Objectives

- Recognize the impact of musculoskeletal referrals
- Recognize indications for orthopedic referrals
- Recognize evaluations, testing and nonoperative treatments to consider
- Recognize when a rheumatologist may become appropriate
- Recognize indications for ultrasound imaging

In 2002, the Centers for Disease Control reported that musculoskeletal problems are second only to upper respiratory illness as reasons why people seek medical attention in the emergency department.


Musculoskeletal symptoms are also the most common reason for visits to outpatient departments.


Economic burden of injury

In 2000 are estimated to cost the U.S. health care system

- $1.1 billion for fatal injuries
- $33.7 billion for injury hospitalizations
- $31.8 billion for injury emergency department visits
- $13.6 billion for other outpatient visits
- costs reflect treatment for physical injuries only


Testing

- Xray
- CT
- MRI
- US
- EMG/NCS
- Vascular studies
- Lab
  - Serum
  - Synovial fluid analysis
Nonoperative Treatments

- Physical therapy
- Eccentric exercise
- Stretching
- AROM/PROM
- ASTYM
- Modalities

- Medications
  - NSAIDs
  - Topical
  - Oral
  - Opioids
  - Tylenol

- Injections
- Cortisone
- PRP
- Sling
- Bracing/Splints
- Casting
- Boots

Education in musculoskeletal medicine has been shown to be inadequate in some medical school curricula.

Seventy-nine percent of the participants failed the basic musculoskeletal cognitive examination.


One of the most frequent referrals from primary care to specialist care is for a patient with a musculoskeletal complaint.

Professional society practice guidelines exist for many musculoskeletal diseases.

American Academy of Orthopedic Surgeons

ACOEM guidelines

American College of Occupational and Environmental Medicine

http://www.mdguidelines.com
Sideline Guidelines

- Searchable database on over 250 conditions
- Annotated x-ray, MRI, CT, and photographic examples
- References to related scientific literature
- Access to emergency guidelines

AO Surgery Reference

- AO Foundation
- Arbeitsgemeinschaft fur Osteosynthesefragen/Association for the study of Internal Fixation

Consensus for Referral

- University of California, San Francisco (UCSF) Health
- 178 PCPs
- 24 orthopedists
- 36 clinical scenarios
- ~65,000 primary care patients
- 214 questions
- 5000 referrals to orthopedics per year

What tests and treatments should be performed in primary care prior to orthopedic consultation for specific common musculoskeletal problems?

Which common musculoskeletal problems could be managed by the PCP with an eConsult by an orthopedist, in place of a face-to-face patient visit?

Referring Wisely: Orthopedic Referral Guidelines at an Academic Institution, The American Journal of Managed Care, VOL. 22, NO. 5, e185-e191

Table 2. Number of Questions That Reached Consensus

| Condition               | Number of Questions | Consensus Round 1 | Consensus Round 2 | Total Consensus
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<td>Foot and ankle</td>
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Consensus for Referral

What tests and treatments should be performed in primary care prior to orthopedic consultation for specific common musculoskeletal problems?

Which common musculoskeletal problems could be managed by the PCP with an eConsult by an orthopedist, in place of a face-to-face patient visit?
Consensus for Referral

Little agreement exists regarding which orthopedic problems a primary care pediatrician should understand to care effectively for children.

A no set of referral guidelines has been established

A judgment has been primarily subjective

A Previous attempts to create orthopedic referral guidelines have not been successful, even with primary care support.

A It therefore is difficult to establish criteria for appropriate referral to a pediatric orthopedic surgeon.

Consensus for Referral

A large proportion of referrals indicated either a lack of basic textbook knowledge or lack of examination skills and appropriate diagnostic tools as demonstrated by a high number of definitive diagnoses indicating normal variants.

Principles of Ambulatory Medicine
Consensus for Referral


Orthopedic Referral

- Expectations/Goals
  - Not met
  - Not set
- Does the patient want to be referred?
- Is the patient agreeable to surgery if recommended?

Emergent Referrals

- Amputations
- Open Fractures
- Closed Fractures with Gross Deformity
- Dislocations
- Acute Compartment Syndrome
- Neurovascular Compromise

Consensus for Referral


Orthopedic Referrals

- Emergent
- Non emergent
  - Urgent
  - Elective

Open Fractures

- Wound cultures
  - Not recommended
  - 20% of positive pre-debridement
  - 60% of post-debridement cultures
- Tetanus prophylaxis
  - Booster
  - 10 years or more if vaccination history
  - Post-traumatic wounds 6 weeks after injury
  - IG 3000 – 5000 units IM
  - Highly contaminated wound
- Antibiotic prophylaxis
  - Recommended within 3 hrs
  - Acute open fracture
  - First-generation cephalosporin
  - Duration debated > 24 hours

Distal Phalynx Fractures

Commonly missed open fracture

AO Foundation

Closed Reductions

- Fractures/Dislocations
- Multiple techniques depending on site
- If it won't reduce
- Fracture (complicated)
- Tissue impeding
- Muscle spasm
- Maintaining reduction
- Immobilization
- Swelling
- Adequate anesthesia

Anesthesia

- Local Anesthetic
  - Metacarpal block
  - Digital block
  - Intraarticular injection
- No monitoring
- Shorter time to discharge
- Regional
  - Nerve block
  - Digit block
  - Intraarticular injection, time, equipment
- General
  - Muscular relaxation
  - Pain relief
  - Neurovascular injury, time, equipment

Dislocations

- External rotation
- Milch technique

- Stimson technique
- Cunningham technique

Dislocations

- Traction/Counter Traction
Dislocations

- Sometimes overlooked
- Perilunate
- High suspicion
- Nursemaid’s elbow

Compartment syndrome

- Rapid Set-up
  - Simple, sterile, disposable
  - Accurate
  - Built-in microchip technology
  - Convenient
  - Pre-filled syringe, hand held
  - Quick and continuous pressure monitoring

Neurovascular compromise
- Warmth of extremity
- Color of extremity
- Pulses
- Pain
- Capillary refill
- Sensation
- Active movement

Nonemergent Referrals

- Urgent/Elective
- Structural
  - Congenital
  - Physical/apophysal
  - Bone
  - Fracture
  - Tumor/malignancy
  - Arthroscopically
  - Joint
  - Cartilage
  - Ligament
  - Tendon
  - Muscle
  - Nerve
  - Hardware
    - Retained ORIF
    - TJA
  - Foreign body/penetrating trauma

- Synovitis/Tenosynovitis
  - Rheumatologic
  - Crystal induced
  - Infectious
  - Reactive

- Neuromuscular
  - Entrapments
  - Dystrophies

- Arthritis/Arthralgias
  - Manual instabilities
  - Tendon disorders
  - Muscle disorders
  - Stress
  - Avulsion

Congenital

- Developmental dysplasia of the hip
- Femoral acetabular impingement
- Femoral torsion
- Genu varum and genu valgum
- Tibial torsion
- Metatarsus adductus
- Club foot
- Tarsal coalition
- Congenital trigger thumb
- Syndactyly
- Webbed digits
- Polydactyly
- Osteogenesis imperfecta
- Ehlers-Danlos
- Marfans
- Trisomy 21

Apophyseal Injuries

- Apophysitis
  - Iliac Crest
  - ASIS
  - Ischial Tuberosity
  - Greater Trochanter
  - Inferior patellar pole
  - Sindig-Larsen-Johansen
  - Proximal tibial tubercle
  - Osgood-Schlatter
  - Calcaneal
  - Heel
  - Severs

Imaging Findings of Lower Limb Apophysitis. AJR.196, March 2011
Avulsion of Apophysis

Fracture

Fracture Classification

- Integrity of Skin
  - Open (compound)
  - Closed

Fracture Blisters

- Delayed treatment
- Leave intact
- Alter treatment
  - Difficult to splint or cast
  - Surgical incision sites

Fracture Classification

- Stable vs unstable
- Displacement & Angulation
- Deforming forces

Orientation of Fracture

- Physis
  - Contributes to length
- Apophysis
  - Is a secondary center of ossification
  - Contributes to contour
- Weakest parts of a developing skeleton
- Vulnerable to injury

SCFE

- More likely or common during a growth spurt
- Boys than girls
- 10-16 years of age
- Risk factors
  - Excessive weight or obesity
  - 95th percentile
  - Family history of SCFE
  - Hyperthyroidism

High Risk Stress Fractures

http://www.orthopaedicsone.com/display/Main/Osteogenesis-and-exercise

AAOS

Clavicle Fractures

- Compromise skin integrity
  - Extremely rare of the skin to be perforated from within


Clavicle Fractures

- Displacement
  - Nonunion of displaced midshaft clavicular fractures was 15.1% after nonoperative care compared with 2.2% after plate fixation


Clavicle Fractures

- Shortening
  - > 2 cm
  - Predispose to nonunion and weakness
  - Wick, Orthop Trauma Surg. 2001

Fracture Nonunion

According to American Food and Drug Administration, a non-union is established when a minimum of 9 months has elapsed since injury and the fracture shows no visible progressive signs of healing for three months.

Fracture non-union epidemiology and treatment. Trauma 2016, Vol. 18(1) 3–11

Fracture Nonunion

Incidence and prevalence vary significantly based on anatomic region and the criteria used to define non-union. It has been estimated that 100,000 fractures go on to non-union each year in the USA.

Fracture non-union epidemiology and treatment. Trauma 2016, Vol. 18(1) 3–11

Fracture Nonunion

Risk factors:
- location of the fracture site
- surgical treatment
- bone displacement
- type of fixation
- treatment delay
- comminution
- inadequate treatment
- wound infection

Biological causes:
- patient age
- smoking
- diabetes
- obesity
- NSAID use


Fracture Nonunion

Locations prone to nonunion:
- Scaphoid
- Femur
- Tibia
- Humerus
- Clavicle
- 5th MT

Bone Stimulators

Bone stimulators:
- Exogen
- 86% healed in an average treatment time of 22 weeks


Bone Tumors

Detected:
- Painful
- Associated with a palpable mass
- Associated with a pathologic fracture
- Discovered incidentally on an imaging study

Staging of Bone Tumors: A Review with Illustrative Examples. AJR:186, April 2006

Lytic bone lesions:
- often not detectable on standard radiographs until the tumor has resulted in 30–50% loss of mineralization
Bone Tumors

Staging of Bone Tumors: A Review with Illustrative Examples, AJR:186, April 2006

<table>
<thead>
<tr>
<th>Clinical Condition</th>
<th>Radiography</th>
<th>MRI</th>
<th>Nucleus Medicine Bone Scanning</th>
<th>CT</th>
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<tbody>
<tr>
<td>Suspected bone</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Suspected soft tissue</td>
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<td>Suspected remote</td>
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<td>Suspected extraskeletal origin</td>
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<tr>
<td>Suspected malignant characteristics on radiography</td>
<td>X</td>
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</table>

Note: Modified from the Journal of the American College of Radiology. (Available online at http://www.jacr.org). The appropriate rating ranges from 1 to 5, with 5 being the most appropriate. Additional studies MRI and CT may be indicated if surgical intervention is contemplated and further diagnostic information is required.

6-year old girl with Ewing's sarcoma

16-year-old boy with osteosarcoma

17-year-old boy with soft tissue mass and osteosarcoma

11-year-old girl with osteosarcoma
Benign Bone Tumors

- Giant cell tumor
- Chondroblastoma


Metastatic Bone Disease

- Presentation
  - Pain
  - Pathologic Fracture
  - Impending Fracture
- Treatment
  - Radiation
  - Bisphosphonates
  - Chemo
  - Hormones


Avascular Necrosis

- Lunate
- Humeral head
- Femoral head
- Knee
- Tarsal Navicular
- 2nd MT head

Legg-Calve Perthes

- Male to female ratio 3:1
- Short stature
- Younger age 4-8
- ? Coagulopathies
  - higher incidence of factor V Leiden mutation, protein S deficiency, elevated factor VII, and G20210A mutation in LCP patients, especially males

Labral tears
- Shoulder
- Hip

Osteochondral Lesions
- Labral tears
- Shoulder
- Hip

Arthritis
- Primary
  - Degenerative
- Secondary
  - Disease driven
  - Injury driven
- Post Traumatic
- Injuries
- Erosive
  - Auto immune
  - Infectious
  - Neuropathic
- Injections
  - Cortisone
  - Hyaluronic
  - PRP
  - Stem Cells
  - Palpation vs guided
- Bracing
- Surgical
  - Fusion
  - TJA

Ligament Injuries
- Scapholunate ligament
- Thumb UCL
  - Stener lesion
- Elbow UCL
- HAGL lesion
- SC Separation
  - postterior
- AC Separation
  - Grade 3-6
- Lisfranc injury
- Syndesmotic injury
- Persistent instability after Grade 3 sprain of ankle and knee
- Cruciate ligament injury

Soft Tissue
- Gas
- Injected Material

Muscle
- Strains
- Contusion
- Myositis ossificans
Accessory Ossicles

Musculoskeletal Ultrasound

**Advantages**
- Ready accessibility
- Portability
- Quick scan time
- Dynamic
- Better patient tolerability
- No radiation, no side effects, no contraindications

**Disadvantages**
- Training
- Highly operator-dependent
- Equipment
- Cost
- Guided procedure(s)
- Personal interaction with the patient
- Selection of physical examination
- Specific for each individual
- Scanning technique is modified
- Contralateral comparison

Musculoskeletal Ultrasound

Physics

- **Transducer**
  - Emits sound waves (1%) and detects returning echoes (99%)
  - Linear array (large footprint & obvious orientation)
  - Superficial > 10 MHz
  - Deep 5-7 MHz

Physics of Sound Waves

- **Transducers**
  - Linear, (M/S)
  - Curvilinear (OB/ABD)
Musculoskeletal Ultrasound

MSK US Applications

- Diagnosis
  - RTC
  - Carpal tunnel
  - Achilles tendon
  - Synovitis

- Guided injections
  - Joint
  - Tendon
  - Cyst

- Percutaneous lavage
- Percutaneous release
- TF
- CT

Supraspinatous

Small Full Thickness Supraspinatous Tear

Supraspinatous

Transverse

Longitudinal
Small Full Thickness Supraspinatus Tear

MSK US vs MRI

- Ultrasound detection of rotator cuff and biceps tendon integrity is comparable to MRI and should be preferred in revision cases.


MSK US Carpal Tunnel

- Better specificity and equal sensitivity as compared with those of electrodiagnostic testing

MSK US Carpal Tunnel

Ultrasound Guided Injection

- AMSSM 2014 Position Statement
- Ultrasound guided injections vs Landmark guided injections
- 717% increase in outpatient diagnostic MSK US from 2000-2009

Ultrasound Guided Injection

<table>
<thead>
<tr>
<th>Level of evidence</th>
<th>Level 1 (mean ± SD)</th>
<th>Level 2 (mean ± SD)</th>
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<td>Patellar tendon</td>
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<td>Scapholunate</td>
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<tr>
<td>Knee joint</td>
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<tr>
<td>Hip joint</td>
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Large joint injection

Small Joint Injections

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Large joint injection

Small Joint Injections

1/17/2017
Evaluating for disability

- Disability
- Injury

Before and After

- Teleconsultation
  - Assessment of imaging
  - Smart phone camera/display
  - Triage
  - Initial treatment/reduce waiting times
  - HIPPA compliance

Dr. Google
Public Expectations

“Those snazzy pilots have a lot more with regular passengers like us. Who thinks I should fly the plane?”

Clinically Correlate

When I grow up...
I want to be like momma!