HIP THIGH KNEE
Ultrasound - Fundamental

STAFFORDSHIRE MSK STUDY DAY
BMUS

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Why Ultrasound

- Readily available.
- Shorter waiting times.
- Less expensive than other modalities
- No radiation.
- No reactions.
- Increase interest within MSK ultrasound
- Rapidly growing and will continue - future improvements with technology.
Ultrasound structure

Structure Characteristics

- Skin, fat, muscle
- Tendon
  - anisotropic
  - parallel collagen fibres
  - echogenic “bright” when sound is perpendicular to fibres
  - hypoechoic “dark” when sound is at an angle
Equipment Overview

- Good quality Ultrasound Machine
- High resolution Multi Frequency Linear Ultrasound Probe. (17.5Mhz, 14.5, 9 mhz)
- Hockey stick probe/ Curvilinear probe
- Colour flow/ Power Doppler
- EFV (trapezoid function)/Panoramic
- Liberal use of ultrasound gel (hairy!)
What’s the big quandrum
Anatomy
Bone structures and Soft tissue structures

- Abdominal wall musculature
- Anterior hip
- Hip joint
- Ilio-psoas
- Adductor origin
Diagnostic difficulty!!

Complex regional anatomy
- Insertion of rectus abdominis, adductor tendons, hip joint/bursae, hip flexors (iliopsoas)
- Inguinal and femoral canals

Complex Nerve distribution
The pubic clock.


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History taking

- How long pain present?
- Pain localised to a particular site?
- Sudden onset?
- What movements or actions precipitate the pain?
- Is there associated clicking or catching?
- Is there a palpable lump?
GROIN/HIP
Causes of pain

- Inflammation of the adductor muscle of the thigh
- Rupture of the adductor muscle of the thigh
- Inflammation of the pubic joint (osteitis pubis)
- Bursitis on the front of the hip joint (bursitis iliopectinea)
- Other bursitis
- Fluid accumulation in the hip joint
- Degenerative arthritis in the hip joint
- Rupture of the superficial hip flexor (ruptura musculus rectus femoris)
- Rupture of the deep hip flexor (ruptura musculus iliopsoas)
- Outer snapping hip
- Inner snapping hip
- Inguinal, femoral hernia
- Stress fracture in the femoral neck
- Nerve entrapment
- Lumbago
- Piriformis syndrome
- Hernia
- Lymphadenopathy
- Undescended testicle
- Varicocele
- Hydrocoele of the canal of Nuk
- Urological problems
Hip

- **Pathology:**
  - Joint effusion
  - Trochanteric Bursitis
  - Septic Arthritis- guided aspiration
  - Haematomas/Soft tissue masses

- **Clinical Conditions:**
  - Pain
  - Swelling
  - Redness
  - Soreness
  - Blood test results/spiking temp.
HIP

- ANTERIOR HIP
- LATERAL HIP
Rule out other causes
Plain film - X-ray
MRI

Normal Pelvis

Right Hip fracture and oedema
CT

- Limited but useful for determining femoroacetabular impingement
- 33 year-old male with cam type FAI. (A) Preoperative computed tomography shows a bump on the head and neck junction. (B) Postoperative computed tomography shows removed bump after femoroplasty. (C) Arthroscopic findings
Ultrasound : Anterior Hip joint - Probe position - Longitudinal along the line of the neck of femur
Anterior hip joint - Pathology

Joint Effusion

Femur

FLUID

Hip joint effusion
Anterior Hip Joint

Iliopsoas bursitis, Snapping hip, frog leg flexion

Paralabral cyst/tear
Trochanteric Bursa
Therapeutic treatment
Steroid Injection
GTPS Ultrasound

- Most commonly caused by gluteus minimis and gluteus medius injury/tear or tendinopathy rather than bursitis
- Distension of bursa often accompany tendon tear, therefore careful assessment of tendons
- Calcific tendinopathy
- Rare that bursae alone involved with the pain

Eur Radiol. 2007 Jul;17(7):1772-83

MRI and US of gluteal tendinopathy in greater trochanteric pain syndrome
Anatomy GT

- Gluteus minimus attaches to the anterior facet GT.
- Gluteus medius inserts superoposterior and lateral facets GT.
- Three bursae common: trochanteric, subgluteus medius, and subgluteus minimus.
Greater Trochanteric region
Probe position - Transverse

Position of Probe

Rt Greater Trochanter
Calcific tendinopathy

Small partial tear at the insertion of Gluteus medius

Bursitis
Tensor fascia latae, iliotibial tract

- Lateral hip pain
- Runners proximal enthesopathy
- ASIS
- Snapping hip - standing flexion and extension - TS
IT Band

- Leg position: extension; hip internally rotated
- Tip: find Gerdy’s tubercle and follow proximally
- MRI equivalent: frontal plane
HAMSTRINGS
Posterior thigh - Hamstrings

Arise from the ischial tuberosity:

- Biceps femoris muscle lies laterally. Tendon inserts into head of Fibula
- Semimembranosus muscle lies medially - tendon inserts medial condyle
- Semitendinosus muscle lies medially inserts via long tendon (Pes Anserinus Tendon) - onto the medial side of the popliteal fossa
Muscle related Pathology

- Haematomas - bruise.
- Morel Lavallee lesion-
- Rupture of muscle - Partial/Complete tears.
- Abscess - Infection.
- Muscle fibrosis - formation of excessive fibrous bands of scar tissue between muscle fibres.
- Seroma - A pocket of clear serous fluid.
- Myositis Ossificans- abnormal bone formation within deep muscle tissue, usually associated with haematoma due to trauma.
- Muscle hernia -
Pathology- Haematoma

Gastrocnemius muscle

Vastus lateralis muscle
Muscle rupture

seroma

Biceps Femoris stump
Muscle Fibrosis

Muscle fibrosis
Defect
Normal muscle
Myositis ossificans

Calcification
Quadriceps tendon
Clinical Conditions

- Pain
- Swelling
- Inability to actively extend knee.
- Palpable defect.

Causes:
- Trauma - falls, direct blows, lacerations.
- Associated Conditions: Renal disease, DM, RA, gout, obesity, osteomalcia, steroid use.
Anatomy - Quadriceps tendon

It attaches the 4 Quadriceps muscle to the patella: function - knee flexion and extension

1. Rectus Femoris - superficial - mid thigh - tendinous 3-5 cm proximal to the patella.

2. Vastus Lateralis - Lateral side of femur - tendinous 3 cm from patella.

3. Vastus medialis - Medial side of femur - tendinous 3 cm from patella.

4. Vastus intermedius - In between - deep layer to RF.

Inserts onto the proximal section of the patella.
Technique Quadriceps tendon

- The anterior aspect of the knee is examined with the patient supine.
- A knee flexion of approximately 20°-30° obtained by placing a small pillow beneath the popliteal space stretches the extensor mechanism.
- Avoids possible anisotropy related to the concave profile that the quadriceps and patellar tendons assume in full extension.
Ultrasound Technique - Transverse section
Anterior thigh - Quad muscles

RF - Rectus Femoris
VL – Vastus Lateralis
VI Vastus intermedius
VM – Vastus Medialis
Probe position - Longitudinal section

Supra-patellar fat

Pathology

- Tendinopathy
- Calcific tendinopathy
- Avulsion fracture
- Partial tear /Complete tear tendon
- Muscle tears
- Abscess
- Miscellaneous - Cyst
Pathology

- Tendinopathy - term that describes predominantly degenerative conditions that cause pain, swelling and stiffness (NICE April 2010).
- Repeated overuse - causes degeneration and disorganization of the Collagen fibres.
- Imbalance between pathological changes that occur in response to injury
- Complications - lead to tears/ruptures. (NICE April 2010)
Tendinopathy

- Focal thickening - tendon is against another structure which causes friction.
- Hypoechoic areas within the tendon.
- Disruption of the normal architecture of the tendon.
- Noticeable vascularity
Pathology - Tendinopathy.
Calcific tendinopathy
Partial /complete tears

- Partial tear/complete tear - generally over 40’s. Men.

- High grade partial tear of the quadriceps tendon.
- Red arrow Quads tendon – as is the large hematoma Green arrow - haematoma
- Pink arrow - Patella is positioned more inferiorly than normal
- White arrow - patellar tendon is lax, suggesting that this is functionally a complete tear.
- The deep layer of the quadriceps tendon, composed of the vastus intermedius (yellow arrow), remains intact.

Avulsion Fracture
Abscess

- Femur
- Abscess
- Quads muscle
KNEE
Extensor Mechanism

- Tendons
  - Patella tendon
  - Quadriceps tendon
- Popliteal fossa
- Bursa
- Medial and lateral Collateral ligament
- Pes Anserinus
Patella Tendon

- 5 cm in length
- Originates from Apex of Patella
- Inserts tuberosity of the Tibia
- Function: attaches the patella to Tibia to allow straightening of the knee.
The anterior aspect of the knee is examined with the patient supine.

A knee flexion of approximately 20°-30° obtained by placing a small pillow beneath the popliteal space stretches the extensor mechanism.

Avoids possible anisotropy related to the concave profile that the quadriceps and patellar tendons assume in full extension.

From its cranial origin down to its distal insertion using long- and short-axis planes.

Because the lower pole of the patella has a V-shaped appearance, one should be aware that the tendon inserts not only on the apex but also along the inferolateral and inferomedial edges of the bone.

Short-axis US images over the proximal patellar tendon should be also performed because tendinopathy may occur out of the midline.
Probe position - Longitudinal section

- Patella Tendon
- HFP
- bursa
- Tibia
Patella tendon - Transverse Positioning.
Clinical indications

- Pain
- Jumper’s Knee
- Injury- Falls/direct impact
- Chronic disease
- Osgood Schlatter Disease
Pathology

- Tendinopathy - usually at insertion or in the mid tendon
- Ruptures:
  - Intrasubstance tear - small fluid filled pocket within the tendon
  - Partial - Some tendon fibres identified through the tear
  - Complete - Complete disruption of fibres, No fibres attached at either ends of the tear.
- Chronic diseases - Weakens the tendon.
Pathology- Tendinopathy
Tendinopathy continued.
Jumper’s Knee

Tendonopathy at apex insertion, thickened patella tendon, micro ruptures, increased cortico- irregularity and increased vascularity.
Partial - Tears/Ruptures

Patella

Mid Tendon

Tibia
Complete Rupture

This x-ray taken from the side shows the normal location of the kneecap. (Right)
The kneecap has moved out of place due to a torn patellar tendon.

To reattach the tendon, small holes are drilled in the kneecap (left) and sutures are threaded through the holes to pull the tendon back to the bone (right).
Popliteal Fossa

- Anatomy: - posterior aspect of the knee joint.
  
  Medial and lateral heads of Gastronemius muscle
  femoral condyle
  Sartorius muscle
  Junction of the semimembranosus tendon (most medial of the 3 hamstrings) and Gastrocnemius tendon - important landmark.
Knee - Bursa

- Protective cushion for the knee

Bursitis

- Prepatellar bursitis (housemaid’s knee)
- Infrapatellar bursitis (clergyman’s knee)
Pre patellar bursitis

Anterior Knee Pain

- Prepatellar bursitis
Probe position

- Head of Gastrocnemius muscle
- Medial Femoral Condyle
- Sartorius
- GT
- SMT
Clinical Indications.
Pathology

Clinical indications.
- Pain
- Swelling
- Aching

Pathology:
- Baker’s cyst
- DVT
- Popliteal aneurysm
Popliteal fossa - Common pathology
Baker’s cyst
Neurovascular bundle

DVT - Popliteal vein

Popliteal aneurysm
Ligaments of the knee-
Medial and lateral collateral ligaments

- Acts as a holding mechanism to keep the meniscus (shock absorbers) in place:
- Clinical indications:
  - instability
- Pathology:
  - Rupture
  - Bowing of the meniscus/ligament
Ultrasound technique for assessment of medial aspect of knee

- For examination of the medial knee, the patient is asked to rotate the leg externally with a 20°-30° of knee flexion.
- Place the transducer obliquely-oriented over the long-axis of the medial collateral ligament.
- Care should be taken to examine the entire length of this ligament.
- Dynamic scanning during valgus stress can improve the assessment of its integrity.
- Check the soft-tissues immediately superficial to the base of the medial meniscus.
Medial Collateral ligament
Probe positioning
Partial rupture of Medial Collateral ligament.
Lateral Collateral ligament
Probe positioning
Meniscus
Pes Anserinus - Goose feet

- The Pes Anserinus Tendon- formed by the conjoined joining of 3 muscles:
  - Sartorius
  - Gracilis
  - Semitendinosus muscles.

Arise from posteriorly lower thigh and go from medially to laterally, Remember:

*Say Grace before Tea*

Clinical importance: Chronic knee pain and weakness.
Clinical conditions: Pain, swelling and tenderness
Pes anserinus
References

- Chan Kang, MD, Deuk-Soo Hwang, MD 2012 Arthroscopic Treatment of Femoroacetabular Impingement of the Hip: 5-7 Years Sep2012;24(3):237-244.
- Eur Radiol. 2007 Jul;17(7):1772-83 MRI and US of gluteal tendinopathy in greater trochanteric pain syndrome
