the other hand and shifting it anteriorly/posteriorly
- normal translation is 25% of glenoid width anteriorly, 50% posteriorly
  - compare with unaffected side
- translation more than the normal, especially when increased compared to other shoulder, strongly suggests clinical instability
Shoulder - Instability

Multidirectional

diagnosed when humeral head exhibits instability inferiorty and at least one other direction

patient may also exhibit generalized ligamentous laxity, but not always
Shoulder - Labrum

O’Brien’s test

performed by having patient bring arm to 90° abduction and 15° towards midline with the elbow extended and thumb down, then resisting downward pressure

next, repeat the test with the thumb up

positive test is pain with the thumb down, relieved with the thumb up
Shoulder – Thoracic Outlet Syndrome

Adson’s test

performed by maximally extending the patient’s arm at 30° abduction, positioning to palpate the radial pulse, then asking patient to turn their head towards the injured shoulder

positive test is a diminished or absent radial pulse, which suggests the possibility of TOS
Shoulder – Thoracic Outlet Syndrome

**Wright’s test**

similar to Adson’s test, but patient’s arm is positioned at 90° abduction and full external rotation
Shoulder – Thoracic Outlet Syndrome

Roos test

performed by having patient abduct the shoulder and flex the elbow to 90° each, then open/close their hands 15 times each while describing any sensations

positive test is numbness, cramping, weakness, or inability to complete the repetitions and is suggestive of TOS
Shoulder - Neurovascular

Axillary nerve
most commonly injured nerve in shoulder trauma
supplies sensation to lateral deltoid

Musculocutaneous nerve
supplies sensation to lateral forearm
Elbow and Forearm Examination

Inspection and Palpation
Alignment
Range of Motion (Active / Passive)
Provocative Maneuvers for Tendonitis
Stability Testing
Neurovascular
   Nerve Compression Syndromes
   Ulnar Nerve Instability
Elbow / Forearm – Alignment

Carrying Angle
assessed with patient facing forward, forearms fully supinated, elbows fully extended
significant variation among individuals

- Male – average 10°
- Female – average 13°
Elbow / Forearm – Range of Motion

Extension: 0° (forearm aligned w/ upper arm)
hyperextension to 10° is common

Flexion: 130 – 140°

“Functional” Range of Motion
adequate for most daily activities
30 – 130°
Elbow / Forearm – Range of Motion

Supination
palm facing up, parallel to floor, should be easily achievable in the normal patient

Pronation
palm facing down, parallel to floor, should be easily obtained in the normal patient

Important to keep elbows at the side flexed at 90° for an accurate exam
Lateral Epicondylitis

“Tennis Elbow”

Involves ECRB and extensor origin, and thus is truly a tendonitis

Tender to palpation just distal to lateral epicondyle

Pain w/ resisted wrist extension
Medial Epicondylitis

“Golfer’s Elbow”

Involves flexor-pronator origin, and thus is truly a tendonitis

Tender just distal to medial epicondyle

Pain w/ resisted forearm pronation and/or wrist flexion
Elbow / Forearm Tendonitis – Provocative Maneuvers

Biceps Tendonitis

TTP near the distal insertion

• palpate just lateral to the lacertus fibrosus at the level of the elbow flexion crease

exacerbated by resisted supination and/or flexion
Elbow / Forearm

Biceps Rupture

asymmetric biceps contour

weakness on resisted supination/flexion

distal insertion not palpable
Elbow / Forearm Tendonitis – Provocative Maneuvers

Triceps Tendonitis

TTP near insertion at olecranon
exacerbated by resisted extension
posterior impingement of the olecranon may mimic, but pain should only be present at endpoint of extension
Elbow / Forearm

Triceps Rupture

asymmetric muscle contour
weakness on resisted extension
insertion not palpable
Elbow / Forearm – Stability Testing

Medial (Ulnar) Collateral Ligament (UCL)
- Valgus stress test
- Milking maneuver
  - performed by grasping the patient’s thumb and pulls it back to fully flex the elbow, stressing the UCL
  - positive test reproduces the patient’s pain
  - increases sensitivity of exam in partial ligament tears

Lateral Collateral Ligament
- Varus stress test
Elbow / Forearm – Stability Testing

Posterolateral Rotary Instability test
also known as pivot shift test
assesses integrity of the lateral ulnar collateral ligament,
part of the lateral ligamentous complex
performed by having the patient lie supine with the
shoulder overhead and externally rotated and the elbow
in supination and fully extended, then flexing the elbow
while applying a valgus force and supination torque
positive test causes pain and/or subluxation of radial head
Elbow / Forearm Nerve Compression Syndromes

Cubital Tunnel syndrome
affects ulnar nerve

- crosses just posterior to medial epicondyle
symptoms include ‘aching’ at the medial elbow and paresthesias in ulnar nerve distribution

Provocative tests

- **Tinel’s test**
  - percussion of ulnar nerve at cubital tunnel
- **Elbow Flexion test**
  - performed by maximally flexing the elbow and holding it in position for a minute
Pronator syndrome: affects median nerve

- much less common than entrapment at carpal tunnel
- compression occurs as nerve passes between the two heads of pronator teres

Symptoms include ‘aching’ in the proximal flexors worsened by repetitive strenuous activity

- paresthesias in median nerve distribution may also occur

Provocative test

- resisted pronation while palpating pronator mass
Radial Tunnel syndrome:
- affects radial nerve, posterior interosseous nerve branch
  - compressions occurs as it passes through the two heads of supinator
- causes vague ‘ache’ in proximal extensors that radiates down the forearm, w/out paresthesias
  - often misdiagnosed as tennis elbow
- provocative test
  - site of maximal TTP is distal to that of tennis elbow
  - long finger extension test
Elbow / Forearm Nerve Compression Syndromes

Anterior Interosseous Nerve syndrome:

branch of the medial nerve

initial symptoms are very similar to pronator syndrome, with ‘aching’ in the anterior proximal forearm, but no paresthesias

provocative test

• FPL / FDP strength
  – have patient make an “okay” sign
  – positive test is relative weakness, may not be able to form an “O”
Elbow / Forearm
Ulnar Nerve Instability

common cause of ulnar nerve irritation

provocative test

examiner palpates ulnar nerve in cubital tunnel while passively flexing and extending the elbow

positive test is feeling a palpable snap as the ulnar nerve subluxes anteriorly over the medial epicondyle
Hand / Wrist Examination

Inspection and Palpation
Alignment
Range of Motion (Active / Passive)
Stability Testing
Nerve Compression Syndromes
Provocative Maneuvers
Hand / Wrist Examination
Alignment

Fingers

Mallet finger
- flexion deformity of DIP
- due to disruption of distal extensor tendon @DIP

Boutonnière deformity
- flexion of PIP combined w/ hyperextension of DIP
- due to disruption of extensor central slip @ PIP

Swan Neck deformity
- flexion of DIP combined w/ hyperextension of PIP
Hand / Wrist Examination
Alignment

Rotational Malalignment

important to assess for “scissoring” of digits w/ metacarpal and phalanx fractures

normally, all fingers should point towards scaphoid tubercle in flexion
Hand / Wrist Examination
Range of Motion

Wrist

Extension: 60 – 75° (active), 90° (passive)
Flexion: 60 – 80°
Radial Deviation: 20°
Ulnar Deviation: 30 – 40°
Hand / Wrist Examination
Range of Motion

Fingers (except Thumb)

Extension

- MCP: 0° (active), 50 – 80° (passive)
- DIP / PIP: 0°

Flexion

- MCP: 80 – 90°
- PIP: 110°
- DIP: 80 – 90°
Hand / Wrist Examination

Range of Motion

Thumb

Flexion: MCP: 20 – 90°, IP: 80 – 90°
Extension: MCP/IP: 0 to 10° hyperextension
Abduction: 60°
Adduction: 0° (thumb to palm)
Opposition: touch little finger to thumb
**Hand / Wrist Examination**

**Stability Testing**

**IP Joints**

stress collateral ligaments by applying:

- ulnar force – assesses ulnar collateral ligament
- radial force – assesses radial collateral ligament

perform with IP joints in 20-30° flexion
Hand / Wrist Examination
Stability Testing

MCP Joints

stress collateral ligaments by applying:
  • ulnar force – assesses ulnar collateral ligament
  • radial force – assesses radial collateral ligament

perform with MCP in full flexion
MCP of the Thumb

performed similarly to other MCP joints, except at 30° flexion

Gamekeeper’s thumb

• injury to ulnar collateral ligament
Hand / Wrist Examination
Stability Testing

Carpals

**Scaphoid Shift (Watson) test**

- assesses scapholunate instability
- performed by grasping patient’s hand, placing the examiner’s thumb on scaphoid tubercle on the volar side of the wrist and placing it in ulnar deviation and dorsiflexion, then radially deviating and flexing the wrist
- positive test reveals dorsal subluxation of scaphoid tubercle
Hand / Wrist Examination
Stability Testing

Distal Radio-Ulnar Joint (DRUJ)

**Piano Key test**

- performed by translating the ulna up and down against the distal radius, with the forearm pronated
- positive test reveals excessive translation potentially accompanied by clicking/popping and/or pain
Hand / Wrist Examination
Nerve Compression Syndromes

Carpal Tunnel syndrome (CTS)
median nerve compression at the wrist
*Tinel’s test* at the carpal tunnel should reproduce the patient’s pain

Carpal Tunnel Compression test
- performed by pressing firmly over the space between flexor carpi radialis and palmaris longus at the distal flexion crease of the wrist w/ full supination and 20° flexion
- most sensitive test for CTS
Hand / Wrist Examination

Nerve Compression Syndromes

Ulnar Nerve entrapment at Guyon’s canal

Tinel’s test at Guyon’s canal should reproduce the patient’s pain

Ulnar Nerve Compression test

• performed by pressing firmly just radial and proximal to pisiform, w/ the wrist fully supinated and flexed to 20°
Hand / Wrist Examination

Provocative Maneuvers

Finkelstein’s test
diagnostic of de Quervain’s tenosynovitis of the 1st dorsal extensor compartment of the thumb
performed by asking the patient to grasp the thumb within their fist, then ulnarly deviating the wrist
positive test reproduces the patient’s pain
Hand / Wrist Examination

Proxvocate Manuevers

TFCC Compression test

assesses for injury to the triangular fibrocartilage complex (TFCC)

performed by applying a compressive loading force to the wrist w/ ulnar deviation

positive test produces painful clicking that reproduces the patient’s pain
Knee Examination

Inspection and Palpation
Alignment
Range of Motion (Active / Passive)
Patellofemoral Joint
Stability Testing
Meniscus
Tendonitis / Bursitis
Knee Examination - Alignment

Physiologic Valgus Alignment
  normal standing knee alignment
  averages 5° male / 7° female

Genu Varum
  “bow-legged”
  knees are separated with feet together

Genu Valgum
  “knock-kneed”
  knees together while feet still apart
Knee Examination – Range of Motion

**Extension:** 0° (neutral)
- hyperextension to 10° is common
  - called genu recurvatum
- extensor lag
  - active extension less than passive extension
  - usually indicates extensor mechanism problem

**Flexion:** 130°-150°
- 110° is usually sufficient for daily activities
Knee Examination
Patellofemoral Joint

Q Angle
measure of overall patellar alignment
angle between line from Anterior Superior Iliac Spine to center of patella and line from center of patella to center of tibial tubercle
normal is 14° male / 17° female
increased Q angle may predispose to patellofemoral pathology
Knee Examination
Patellofemoral Joint

Patellar Alignment abnormalities
- Squinting (in-facing) patella
- Out-facing patella

Patellar Height abnormalities
- Patella Alta – high riding
- Patella Baja – low riding
Knee Examination
Patellofemoral Joint

Palpation
  patellar facets, medial and lateral
  patella grind test
    • performed by downward pressure on patella while patient actively contracts quadriceps
  medial patellar plica
  quadriceps tendon (especially VMO insertion)
  tibial tubercle
  patella tendon
Knee Examination
Patellofemoral Joint

Patellar Tracking

active extension with leg off the side of the exam table

look for a "J sign"

- lateral shift of the patella near endpoint of extension
- indicates abnormal patellar tracking
Knee Examination – Stability Testing

**ACL**

**Lachman’s (most sensitive)**
- performed by translating the tibia anteriorly while keeping the distal femur fixed
- knee should be at 20° flexion to isolate ACL

**Anterior drawer**
- performed by translating the tibia anteriorly with the knee flexed to 90° and the foot stabilized
Knee Examination – Stability Testing

PCL

Posterior drawer
- performed by translating the tibia posteriorly with the knee flexed to 90° and the foot stabilized

Posterior Sag sign
- performed by examining knees in profile while flexed to 90° and the foot stabilized
Knee Examination – Stability Testing

Medial Collateral ligament (MCL)

Valgus stress test

- perform w/ knee in full extension
- repeat w/ knee in 10-15° of flexion
  - better isolates MCL by relaxing posteromedial capsule
Knee Examination – Stability Testing

Lateral Collateral ligament (LCL)

Varus stress test

- perform w/ knee in full extension
- repeat w/ knee in 10-15° of flexion
  - better isolates LCL by relaxing posterolateral capsule
Knee Examination – Meniscus Testing

**McMurray’s test**

Medial meniscus

- performed by fully flexing the knee, applying an external rotation force to the foot and varus stress to the knee, then extending the knee
- positive test is pain over medial joint line w/ or w/out a click

Lateral meniscus

- same as above except the examiner applies an internal rotation force to the foot and a valgus stress to the knee
Knee Examination – Meniscus Testing

Apley Grind test
performed by having the patient lie prone and flexing the knee to 90°
distraction portion involves internal/external rotation of the foot w/ a distracting force
compression portion involves internal/external rotation of the foot w/ a compressive force
positive test is pain w/ compressive portion relieved with distraction portion
Knee Examination
Tendonitis / Bursitis

Quadriceps tendonitis
  TTP at insertion onto superior pole of patella
  pain w/ resisted extension

Patellar tendonitis (Jumper’s knee)
  TTP at proximal patella tendon

Pes Anserine tendonitis/bursitis
  TTP at pes anserine bursa, medial proximal tibial plateau
Knee Examination

Tendonitis / Bursitis

ITB Syndrome

TTP as ITB crosses lateral femoral condyle or at insertion on Gerdy’s tubercle

Hamstring tendinitis

TTP at distal hamstring insertion laterally onto fibular head or medially along medial tibial plateau
Foot / Ankle Examination

Inspection and Palpation
Alignment
Range of Motion (Active / Passive)
Stability Testing
Tendonitis
Peroneal Tendon Instability test
Thompson’s test
Nerve Compression Syndromes
Foot / Ankle Examination

Alignment

Arch

Pes planus (flat foot)
  • “too many toes” sign
    – ability to see more than normal # of toes from posterior view
    – seen in unilateral pes planus

Pes cavus (high-arched foot)

Hindfoot

normally 5-10° valgus relative to midline of calf

excessive valgus or varus
Foot / Ankle Examination

Range of Motion

Ankle Motion
Dorsiflexion: 20°
Plantarflexion: 50°

Subtalar Joint
Inversion: 40°
Eversion: 20°

Forefoot
Abduction and Adduction: 5°
Foot / Ankle Examination
Range of Motion

Great Toe MTP Joint
Flexion (Plantarflexion): 70°
Extension (Dorsiflexion): 45°

Lesser Toes MTP Joints
Flexion: 40°
Extension: 40°
Foot / Ankle Examination
Stability Testing

Anterior Talofibular ligament (ATFL)

Anterior Drawer test
• performed by anteriorly translating the foot / heel while stabilizing the tibia

Calcaneofibular ligament (CFL)

Inversion Stress test
• performed by applying an inversion stress to the heel with the ankle maximally dorsiflexed
Foot / Ankle Examination

Tendonitis

Peroneal tendonitis

- TTP posterior to lateral malleolus or along peroneus brevis tendon to base of 5th metatarsal
- pain w/ resisted eversion

Posterior Tibial tendonitis

- TTP posterior and distal to medial malleolus
- pain w/ resisted inversion (foot in plantarflexion)

Achilles’ tendonitis

- TTP along distal achilles’ tendon or at insertion
- pain w/ resisted plantarflexion
Foot / Ankle Examination

Peroneal Tendon Instability Test

Peroneal Tendon Instability

cause of chronic lateral ankle pain

assessed by palpating the peroneal tendon just posterior to lateral malleolus, while patient actively everts subtalar joint

positive test causes subluxation or frank dislocation of peroneal tendon anteriorly over the lateral malleolus
Foot / Ankle Examination

Thompson’s Test

Thompson’s test assesses the continuity of the Achilles’ tendon performed by having patient lie prone on the exam table with feet hanging loosely over the edge, then squeezing the calf. Positive test is lack of plantarflexion with calf squeeze.
Foot / Ankle Examination

Nerve Compression Syndromes

Tarsal Tunnel syndrome:
- entrapment of the posterior tibial nerve at the medial malleolus
- Tinel’s test at the tarsal tunnel should exacerbate the pain and/or plantar dysesthesias

Morton’s test
- used to detect interdigital neuromas
- performed by applying a compressive force to the 1st and 5th metatarsal heads
Summary

You must examine the body part to detect the injury.

Check

- range of motion
- strength
- stability
- pain to palpation
- special tests