Objectives

Assess the patient and educate the family on development of physiologic variations. Recognize when to refer to a specialist and when you, the provider, can observe.

- Genu Varum
- Genu Valgum
- Tibial Torsion
- Femoral antversion
- Habitual toe walking

A hands on approach for an age appropriate physical exam for the pediatric orthopaedic patient.

- Spine/neck - Scoliosis, kyphosis, back pain, torticollis
- Hip - Developmental Dysplasia of the Hip, Leg Length Discrepancy, Slipped Capital Femoral Epiphysis
- Foot - Clubfoot, metatarsus adductus, calcaneovalgus foot deformity, pes planus

3. Formulate an appropriate work up the pediatric patient with orthopedic concerns.

4. Develop a depth of knowledge in the pediatric orthopedic field to educate and ease parental concerns.

Lower Extremity Variations

- Genu Varum (Bow Legs)
  - Physiologic
  - Blount’s Disease
  - Rickets
- Genu Valgum (Knock Knees)
  - Physiologic
  - Post-traumatic
  - Rickets
- In-toeing
  - Metatarsus adductus
  - Internal tibial torsion
  - Femoral antversion
- Out-toeing
  - External tibial torsion
  - Femoral retroversion
- Toe Walking
Presenting Complaint

• “Pigeon Toed”
• “Grandma’s worried”
• “Keeping him from walking”
• “Tripping & Falling”
• “Walks funny”
• “Just not normal”
• “Doesn’t look like any of my other kids”

Angular Deformities

From Bowed legs to Knock knees to Neutral

[Diagram showing normal progression of growth over time]

[Graph showing progression of varus and valgus angles over age]

[Images of x-rays at 24, 25, and 36 months]
Physiologic Genu Varum
"Bow Legs"

- Symmetric genu varus
  - Age: 0-2 years
  - Normal growth plate on x-ray

Angular Deformities

- Worrisome clinical features
  - Lateral thrust during gait
  - Short stature
  - Abnormal location of the deformity
  - Apparent enlargement of elbow, wrists, knees & ankles
- X-rays indicated if:
  - Asymmetry
  - Atypical age
  - Worsening deformity

Genu Varum

- Symmetric varus
  - Normal growth plate on x-ray
Blount's Disease
Pathologic Genu Varum

- A progressive deformity
- 60% bilateral
- Early walking, obesity, family history of Blount's
- Hard to diagnosis before age 2-3 at earliest.
- Lateral Thrust during gait.
- Corrected with bracing or surgery.
- If a child after 2 still has Genu Varum, REFER!

Rickets
Pathologic Genu Varum

- Rickets
  - Short Stature
  - Enlargement of elbow, wrists, knee, and ankles
Skeletal dysplasia

- Short Stature
- Positive Family History

Physiologic Genu Varum vs. Blount's Disease vs. Rickets

Physiologic Genu Varum
Blount's Disease
Rickets

Physiologic Genu Valgum
“Knock Knees”

- Symmetrical valgus,
  - Age 3-5 years
  - Improves with growth
  - Normal growth plate on x-rays


Pathologic Genu Valgum
Differential Diagnosis
- Proximal metaphyseal tibial fracture – 2° to overgrowth
- Rickets
- Skeletal dysplasia
- Fibrous dysplasia
- Osteochondromas

More of Pathologic Genu Valgum

Treatment
- Observation
  - X-ray order: AP standing bilateral lower extremities
  - Need to be able to compare both sides of the entire lower extremity
- Orthotic – very rarely
- Hemi-epiphysodesis
- Osteotomy
Physiologic

- Symmetric
- Varus to Valgus to Straight pattern of resolution depending on age
- Normal function and gait
- Otherwise healthy child

Pathologic

- Asymmetric deformity, gait disturbance
- Failure to resolve within normal age parameters
- + Review of Systems or Family history
- X-rays diagnostic

Rotational Deformities

- Most common pediatric orthopedic referral
- Noted in 1 out of 10 children
- “Deformities” are structural, rarely dynamic, usually symmetrical
- Most “Deformities” are normal variants – and change with age
- Determine Level of “Deformity” (age provides a big hint)

In-toeing

- Metatarsus adductus (< 18 months)
- Internal tibial torsion (18 months to 3 years)
- Femoral anteversion (> 3 years)
**Metatarsus Adductus**

- Most common congenital foot deformity
- Between birth and 18 months
- Frequently bilateral
- Flexible
- Spontaneously resolves in 85%

**Treatment**

- If mild/flexible:
  - Parents may stretch with diaper change
- If severe/rigid:
  - Serial cast
  - Reverse last shoes – up to 1 year

**Internal Tibial Torsion**

- Most common between 18 months and 3 years
- Usually bilateral
- Mother (or often Grandmother) notices
  - “trips and falls”
Internal Tibial Torsion

Physical Exam

- Intermalleolar axis
  - “normal” = 20 degrees external

Thigh-Foot Axis

Natural History

- Spontaneous improvement
- NEVER a functional problem

Treatment

- Observation and reassurance
University of Arkansas football program 1976

Compared coach's evaluations of players' football abilities with multiple physiologic parameters.

The correlation matrix for the criterion measure and the predictor variables of selected anatomical strength, balance, and power measures are presented, and the results of the study indicate that genu varum (0.445) and tibial torsion (—0.33) had the highest correlation with the coaching criterion variable. The average tibial torsion was 42.6 for these scholarship athletes, while normal average tibial torsion among a non-scholarship group was 27.4 degrees. Other anatomical characteristics measured, as well as strength and power measures, could not reach the critical level of ±0.263 to be significant at the 0.05 level, although horsepower was close (0.255).

Sprinting and intoeing.

Abstract

The relationship between sprinting ability and intoeing was explored in a single blinded controlled study performed on 100 high school students. Rotational profiles and sprinting foot progression angles were compared in 50 high school sprinters and 50 high school controls. Significantly more sprinters intoed during sprinting than controls (p < 0.05). Neither walking foot progression angle nor hip rotation appears to be a factor in sprinting.

The findings of this study suggest that low normal thigh-foot angles and sprinting intoed may correlate with sprinting ability. This information may reduce anxiety of parents of children with medial tibial torsion.
Femoral Anteversion

- Relatively common between 3 to 7 years
- May be familial
- Usually more common in girls
- Sit “V” style, “kissing patella”
- Most prominent running

PE
- Internal vs. External rotation of the hip
- Up to 60˚ medial rotation normal
- 70˚ - 90˚: Mild increased anteversion
- > 90˚: Severe increased anteversion

Natural History
- May show improvement up to age 10
- Does not lead to arthritis
- **NO FUNCTIONAL DISABILITY**
Out-Toeing

- Initially noted when infant is held upright <12 months
- Increased external rotation of hip
- Residual intrauterine position of LE’s
- Spontaneously resolves by 18 months

Differential Diagnosis:
- Calcaneovalgus foot
- External tibial torsion
- Neuromuscular imbalance (CP, Spina Bifida)
- SCFE
Summary

• In-toeing
  - Metatarsus adductus (Birth - 18mo)
  - Internal tibial torsion (18mo to 3 years)
  - Femoral anteversion (3 to 7 years)

• Out-toeing
  - External tibial torsion
  - Femoral retroversion

Reassurance and Education
  - Don't tell mother it will always get better, BUT NEVER A FUNCTIONAL PROBLEM

Idiopathic Habitual Toe Walking

• Cause unknown, tends to be habitual or familial.
• Natural History: Always bilateral, presents when toddler begins to walk.
• Improves later spontaneously with maturity and weight.
• Clinical Exam: +/- Reduction of ankle dorsiflexion. Normal neurologic exam.
• Treatment: Reassurance. PT: Heel-cord stretching. Serial casting. Sx: Heel-cord lengthening if not better on own.

Idiopathic Habitual Toe Walking

• Parents report: My child often walks on his/her toes. Poor balance, trips often, bouncy gait.
• Dx: Diagnosis of exclusion. Must rule out CP autism, etc....
If at all concerned about a secondary diagnosis, refer to neurology first!

Congenital Muscular Torticollis

AKA “twisted neck” or “wry neck”
- Tightness with the sternocleidomastoid muscle.
- Present at birth or develops soon after. Discovered in first 6-8 weeks of life when newborn begins to gain more head and neck control.
- Etiology unknown: Associated with first born (due to “crowding” in the uterus), DDH, breech.
- *Ask Parents* “Does he/she hold their head in one direction more often?”

Physical Exam
- Infant holds his or her head tilted to one side, chin to opposite direction
- Decrease ROM
- Soft lump may be felt (tightness of SCM)
- Plagiocephaly: one side of the face and head may be flattened because the infant always sleeps on that side
- 75% of babies affected is on the right side

Treatment
- Gentle stretching of the SCM
- Position toys where child has to turn head to see
- Surgical treatment last resort (only ~10% require)
Torticollis

- If the torticollis does not respond to conservative measures, then radiographic evaluation is mandatory, along with ocular and central nervous system evaluation.
- C-spine AP and lateral to rule out congenital vertebral abnormality

Scoliosis

- Scoliosis: spinal deformity resulting from laterally rotated vertebral bodies of the spine greater than 10 degrees.

Types of scoliosis:
- Idiopathic
- Congenital
- Neuromuscular

Idiopathic classification by age

- Infantile (0-3 yrs)
- Juvenile (3-10 yrs)
- Adolescent (>10 yrs)
Proper Scoliosis Exam

- Proper dress attire
- Pt should stand erect with feet slightly apart, knees straight, and arms hanging loosely at his or her sides.
- Observe for
  - One shoulder higher than the other
  - Larger space from arm to the side of the body (compare both sides)
  - Uneven waist creases
  - Uneven hip levels
- Adams Forward Bend

Leg length difference vs. Scoliosis

[Diagram showing a comparison of leg length difference and scoliosis]

[Diagram showing a scoliosis assessment technique]
Assessing and Diagnosing Scoliosis

Radiographs
- A & Lateral
  - Vertebral anomalies
  - Disc height
  - Hips
    - Pelvic obliquity with Limb Length Discrepancy
  - Curve (Cobb measurement)
  - Triradiate / Risser sign
  - Apical Lordosis on lateral film
Triadiate cartilage closure
Risser staging of iliac apophysis
Ossifies from anterior lateral to posterior medial along iliac crest

Treatment Options

<table>
<thead>
<tr>
<th>Curve Size</th>
<th>Risser 0, Premenarchal</th>
<th>Risser 1, 2</th>
<th>Risser 3-5</th>
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<tbody>
<tr>
<td>&lt; 25°</td>
<td>Observe</td>
<td>Observe</td>
<td>Observe</td>
</tr>
<tr>
<td>25° – 45°</td>
<td>Brace</td>
<td>Brace</td>
<td>Observe</td>
</tr>
<tr>
<td>&gt; 50°</td>
<td>Surgery</td>
<td>Surgery</td>
<td>Surgery</td>
</tr>
</tbody>
</table>

Treatment for Scoliosis

- Observation
- Bracing
- Surgery
Kyphosis

- Increased convex curvature of the thoracic spine
  - "Round-back" deformity
- Type of Kyphosis
  - Postural
    - Correctable by passive and active forces
  - Scheuermann
    - Fixed angular kyphosis with anterior wedging of the vertebral bodies
  - Congenital
  - Neuromuscular

Kyphosis - Treatment

- Postural
  - Muscle strengthening and stretching exercises
- Education
- Scheuermann
  - Observation
  - Physical Therapy exercises
  - Bracing (relatively infrequent)
  - Surgery
    - Reserved for patients with pain, rigid deformity, a curve more than 75 degrees, and unacceptable cosmetic appearance.

Back Pain

- History
  - Onset, character, location
  - Constitutional symptoms
  - Aggravation and alleviation factors
  - Age-related conditions
  - Assessment of general symptoms
- Physical Exam
  - Inspection, palpation, ROM, neurological exam
  - DTRs, clonus, abnormal Babinski, umbilical reflex
  - General physical assessment
- X-ray
  - Standard radiographs should be ordered for all children age 4 or younger with back pain and in older children when pain has lasted greater than 2 months.
  - Advanced imaging is reserved for patients with abnormal plain films, constant pain, night pain, radicular pain, or abnormal neurologic examination
  - Nonspecific back pain was diagnosed in patients with intermittent pain and normal radiographs
Back Pain - Treatment

- Pending normal radiographs and neurological exam
- Core and hamstring stretches
- Yoga
- Activity modification
- NSAIDS

There are many different causes of back pain. The patient needs a full history. Imaging depends on history and PE.

Normal Hips

Normal Hips

Hip Disorders

- Developmental Dysplasia of the Hip - DDH
- Legg Calve Perthes - LCP
- Slipped Capital Femoral Epiphysis - SCFE

Normal Hips
DDH
Developmental Dysplasia of the Hip

- A common pediatric orthopedic condition with an area of focus in a newborn evaluation
- Diagnosed with a spectrum of anatomic abnormalities including:
  - A hip that is dislocated and irreducible
  - Unstable (meaning dislocatable and reducible)
  - Or simply dysplastic but reduced within the acetabulum
- This is differentiated from a Teratologic hip dislocation noted in infants at birth with underlying genetic, neurologic or muscular conditions

DDH
Incidence and Association

- Acetabular Dysplasia: 1/100
- Hip Dislocation: 1/1000
- Unstable hip: somewhere in between
- Associated diagnoses:
  - Congenital Knee Dislocations
  - Congenital muscular Torticollis
  - Menatarsus Adductus and/or Clubfoot

DDH
Risk Factors

- First Son: theorized due to a smaller uterus
- Female: 4 times as likely as boys
- Breech Positioning in utero: 16% of infants with DDH were in Breech positioning in uterus
- Positive Family history of Hip Dysplasia or early Total Hip Replacement: 12 times more likely to have DDH than children of unaffected parents
**DDH - History**

- Newborn
  - Birth order, position, weight
  - Family History

- Infant/Child
  - Toe walking - can be unilateral
  - Limb length inequality
  - Waddling Gait
  - Hyperlordosis (Swayback)

**DDH - Physical Exam**

- Relaxed, quiet child - use pacifier, music...
- Controlled setting and experienced examiner
- Delicate examination of the hip - no white knuckles!!
- Don’t forget the neck, feet and spine exam to evaluate for associated diagnoses

**Ortolani Positive (VERY GENTLE!!)**
Abnormal Klisic • One finger on Greater Trochanter of the femur • One on Anterosuperior iliac spine • Draw an imaginary line from your fingers - it will be below the umbilicus when abnormal

Abduction • Observe for symmetry • Full, wide symmetric - Normal • Asymmetric - Abnormal

Abnormal Klisic - 9

Abduction • Observe for symmetry

Abduction
• Full, wide symmetric - Normal
• Asymmetric - Abnormal

DDH - Treatment

Pavlik Harness
Abduction orthosis (if Pavlik harness fails)
If all conservative measures fail or >6 months of age at diagnosis:
• Closed reduction 1st surgical option
• Open reduction if closed reduction fails
• Spica cast to hold hips in reduced position
Legg-Calve Perthes

**LCP**

- Idiopathic osteonecrosis of the capital femoral epiphysis.
  - Vascular interruption to subchondral bone; periartricular cartilage is not affected.
  - Epiphyseal changes due to subchondral $Fx$
- Ages 2-14 (mostly 5-8); Boys $>$ Girls; 15-20% b/l; Caucasian.

**Clinical Presentation**
- Boy
- Small for age
- Delayed bone age
- Very active or hyperactive
- Pain may be non-specific
  - Anterior hip, thigh or knee
- Insidious onset (maybe weeks-months)
- Mild limp
- Usually no history of trauma
PE
- Limp
- Limited motion: abduction and internal rotation
  - Depends on the stage of disease
  - Guarding with leg rolling
- Atrophy of thigh muscle secondary to disuse.
- Leg length inequality due to collapse of femoral head

AP Pelvis and Frog Lateral
- compare to the contralateral side
- Early changes: smaller epiphysis, radiodense, crescent sign or mild flattening
- Metaphyseal radiolucency

Initial stage ➔ Resorption/Fragmentation stage ➔ Re-osseification ➔ Healed stage

- Self-healing in 2-4 years
- Problem: Not always end up with a spherical head
- Can produce permanent femoral head deformity and early arthritis in adulthood
- Poorer outcome in older patients (>8 years of age)
**Diagnosis of Exclusion!**

**Differential Diagnosis**
- Non-specific synovitis
- Arthritis
- Septic arthritis
- Other causes of avascular necrosis: sickle cell disease, steroids, MED, chemotherapy

**Treatment**
- Reduce activities (sports, running, jumping, etc.)
- Crutches, walker, and/or wheelchair
- NSAIDS—judicious use as it may prevent bone formation with chronic use
- Referral to pediatric orthopedist (within 2-3 weeks)

**Slipped Capital Femoral Epiphysis (SCFE)**
- Displacement of the epiphysis relative to the femoral neck and shaft
- Epiphysis held in the socket while neck and shaft displace anteriorly and rotate externally
- Head “slips” posteriorly through the growth plate
- Weakened physis and mechanical factors (Obesity, growth plate orientation, periosteal thinning)
SCFE

Classification
- Stable: able to weight bear
- Unstable: unable to weight bear with or without aid
- Fracture-like symptoms
- Predictive of Avascular Necrosis
- Stable: rare
- Unstable: 47%

Incidence: 2-13/100,000
Adolescents (peripubertal age)
- Boys 13.5 (12-15) > Girls 12 (10-13)
Obesity: 51-77% patients with SCFE
- More common in African-American and Polynesian children

SCFE

Presenting Features
- Hip/groin pain
- Knee pain
- Limp/weakness
- Externally rotated, short leg
- Limited internal rotation
- Leg externally rotates upon hip flexion
- Acute slip: like fracture
SCFE

- Radiographic Changes - Diagnostic
  - AP Pelvis:
    - Widened physis
    - Decreased epiphyseal height
  - Frog Lateral:
    - More sensitive evaluation for the degree of slip

Treatment of choice: In Situ Fixation
- Immediate referral to Peds Ortho. Non-weight bearing!
- Abnormal gait and externally rotated leg position are permanent
- Outcomes depend on the severity of the slip and whether stable or unstable slip
Clubfoot
Talipes equinovarus

- Congenital abnormality that occurs in 1/1000 births; 50% bilateral.

Clinical Exam
- Equinus, adductus, varus, cavus and medial rotation
- Differentiate from metatarsus adductus by seeing the equinus in clubfoot.
- Dx should be prompt
- Immediate referral to initiate casting

Goal of Treatment
- Flexible, shoeable foot
- Foot, leg never looks entirely normal in true congenital clubfoot deformity

Treatment options
- Serial casting (Ponseti technique)
  - Casting 3-6 weeks, heel cord lengthening, shoes with brace full time for three months, then nights and naps till 4 years old.
- Or: PT guided daily stretching program ("French technique")

Calcaneovalgus

- Common positional abnormality of the neonate

Characterized by:
- Excessive dorsiflexion and eversion of the foot/ankle
- Limited plantar flexion
- May be unilateral or bilateral

Expect resolution by walking age without treatment
- You can teach parents stretching exercises
- If not resolved by walking age, reconsider the diagnosis
Foot Deformity

- Flat Feet
  - Flexible
    - Common
    - Benign
    - Variation of normal
  - Tarsal Coalition
    - Calcaneonavicular coalition
    - Talocalcaneal coalition
    - Accessory Navicular

Physiological Flexible Flatfeet
Pes Planovalgus

- Typically not painful. Parental anxiety is a hallmark, pain is not.
- Increased joint laxity throughout examination.
- If painful: Symptoms include medial arch pain and fatigue, cramping at night.
- Incidence: Most frequently manifests in the 2-6 year age group, peaking at 3%

Flexible Flatfeet

- PI: Longitudinal arch absent on standing. Appears on toe stand.
- Asymptomatic patient: Reassurance.
- Orthotics are reserved for symptomatic patients.
  - Exclude other more likely sources of pain.
  - Orthotic wear does not change the shape of the foot, and this should not be the goal of treatment.
- Surgery to correct flexible flatfoot deformity is rarely necessary.
  - Surgery often results in scarring of the foot with loss of flexibility.
  - May not resolve complaints of discomfort.
Flat Feet
Tarsal Coalition

- Probably the most common source of diagnosable foot pain in children
- Patients rarely complain of pain before ages 8-13, despite the congenital nature of the problem
  - Pain is usually vague, around the outer ankle, instep or lower leg
  - Usually worse after exercise
  - Recurrent ankle sprains

Tarsal Coalition

- Clinical features:
  - Fixed Flattening of the longitudinal arch
  - Fixed hind foot valgus
  - Limited passive inversion of the subtalar joint (peroneal muscle spasm)
  -Externally rotated, inflexible foot on exam
  - Tight heel cord may be present
  - Longitudinal arch may/may not reconstitute when foot is in non-weight bearing position or walks on toes

- Congenital deformity characterized by failure of two or more foot bones to separate
  - Calcaneonavicular
  - Talocalcaneal
Accessory Navicular

- **Clinical features**
  - Prominence of the medial aspect of the navicular (with or without tenderness)
  - Often seen in association with mild flatfoot

- **Radiographs**
  - Medial navicular prominence with accessory ossicle
  - Reverse oblique films or CT to see properly

- **Treatment**
  - Initial trial with orthotics to provide comfort
  - Surgery when daily activities are limited by pain
Objectives

1. Recall the elements of a good history intake for a hand examination.

2. Describe the elements of a motor and sensory examination of the hand.

3. Discuss findings associated with common hand disorders seen in your clinic setting.
Key Points in the History
"Get your ducks in a row"

- **IMPORTANT TOOL**
  - helps develop accurate diagnosis
  - current problem and choose treatment option

  "Chief Complaint"
  - Location, intensity, duration, frequency,
    radiation and associated symptoms

  Patient Demographics
  - Age, gender, hand dominance

---

History

- How did it happen or begin?

  Other medical conditions:
  - Diabetes or renal disease, cardiac, pulmonary, rheumatologic or dermatologic disease?
  - Prior surgical history, personal and family history with bleeding and anesthesia

Family History

---

History

- Social History
  - Tobacco use, ETOH, occupation, hobbies/sports activities? Caretakers?

  Allergies
  - Food, drug, chemicals

  Medications
  - OTC, herb supplements, breathing treatments

  Tetanus Immunization status
Basic Exam Skills

- Inspection
- Palpation
- Range of Motion
- Neurologic - Motor and Sensory
- Special tests

Trauma:
"Topographical Anticipation"

- Think while you are examining!
- By knowing anatomy, you’ll anticipate which structures are injured
- Then you can direct your examination

Open wounds
What lies beneath?

- Get a map! Use the anatomy book!
- Assess the function of potentially injured structures
  - Distal perfusion? Pulses, color, cap refill
  - Distal sensation and motor function?
  - Tendon continuity? Stance, full active movement
  - Bone or joint injury?
**Inspection**
- Use the “Control” – the other upper extremity
- Skin?
  - Open wounds? Scars/markings? Discoloration?
  - Redness? Ecchymosis?
- Muscular Atrophy?
- Trophic changes? (sweat pattern, hair growth)
- Deformity?
- Swelling?
- Vascular perfusion?

**Palpation**
- Local Tenderness? – One finger
- Abnormal bony anatomy?
- Masses?
- Joint effusion? Crepitus?
- Pulses?
- Temperature?

**Range of Motion**
- Active – patient moves the joint
- Passive – examiner moves the joint
  - Remember for recording ROM for each joint – look it up
- Is it limited? Why?
  - Swelling?
  - Bone, Tendon, Nerve or Joint injury?
  - Arthritis? Disease?
- Record the range of motion!
Upper Limb Neurologic Examination

Motor
- Muscle Strength
- Ability to move through arc of motion
- Gross Motor Testing
  - Have the patient move all joints fully
  - "Make a full fist" - fingers should touch palm
  - "Straighten out your fingers all the way and bring your wrist up"

Three major nerves
- Median
- Ulnar
- Radial

PE: Muscle and Tendon Assessment

<table>
<thead>
<tr>
<th>Muscle Grade</th>
<th>Physical Exam Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No contraction</td>
</tr>
<tr>
<td>1</td>
<td>Fibrillations</td>
</tr>
<tr>
<td>2</td>
<td>Muscular contraction, insufficient to overcome force of gravity</td>
</tr>
<tr>
<td>3</td>
<td>Sufficient to overcome gravity through range of motion</td>
</tr>
<tr>
<td>4</td>
<td>Diminished strength</td>
</tr>
<tr>
<td>5</td>
<td>Normal strength</td>
</tr>
</tbody>
</table>

Secret Weapon
Neurologic Examination

- Sensory
- Three major nerves
  - Radial, Median, Ulnar
- Know distal anatomy
- Two point Discrimination - Paper clip!

Two Point Discrimination

- Static vs. Moving
- Objective
- Test both sides of finger - different nerves
- Normal ≤ 5 mm.

Moving 2PD
**Median nerve - Motor**

- "Extrinsic" muscles - Origin in Forearm
  - Radial wrist flexor
  - 4 FDS, 2 FDP
  - Thumb flexor

- "Intrinsic" muscles - Located in Hand
  - Thenars
  - Lumbricals II, III

**Median nerve - Extrinsic Motor**

- "OK" sign
- AIN - Anterior Interosseous n.

**Median nerve - Intrinsic Motor**

- Opposition
  - "pull your thumb up out of the palm"

**Best Test**

Palpate here. Pull the Abductor Pollicis Brevis.
Best Median Sensory

Ulnar nerve – Motor

- **Extrinsic** – forearm origin
  - Ulnar wrist flexor
  - FDP – ring and small

- **Intrinsic** – located in the hand
  - Hypotenar muscles
  - Adductor
  - 1st dorsal interosseous – best test

Ulnar nerve – Extrinsic Motor

- Small finger DIP flexion – FDP
Ulnar nerve – Intrinsic Motor

Hypothenar m.  Palmar side  1st dorsal interosseous m.

Ulnar nerve lesion

- Froment’s sign – substitutes FPL for adductor

Ulnar nerve lesion

- “Claw” deformity – “intrinsic minus”
Best Ulnar Sensory

Radial nerve - Motor

- All Extrinsic - from forearm
- Wrist, finger and thumb extension
- * PIP extension is intrinsic function - median or ulnar

Best Radial Sensory
The "No Sweat" Test

Vascular Occlusion:
Patency of arterial inflow

- Allen test - check one artery at a time

Easy Check for Flexor Tendon

- Stance test
  - Checking for tendon lacerations
  - Loss of normal cascade of flexor stance of the hand
  - "Squeeze test" the midforearm
Mid Point Review

- History
- Inspect, Palpate, ROM
- Neurologic - Motor and Sensory
  - Three nerves - RUM (radial, ulnar, median)
    - A-Ok, palpate the thenar muscle
    - Feel 1st dorsal interosseus, hypothenar
    - Wrist and fingers extended
    - 2 point discrimination
    - Sweat patterns

Special Tests - feeling like a pretty cool duck now 😊

Quick testing tips...

- DeQuervain’s tenosynovitis
- Carpal Tunnel Syndrome
- Cubital Tunnel Syndrome
- Thumb CMC arthritis
- Ganglion Cysts
- Tennis Elbow
- Mallet Fingers
- The wrist……
- The shoulder……
DeQuervain's Tenosynovitis:
- APL and EPB tendons in 1st dorsal wrist compartment - radial styloid tenosynovitis
- Pain over the radial styloid
- Finkelstein's test

Treatment:
- RICE (Rest, Ice, Compression, Elevation)
- Splint
- Medications: NSAIDs, Steroids
- Therapies: OT, stretching, massage, iontophoresis
- Surgery: Rare

Carpal Tunnel Syndrome:
- Pressure on median nerve in carpal canal as it passes under transverse ligament
- Conditions: MPS, driving car, RA, pregnancy or no medical issues
- Numbness (thumb, index, middle, radial side of ring)
- Exam:
  - Symptoms reproduced with Tinel's sign: tap the wrist
  - Phalen's Test: wrist in flexion

From Blausen Gallery 2014
**Phalen's test**

"Tell me what you feel?"

Increases pressure on median nerve

Positive if patient quickly reports numbness in median distribution

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**Treatment**

- **RICE**
  - Change patterns of hand use.
- **Splinting**
  - Steroid injections into the carpal tunnel (helps reduce swelling around the nerve)
  - Symptoms that are severe or do not improve:
    - surgery may be needed (EMG/NCS)
    - transverse carpal ligament release
    - recovery may take several months

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**Cubital Tunnel Syndrome**

- **Symptoms:**
  - Numbness/tingling ring and small fingers, pain in the forearm, and/or hand weakness.
  - Tinel's sign present
- **Causes:**
  - Pressure: little padding over nerve
  - Stretching: keeping the elbow bent for a long time can stretch the nerve
  - Anatomy: does not stay in its place and snaps back and forth

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Treatment
- Avoid actions that cause symptoms: keeping elbow bent, leaning on elbow
- Wrap pillow or towel around the elbow or wear a splint at night to keep the elbow from bending. Heel bows during day. Nerve gliding exercises
- Surgery to relieve the pressure on the nerve: releasing the nerve, moving the nerve to the front of the elbow, and/or removing a part of the bone. (EMG/NCV for preop)
- Recovery can vary: numbness and tingling may improve quickly or slowly. In severe cases, symptoms may not completely go away.

Thumb CMC Arthritis
- "Grind" test - stresses joint
  - Positive if painful

Treatments
- Aging population, more frequently women.
- Non-surgical methods: ice/heat, NSAID, splinting, and injections.
- Surgery consists of removing the trapezium bone.
Ganglion Cysts

- Common locations:
  - Top or palm side of the wrist
  - Base of the finger on the palm side
  - DIP joint of the finger
- "Water balloon on a stalk": Filled with clear fluid or gel.
- Causes unknown: ? mechanical changes, ?arthritis, old injury
- Exam:
  - oval or round
  - soft or firm
  - pea sized nodules
  - large nodules
  - may be tender to applied pressure, such as when gripping

Treatment

- Often non-surgical.
- Observe, especially if painless, frequently disappear spontaneously.
- Painful cyst: limit activity, use of splints, NSAIDs.
  - Do not aspirate dorsal cyst on radial side of wrist (radial artery near by).
- If nonsurgical options do not work...
  - surgery involves removing the cyst along with a portion of the joint capsule or tendon sheath.
  - both traditional open and arthroscopic techniques usually yield good results.

Tennis Elbow - Lateral Epicondylitis

- Degeneration and micro-tears of the ECRB origin.
- Located anterior to the lateral epicondyle, elicited by forced wrist extension
- Causes:
  - hammering, tennis backhand
- Worse with elbow extended (extends the origin)
Tennis Elbow - Lateral Epicondylitis

- Treatment: Nonsurgical (80-90%)
  - Modify activity
  - Therapy: Stretching, heat
  - Counterforce brace
  - Steroid injection

Mallet Finger - “baseball finger”

- Loss of active extension of the DIP joint
- Causes:
  - Baseball or other objects hits the tip of the finger
  - Can order x-ray - rule out large fragments from tendon avulsion of the distal phalanx that may need surgery: Jersey finger
  - Immobilize for 6 - 8 weeks
Let’s Review

- DeQuervain’s tenosynovitis
- Carpal Tunnel Syndrome
- Cubital Tunnel Syndrome
- Thumb CMC arthritis
- Ganglion Cysts
- Tennis Elbow
- Mallet Fingers

THE WRIST

And OMG...

BE SYSTEMATIC AND KNOW DIFFERENTIALS
Examination

- Best position...
  - Elbow flexed to 90
  - Wrist at neutral
  - Pronation
- Approach the exam by wrist extensor compartments
- Is it "Extra-articular" vs. "Intra-articular"
- Radial sided vs. Ulnar sided
### Differential Diagnoses

**Radial sided wrist pain**
- Dorsal
  - Scaphoid (fracture, nonunion, ligament disruption, SL ganglion, synovitis, SNAC, SLAC)
  - Lunate (Kienboch, intersosseus ganglion, synovitis)
  - Tendonitis: Dequervains or intersection syndrome
- Volar
  - OA CMC arthritis
  - FCR tendonitis
  - Median nerve entrapment

**Ulnar sided wrist pain**
- Dorsal
  - Triquetrum: fracture, ligament disruption or tear, EOD tendinitis, TFCC tear or detachment, ulno-quadrate collateral ligament repair
  - Volar
  - Fracture hook of hamate
  - OA pisotriquetral joint
  - Volar TFCC tear

### 1st compartment
- Abductor pollicis long (APL) and extensor pollicis brevis (EPB) tendon forming the anatomical snuffbox, palmar boundary
  - Dequervains
    - Abductor origin
      - Flexor carpi radialis, APL, and EPB
  - CMC joint
  - Scaphoid
    - Flexor carpi radialis
Scaphoid injury - fell on outstretched hand

Radiographs may be normal at first.
If painful, best to immobilize and repeat the radiographs in 2-3 weeks to confirm scaphoid injury.

- Push on anatomic "snuffbox"

Scaphoid injury

- Tenderness, swelling
- High index of suspicion
- Base of thumb - anatomic "snuffbox"

2nd compartment

- Radial wrist extensors - extensor carpi longus and extensor carpi radialis brevis (ECRL and ECRB)
  - Pass beneath the EPL distal to the radius and palpated with the wrist in resisted dorsi flexion and thumb relaxed
  -Intersection Syndrome
    - "Wrist Leather"
  - Cause: Wrist extension and flexion overuse
3rd/4th compartment

- 3rd compartment: Extensor pollicis longus (EPL) forming medial border of anatomical snuffbox and passing on ulnar side of radial tubercle.
- 4th compartment: Extensor digitorum communis (EDC) and extensor indicis pollicis (EIP) tendons to four fingers. 
  - Dorsum of radius between the radial tubercle and ulnar head. 
  - Watson's test – SL tear (scapholunate tear) 
  - Put pressure on the scaphoid and the tubercle 
  - Start with ulnar deviation to radial deviation – positive if you hear a clunk

Wrist Stability Tests

Scaphoid shift test (Watson's test)

- Scapholunate instability
  - Put pressure with thumb on distal pole of scaphoid, index finger on radial styloid
  - Flex/flex. Release the thumb, clunk with radial and ulnar deviation. 
  - Pressure on the distal pole will cause the proximal pole to sublux dorsally and hit the examining index finger

- http://www.youtube.com/watch?v=79qOTKva5Yg

5th/6th compartment

- 5th compartment: Extensor digiti minimi (EDM) – the groove between the ulnar head and radius
- 6th compartment: ECU – ulnar aspect of ulna palpated distal to ulnar head with wrist in ulnar deviation
- Ulnar sided wrist pain
  - ECU tenderness
  - Piano key sign – checking the distal radial tubercle (PDRB)
  - Lacer’s test – STS (Scaphoid Tendon Stress Test)
  - Fosset’s test – FATS joint tip of the index
  - Ulnar abutment or impaction
**Extensor Carpi Ulnaris Tendonitis**

*Extraarticular* cause of ulnar sided wrist pain
- Office of the wrist (office workers, rowers, rowing)

**Symptoms:**
- Pain with wrist up and down, decreased grip strength

**No imaging:**
- US may assess stability. MRI may show tendonitis, TFCC pathology or tears

**Exam:**
- Pain with extension and supination, ECU reduces with pronation

**Treatment**
- Splint
  - Ulnar gutter to prevent ulnar deviation
  - Advise patient to avoid forearm rotation
  - 3-6 weeks
- Conservative Management
  - Steroid injection

**What is the TFCC??**

*Triangular fibrocartilaginous complex*

*Extraarticular* cause of ulnar sided wrist pain
- Traumatic: Fall on extended wrist with forearm in pronation. Traction injury to ulnar sided wrist
- Degenerative: Associated with ulnocarpal impaction and positive ulnar variance

**Ligaments:**
- Dorsal and volar radioulnar, ulnar collateral

**Symptoms:**
- wrist pain, turning a door key painful

**Exam:**
- Positive fovea sign, pain with ulnar deviation
- TFCC compression and radial deviation (TFCC tension)

**Imaging:** MRI, x-rays may be negative
Wrist stability test – ulnar sided

- Piano key
- Ulnar carpal abutment
- LT shuck
- Fovea sign

Wrist Stability Tests

Piano Key Sign

- DRUJ instability
- The patient’s arm is pronated and supported by the examiner.
- Push down on the ulna like a “piano key”.
- Positive: difference in mobility and pain compared to the contralateral side.
- [https://www.youtube.com/watch?v=EFb5H7JZD8](https://www.youtube.com/watch?v=EFb5H7JZD8)

Wrist Stability Tests

Ulnar carpal abutment

- TFCC tear or ulnar carpal impingement
- Ulnar deviate wrist with axial compression
- Positive: pain, pop or click, worse with wrist in ulnar deviation; pronation.
- [https://youyube.com/watch? Video ID](https://youyube.com/watch? Video ID)

Wrist Stability Tests

Ulnar carpal abutment

- TFCC tear or ulnar carpal impingement
- Ulnar deviate wrist with axial compression
- Positive: pain, pop or click, worse with wrist in ulnar deviation; pronation.
- [https://youyube.com/watch? Video ID](https://youyube.com/watch? Video ID)
Wrist Stability Tests

- **Lunotriquetral ballottment (Reagan test)**
  - LT instability
  - Anterior and posterior stresses of LT joint (pisotriquetral and lunate)
  - Positive: increased laxity and pain
  - [https://youtu.be/gFM25GC-Llc](https://youtu.be/gFM25GC-Llc)

- **Fovea Sign**
  - Ulnatriquetral ligament
  - Apply pressure to the ulnar fovea region of patient's wrists to detect tenderness.
  - Press your thumb between the ulnar styloid process and flexor carpi ulnaris tendon (between the volar surface of the ulnar head and pisiform)
  - [https://www.youtube.com/watch?v=q_Q_n7Adg9g](https://www.youtube.com/watch?v=q_Q_n7Adg9g)

Painful Shoulder Testing

- **Rotator Cuff (supraspinatus, infraspinatus, teres minor and subscap)**
  - Neer
    - Stabilize shoulder, arm extended in full flexion, subacromial
  - Hawkins Kennedy - Forward flexion of shoulder to 90 degrees and forcibly internal rotation, subacromial
  - Ziehr (long test) - subacromial
  - Arm out, thumb pointed down, ag resistance
  - Full can test - rotator cuff lesion, integrity of supraspinatus
  - Drop arm
    - Arm lowered slowly to waist - supraspinatus tear
  - Anterior shoulder dislocation - apprehension test -
Painful Shoulder Testing
- Scapular winging
  - Serratus anterior or Trapezius function (long thoracic nerve)
- Posterior shoulder dislocation
  - Brachial plexus injury, cannot passively or actively ER
- Glenohumeral Internal Rotation Deficit
  - Decreased internal rotation with arm out in external rotation
- Labral disorder
  - Pain, clicking with overhead motion
  - Rotation of loaded shoulder from extension to forward flexion
- Multidirectional instability
  - Generalized ligamentous laxity

Acromioclavicular joint arthritis
- Thoracic outlet symptoms
  - Border by scalene muscles, first rib and clavicle
  - Winger abduction and ER with neck rotated away and loss of pulse, reproduced
  - Adson - arm and neck extended, turned towards affected side, loss of radial pulse and reproduced
  - Roos - open and close hands held overhead

Last Review
- DeQuervain’s tenosynovitis - wrist
- Carpal Tunnel Syndrome
- Cubital Tunnel Syndrome
- Ulnar nerve lesion - Froment’s sign: clawing
- Thumb CMC arthritis
- Ganglion Cysts
- Tennis Elbow
- Mallet Fingers
- Scaphoid Fractures
- ECU tendinitis
- Wrist stability tests - piano key, LT shock, Fovea, ulnar abrasion
- Shoulder tests - Neer, Hawkins, drop arm, empty can, full can, apprehension testing, thoracic outlet syndrome
Resources

American Society for Surgery of the Hand (ASSH)
- Find a hand surgeon
- Books:
  - The Hand: Examination and Diagnosis
  - The Hand: Primary Care of Common Problems

Orthobullets

Phone apps:
- Peter Carter, MD - Common Hand Injuries - a cost of 99 cents
  - (Android users) http://www.amazon.com/dp/B01ES21QQ2

Thank you!