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

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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 the normal, especially when increased compared to other shoulder, strongly suggests clinical instability

Shoulder - Instability

Multidirectional

diagnosed when humeral head exhibits instability inferiorly 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

Elbow / Forearm Tendonitis – Provocative Maneuvers

- 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

Elbow / Forearm Tendonitis – Provocative Maneuvers

- 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

Elbow / Forearm
Nerve Compression Syndromes

Pronator syndrome: affects median nerve

- much less common then 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

Elbow / Forearm
Nerve Compression Syndromes

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

Hand / Wrist Examination
Stability Testing

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
Provocative Maneuvers

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 tendonitis

- 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