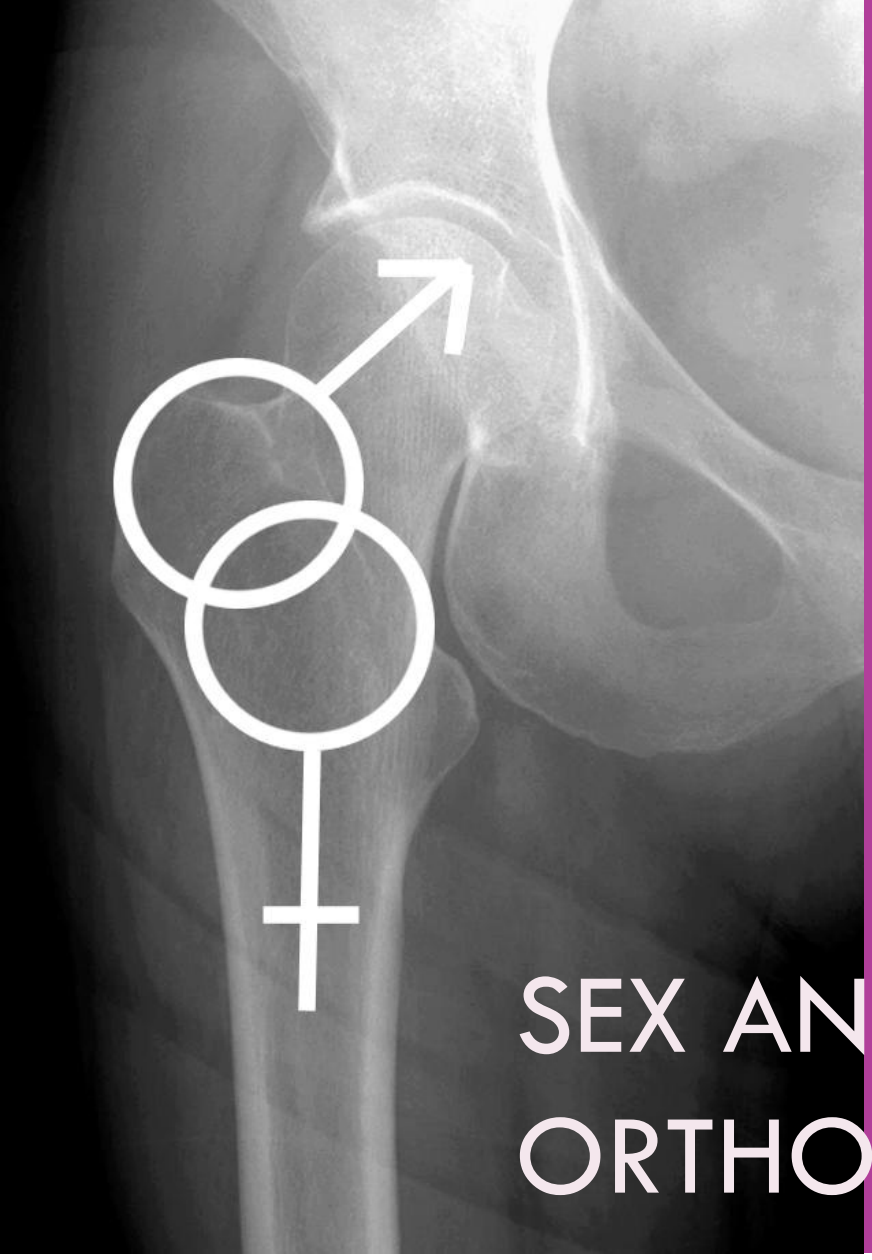

SEX AND YOUR ORTHOPAEDIC PRACTICE

AAOS
American Academy of Orthopaedic Surgeons

Women's Health Issues Advisory Board

Women's Health Issues Advisory Board

- The AAOS Women's Health Issues Advisory Board (WHIAB) seeks to advocate, advance, and serve as a resource on sex and gender differences in musculoskeletal health.
- Females suffer from injury/disease in different ways than males. Recognizing sex-related differences is critical to optimizing patient care.

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SEX vs. GENDER

- SEX: Determined by chromosomes

- GENDER: How one presents oneself in society

Dimorphism – What is it?

DIMORPHIC= Occurring in two distinct forms

- **Sexual Dimorphism:** Differences in biological response that is inherent in one's sex or chromosomal make-up

- **Gender Dimorphism:** Differences in response due to environmental and/or societal concerns

Mechanisms for Sexual Dimorphism

- Hormone-responsive genes influenced by hormonal milieu
- Genes located on X and Y chromosomes encode proteins that vary biochemical and physiologic pathways

Sexual Dimorphism in Orthopaedics

- **The musculoskeletal systems of males and females are different!**
  - Women have less muscle mass and different muscle fiber composition
  - Testosterone as well as high levels of physical activity increase muscle mass
  - Joint load is influenced by muscle strength and fatigue

- **So, why apply a "one size fits all" mindset to orthopaedics?**

Health Research: Males and Females

- Historically, "women's health research" focused on reproductive health
- Until the mid-1990s, clinical trials included only males

How should understanding of sexual dimorphism change the way we treat patients?

CAN WE IMPROVE OUTCOMES?

Sexual Dimorphism: Overview of Topics

- **Osteoporosis**
- **Arthritis:**
  - Osteoarthritis
  - Obesity and Leptin Production
  - Joint Laxity
- **Shoulder:**
  - Instability
- **Hand:**
  - Fibrosing Conditions
- **Spine:**
  - Scoliosis
  - Degenerative Spinal Disorders
- **Hip and Pelvis:**
  - Arthritis, DDH, and Impingement
  - Hip Fracture
  - Sexual Dysfunction after Pelvic Fracture
- **Knee:**
  - ACL Injuries
  - Gender Bias in TKA
  - Patellofemoral Conditions
- **Feet:**
  - Bunions
  - Posterior Tibial Tendon Dysfunction
- **Trauma and Pain:**
  - Trauma and Pregnancy
  - Intimate Partner Violence
  - Pain
- **Musculoskeletal Tumor**

Osteoporosis: Not Just a Women's Issue

- Historically thought of as a "disease of postmenopausal women"
- Few studies include males, though men are also affected by osteoporosis
  - Males are affected ~10 years later than females
- Estrogen affects bone size, timing of physeal closure, yet its action in males not well studied/understood

Arthritis: Osteoarthritis

- More females are affected by OA than males
- Incidence of OA is higher in obese females than obese males
  - Estrogen effects cartilage: fat cells make and store estrogen
  - Mechanics of increased joint loading is clear, however increases in OA are seen in non-weight-bearing joints

Arthritis: Obesity and Leptin

- Leptin is protein product of adipose tissue
- Leptin levels in synovial fluid directly correlates with Body Mass Index (BMI)
- Females have higher leptin levels due to higher total body fat composition
- Females with OA have higher leptin levels in synovial fluid than males with OA

Arthritis: Leptin, continued

- Leptin-deficient obese mice have no OA in knees despite increased weight bearing
- Leptin receptors are found on marrow stromal cells, osteoblasts, and osteoclasts
- Effects on osteoblasts may effect osteophyte development

Arthritis: Joint Laxity

- Trapeziometacarpal (TMC) arthritis is more common in females
  - Relaxin receptors identified in TMC joint
    - Member of insulin superfamily of peptides
    - Produced by corpus luteum during pg to soften cervix and pubic symphysis
    - Present in low levels in men and women
- Relaxin upregulates MMP-1 and 3
  - May lead to increased joint laxity
  - MMPs breakdown cartilage and ECM
  - May lead to arthritis of CMC

Shoulder Instability

- AMBRI (Atraumatic, Multidirectional, frequently Bilateral, responds to Rehabilitation and rarely requires an Inferior capsular shift) thought to be more common in females
- Generalized laxity measures do not assess shoulder
- Female sex is associated with BHS, not necessarily with shoulder laxity
- Females have decreased joint proprioception at the shoulder

Shoulder Instability

- Females are underrepresented in studies of surgical treatment of instability
- Male sex is associated with higher failure rate of surgery
- Limited research on outcomes of nonsurgical management in males versus females

Hand: Fibrosing Conditions

- Males get Dupuytren's 9:1
- Females get adhesive capsulitis 2.3:1

Spine: Scoliosis

- Scoliosis occurs more frequently in young females
  - Curves <10° 1.4:1 female:male
  - Curves > 30° 10:1 female:male

Spine: Degenerative Spinal Disorders

- Females demonstrate a greater incidence of instability-related disorders
- Males show disorders caused by structural deterioration
- Back pain increases in males up to age 50 then declines
- Female back pain peaks at 60

Hip: Arthritis, DDH, and Impingement

- Hip arthritis more common in females
  - Females are less likely to undergo arthroplasty
- Developmental Dysplasia of the Hip (DDH) is more common in females, especially breech births
- Pincer-type impingement more common in females

Hip: Fracture

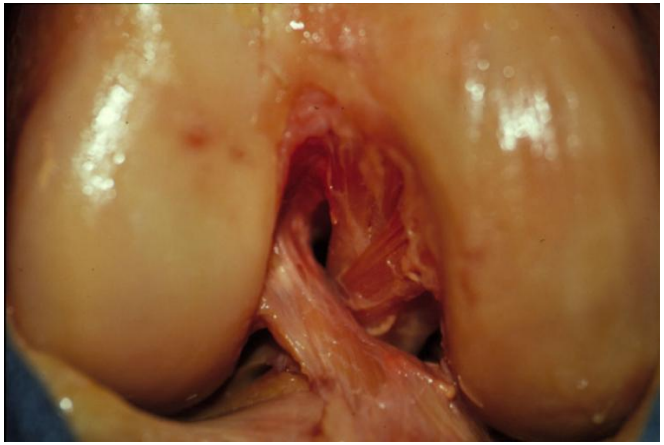
- Males who sustain hip fracture have more co-morbidities and higher mortality
- Males are more likely to sustain a secondary hip fracture and experience severe disability
- Few osteoporosis or hip fracture studies include males

Pelvis: Sexual Dysfunction after Fracture

- 38% of patients treated surgically for sacral fracture reported sexual impairment at 1 year
  - 46% of males, 14% of females
- Study: 71 young females with pelvic fracture
  - 49% had genitourinary complaints
  - 38% experienced pain with intercourse
- Due to urethral, vascular, neurologic, psychogenic injuries, up to 50% of males experience impotence with urethral disruption
- **Orthopaedic surgeons seldom ask nor offer counseling regarding return to sexual activity**

Knee: ACL Injuries and Treatment

- **Females ACL Injuries are seen at an increased frequency**
  - Increased recognition of injury
  - Improved technology and access to MRI
  - Increased female participation in sports



Knee: ACL Injuries and Treatment

- **Females likely at increased risk for ACL Injury**
  - Estrogen influences collagen synthesis and degradation
  - ACL tears show association with pre-ovulatory and perimenstrual timing
  - Female landing from jump: hip straight, internal rotation, straight valgus knee, exterior tibial torsion, pronated foot

Knee: ACL Injuries and Treatment

- **There is little research on sex differences in ACL reconstruction**
  - Graft choice, graft position, fixation, rehab, outcome, long term results
  - Recent meta-analysis found hamstring ACL in women to be more lax than in men, or in men and women who underwent B-T-B (no RCTs)

Knee: Gender Bias in TKA

- Canadian study: a male and a female patient with an identical story and identical disease visited 71 physicians (33 orthopaedists, 38 family practitioners)
  - Orthopaedic surgeons were 22x more likely to recommend TKA to males with moderate OA than to females

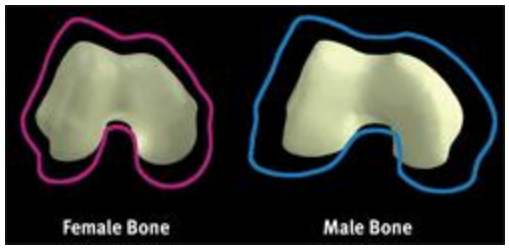
- ***No surgeon admitted awareness of gender bias.***

Knee: Gender Bias in TKA

- Why different recommendations?
  - Some attribute women's symptoms to emotional rather than physical causes
  - Females are more likely to use a narrative style and voice complaints, while males are more likely to describe symptoms factually
- Additional Considerations
  - Belief that females are less likely to agree to TKA
  - Belief that females more accepting of pain and functional limitations
  - Perceived greater importance of male's quality of life/ability to support family
  - Desire to protect female from surgical pain or cosmetic after effects of scar
- **Result: Females tend to receive TKA at a more advance stage of OA and have worse surgical outcomes**

Knee: Patellofemoral Conditions

- Females widely thought to have more PF issues
  - Sex disparity in first-time dislocations debatable, but females have higher rates of recurrence
- Anatomy:
  - Higher Q angle
  - More Anteversion
  - Higher rates of patella alta



Feet: Overview of Disparities

- Anatomical differences
  - Females have wider forefoot, shorter arch, shorter MTs
  - Females have thinner cartilage in foot/ankle joints
  - Females have greater ROM (plantar flexion, ankle) on gait analysis

Feet: Bunions

- Bunions are more common in females
- Adults seeking surgical correction favor females 9:1
  - Is women's shoewear to blame?
- Genetics implicated, esp. maternal transmission
  - Juvenile bunions are 84 -100% female in reported studies

Feet: Posterior Tibial Tendon Dysfunction

- Posterior Tibial Tendon Dysfunction is also known as *Acquired Adult Flatfoot Deformity*
- Spectrum of disabling symptoms and subsequent deformity associated with compromise or complete loss of the function of the posterior tibial tendon

Feet: Posterior Tibial Tendon Dysfunction

- The range of dysfunction seen in the clinical setting varies from mild symptoms of annoying tenosynovitis to complete rupture
- Symptoms include medial ankle pain, loss of arch, abnormal shoe wear with foot rolling inward, difficulty with ambulation, especially stairs
- **80% female**

Trauma and Pregnancy

- Anesthesia Considerations
  - Increased edema can obscure vocal cords, decrease gastric tone, and increase aspiration risk
- CT only if essential
- Radiation-labeled contrasts and gad contraindicated: iodinated contrast OK
- Shield above and below abdomen
- Pregnancy is hypercoagulable state
  - Warfarin crosses placenta, may contribute to teratogenicity
  - Low molecular weight heparin safe and effective

Trauma and Pregnancy

- Fetal heart rate responds faster than maternal heart rate
- Tip backboard to L to decrease aortocaval compression
- Midazolam teratogenic in animals
- Plate/screws less imaging than IM nail
- Avoid NSAIDS

Trauma: Intimate Partner Violence

- Females are more likely to experience orthopaedic injury from partner violence

Pain and Sexual Dimorphism

- Females are:
  - More sensitive to pain stimuli
  - Less tolerant of pain
  - More able to discriminate different pain patterns
- Efficacy of analgesics different in males and females
  - Differences in opiod receptors in body and their response in the presence of estrogen
  - Qualitative differences in neural processing of pain and analgesia?

Musculoskeletal Tumor: Epidemiology

- Bone and soft tissue benign and malignant tumors typically favor Males > Female ~ 3:2
  - Osteoid Osteoma M : F 2:1
- Exceptions: Females > Males
  - Giant cell tumor
  - Surface osteogenic sarcoma
  - Desmoid tumor

Musculoskeletal Tumor: Sarcoma

- Synovial Sarcoma
  - Translocation fuses the SYT gene from chromosome 18 to either of two highly homologous genes at Xp11, SSX1 or SSX2. SYT-SSX1 and SYT-SSX2
- Ewing's Family Tumor
  - MIC2 ag encoded by gene on Y chromosome. HBA 71, O13 diagnostic for disease
- Females are more likely to experience toxicity to chemotherapy agents

Conclusions

- Sexual dimorphism exists in orthopaedic surgery
- Be aware of sex/gender difference in incidence, presentation, response to treatment
- Consider sex differences planning research and reporting results
- Be conscious of bias in oneself and others

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