Musculoskeletal

cutaneous = sensory area of skin supplied by a single spinal nerve.
There is NO overlap between pre and post axial cutaneous, i.e. overlapping.

4 S's
Stab S1
Stab S2
Stab S3
Stab S4

Hip joint is predominately supplied by the obturator nerve as well as the femoral nerve.

sensory deficit = bony area
motor deficit = loss of muscle

Radial nerve supplies NO muscles of the hand.

Ulnar nerve = along posterior medial epicondyle of elbow, nerves in # ulnar tunnel.

Ulnar sensory deficit = little finger
Ulnar motor deficit = claw hand, hypotenar, and 2nd, 3rd, and 4th finger abduction.

Lumbar plexus = lies on the surface of quadratus lumborum and within the psoas muscle.

Femoral nerve = largest branch of lumbar plexus
at risk as it passes through psoas muscle (psoas above in spinal TB).

- Supplies quadriceps muscle in thigh.

Sciatic nerve = largest nerve in body, branches of sciatic plexus = entry points throughout foot.

Nerve supply to gluteus maximus muscle.

Sciatic nerve = lower leg + foot muscles. supplying the leg + feet muscles.
Rheumatoid Arthritis - inflammation of joints
- pain
- stiffness
- swelling
- functional impairment
- tenderness
- restriction of movement
- heat
- redness
- ulnar deviation
- swans neck deformity

RA: chronic autoimmune systemic disease characterized by symmetrical peripheral arthritis and other systemic features of a disease of the immune system.

EULAR - classification occurring system - maximum of 10.
- M:F = more common in 1:3 females
- It is a disease of the immune system.
  - Inflamed swelling of synovial membrane
  - Erosion of the cartilage

RA can occur any time from age 16 onwards.
- gender
- environmental - smoking, chronic infection
- genetic

Investigations:
- Rheumatoid factor (RF)
- Anti-CCP (anticyclic citrullinated antibodies)
- ESR (erythrocyte sedimentation rate)
- CRP
- X-ray
- US with doppler

Rheumatoid nodules can be found anywhere in the body including at major joints.

Systemic features:
- fatigue
- anorexia (reduced appetite)
- kidney
- weight loss
- lung
- anaemia
- skin

Assessment - DAS (disease activity score) <= 2.4 - clinical remission
- DAS 28 < 2.6 - moderate disease
- DAS 28 2.6-5.1 - severe disease

Life expectancy is shortened by 7 years.

Management:
- DMTARDs - Disease Modifying Antirheumatic Drugs
- DMARDs - first line treatment
  - methotrexate, sulfasalazine and hydroxychloroquine combination
- steroids, rapidly reduce symptoms and inflammation
- NSAIDS for symptom relief
- encourage regular exercise
- surgery may relieve pain and improve symptoms

Rituximab is used with methotrexate for severe active RA. IV infusion every 6-12 months. If TNF or IL-1 inhibitors have failed to inflnmab.

Rituximab:
- Pannus - Swelling, joint erosion
- Synovitis - pain, stiffness, swelling, joint space narrowing
- allows hyperplasia

DMARDs:
- anti-TNF:
  - infliximab
  - adalimumab
  - golimumab
  - etanercept

- anti-IL-6:
  - tocilizumab
  - sarilumab

- anti-CD123: rilonacept

- JAK inhibitors:
  - tofacitinib
  - upadacitinib

- B cell depleting:
  - rituximab
Osteoporosis

periosteal bone disease when RANK ligand ↑, bone resorption↑

1. Low bone mass and microarchitectural deterioration of bone tissue leading to increased bone fragility and an ↑ in fracture risk.

2. Bone density scan measures this

- weight:
  - low body weight, osteoporosis↑
- genetics:
  - medications or steroids, warfarin, anticoagulants
- diseases which influence bone turnover (inflammatory arthritis, malabsorption, hyperparathyroidism)

Dxa = bone density scan
- can see full spine in one image
- can give an oz score compared to their equivalent in density and a T score,
  - if less than -2.5 it is deemed as osteoporosis.

Osteoporosis is dealt with differently to other causes

Treatments:
- SERMS - selective estrogen receptor modulator
  - reduces vertebral fractures but not others
  - SE = ↑ clotting risk

2. DBA - dual action bone agent
  - estradiol + raloxifene
  -↑ bone formation and ↓ bone resorption
  - ES = ↑ clotting risk
  - UC → cardiovascular risk →

3. Intermittent human parathyroid hormone
  - teriparatide
  - ↑ bone density
  - patient gives themselves an injection of this every week (injection site injected)
  - unsafe for longer than 2 years.

Wrist fracture in an low energy fall: this is an early warning sign of osteoporosis.

5 common osteoporotic fractures:
- vertebral body
- distal radius
- neck of femur
- neck of humerus
- pars interarticularis

Osteomalacia: qualitative bone weakness
osteoporosis = quantitative bone weakness

osteomalacia: quantitative bone weakness
osteoporosis = qualitative bone weakness

50 g poers bone = large, hard, heavymage, horrible
common cancers with metastasis to bone = breast lung prostate larynx thyroid

Vertebral Crush Fracture (VCF):
- Exp. excessive vertebone, wedge fracture
- Often, likely to have another
- Sudden onset of back pain with little/none trauma is coughing, bending

Treatment:
- Symptomatic = analgesia, avoid bed rest
- Perhaps surgery to correct the deformity

Complications:
- Malunion or neural entrapment or softness

Osteomalacia
- Osteomalacia of bone causing an accumulation of undermineralized bone matrix called osteoid
- Defect = occurrence of this defect in growing children before the closure of the epiphyses
- ID deficiency: primary - neonates, elderly - housebound secondary - partial gastrectomy, pancreatic disease small bowel malabsorption chronic renal failure

- Liver disease or P hydroxylation of Vit D
- Hypophosphatemia
- X-linked Deafness disease
- High aluminium ingestion

Symptoms:
- Asymptomatic
- Bone pain = worse on weight bearing, weight loss
- Raynaud parathesia + tetany, proximal muscle weakness

X-ray:
- Bone scan
- Serum biochemistry
- Bone biopsy

Serum
<table>
<thead>
<tr>
<th>Calcium</th>
<th>Osteoporosis</th>
<th>Osteomalacia</th>
<th>Primary Hypophosphatemia</th>
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<tr>
<td>normal</td>
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<td>normal</td>
<td>high</td>
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<tr>
<td>normal</td>
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</tr>
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<td>250H vit D</td>
<td>normal</td>
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</tr>
<tr>
<td>normal</td>
<td>normal</td>
<td>normal</td>
<td>normal or low</td>
</tr>
</tbody>
</table>

Treatment:
- Depends on cause
  - Calcium - ergocalciferol
  - If due to renal disease = dialysis or if hepatic disease
    - Monitor plasma Ca++ weekly to begin with
Paget's Disease

- Autosomal dominant
- Sporadic
- Viral

Investigations:
- Plain X-ray
- Bone scintigraphy — increased uptake
- Bone biopsy — alk-pers

Complications:
- Bone pain
- Deformities of adjacent joint
- Fractures
- Rarely spinal stenosis or nerve root entrapment

Osteonecrosis
- Oral — 2 months
- SE = upper 1/2 iliac

Salicylate
- SC or IV — once daily
- SE = flushing, nausea

If given IV, calcium containing bisphosphonate up to 50% get FCP, TNFα, IL-6, fever, rashes.

Juvenile Idiopathic Arthritis

- Causes disability + blindness
- Cervical spine involvement
- Fingers and toes

- 3 types:
  1. Pauciarticular
  2. Polyarticular
  3. Systemic onset

1. Pauciarticular — 3 types:
   - 5:1 F:M (8 yo)
     - Lump
     - Lower limits
     - ANA in 40-75%
     - Chronic arthritis in 20%
     - 50% asymptomatic
     - Irregular iris
   - 2. 1:7 F:M (35 yo)
     - Lump
     - Lower limits — mainly knee
     - Knee replacement
     - Rheumatoid factor
     - HLA-B27
     - Osteitis

- Complete inflammation of finger or toe
- 3. 4:1 F:M any age

- Asymptomatic WNL
- Deformities
- Very destructive arthritis
- Nail pitting
- Panniculitis
- Lower limb
- Osteomalacia

Eye disease: rare
2. Polyarticular

1. Rheumatoid factor -ve
   - 9:1 F:M
   - amenorrhea
   - rheumatoid factor +ve
   - fever
   - weight loss
   - sicca symptoms
   - RA nodules
   - small or large joints

2. Rheumatoid factor +ve
   - 7:1 F:M
   - late childhood onset is 12-16 years
   - low-grade inflammation
   - arthralgia
   - morning stiffness
   - effusions
   - pleurisy
   - pulmonary fibrosis
   - Sjogren syndrome

3. Systemic onset (Still's disease) - least common
   - starts early
   - disappears after 2-5 years
   - 1:5 F:M
   - throughout childhood
   - fever - daily for at least 2 weeks in evening, normal in the morning
   - rash - salmon red eruptions on trunk + thighs
   - lymphadenopathy
   - arthralgia
   - fever
   - pleurisy
   - rash
   - pleural effusion
   - arthritis within 3-12 months of fever

Management:

- Indications = pain killers + NSAIDs / steroid joint injections
- Indications = methotrexate
  - anti-TNF
  - IL-1R antagonist
  - IL-6 antagonist
  - Physical
  - Occupational therapy

- Indications = systemic steroids - rarely used
  - to control pain + fever

- Indications = DMARDS

- Indications = surgery: synovectomy, joint replacement

Sero-negative arthritis = syn. spondyloarthritis

- Rheumatoid factor
- HLA - B27
- Symmetric arthritis
- Axial skeleton involvement to spine
- Uveitis
- Inflammatory bowel disease

Ankylosing Spondylitis

- Chronic inflammatory
- 2/3rd decade of life = onset
- males > females
- Investigations:
  - MRI scan
  - Pelvic X-ray for sacroiliitis
  - Fabbris (?)

Management:

- Physical
- NSAIDS + DMARDS (sulfasalazine + anti-TNF)
- Surgery: joint replacement + spinal surgery
Prevalent arthritis

- Severity of joint disease does not correlate with skin disease.

- Different subtypes

- Treatment:
  - Sulfasalazine
  - Metotrexate
  - Cyclosporine
  - Anti-TNFα
  - Steroids
  - Physical/occupational therapy

Reactive arthritis

- Staphylococcal mononuclear cell arthritis
- Usually non-sacroiliitis
- Often in the first 6 months
- Commonly affects 2-4 joints
- Commonly affects hands, wrists, and ankles

- Reiter's syndrome

- Treatment:
  - Acute: NSAIDs
  - Chronic: NSAIDs

- Crystals: monoarthritis + oligoarthritis

- Interstitial arthritis

- Associated with UC or Crohn's

- Treatment:
  - NSAIDs
  - Sulfasalazine
  - Steroids
  - Anti-TNFα

- Crystal deposition disease
  - Tophus: tophus = massive accumulation of monosodium urate

- Overproduction of urate:
  - Malignancy
  - Severe hepatic/renal disease
  - Drugs (alcohol)
  - Uricosuria + HPRD

- ESCN Nephropathy

- X-linked recessive
- Renal disease
- Malignancy

- HPRD deficiency

- Hyperuricosuria

-management:
  - Revers: uric acid
  - Sulfasalazine
  - Allopurinol
  - Xanthine oxidase inhibitors

- Fanconi syndrome

- Canakinumab

- Uricosuric agents

- Management of hyperuricosuria

- Chondrocalcinosis

- Causes:
  - Pseudogout
  - Elderly females
  - Trauma
  - Disseminated familial

- Management:
  - NSAIDs
  - Steroids

- Address cardiometabolic factors
Polyarthritis

20% involve small arteries
50% with giant cell arteritis have polymyalgia
anemia, malaise, weight loss, fever, depression, arthralgia, synovitis

Dramatic second response (treatment: prednisolone 15-24 months)
F:M 2:1 usually >70 yrs

Sudden onset of shoulder, pelvic girdle stiffness, weakness

Embryology

HOX all and HOX all are required for the radius to form.

Week 7 = fingers, toes webbed
Week 8 = distinct and separate

Clawed foot = autosomal dominant
Polydactyly = presence of more than 5 digits on hands/feet
Syndactyly = cutaneous syndactyly = webbing between digits - skin/tissue
Ossous syndactyly = fusion of bones
Congenital club foot = talipes equinovarus

Developmental dysplasia of the hip
Abnormal development of acetabulum.

Immunology

ANA = autoantibodies
-SLE = Sjögren’s
-RA = rheumatoid arthritis

Cryoglobulins = Raynaud’s

ANCA = anti-neutrophil cytoplasmic antibodies
-Vasculitis - you get C-ANCA and P-ANCA
Logan’s disease
-Granulomatosis polyangiitis (Wegener’s disease)
Kawasaki disease

Multi-system autoimmune diseases

Connective tissue diseases: SLE, scleroderma, Sjögren’s syndrome, autoimmune myositis

Systemic vasculitis: Giant cell arteritis, granulomatosis polyangiitis (Wegener’s disease)

Systemic lupus erythematosus - disease of the young

SLE: M:F 1:9

Face = butterfly rash
Photophobia
Pocks = acral necrosis of lips, umbilicus in small glands
Roof = pericarditis
Urticaria lesions
Lungs = pleurisy
Platelet dysfunction
Skin = vasculitis

Blood = hemolytic anemia
Renal crisis
Low WCC

General = fever, depression, alopecia, weight loss
Raynaud’s
Renal crisis
Neutropenia
Alopecia
Extravasation
Peripheral neuropathy

In SLE provide warm dipstick
Some antibodies in SLE but not in everyone with it.
Bone growth

Primary ossification centre forms in the diaphysis.
- Hypertrophy of chondrocytes
- Invasion of blood vessels (angiogenesis)
- Conversion of bone starts circumferentially from the peristomeum.

Peristomeum = where bone starts to form.

Secondary ossification centre:
- At the epiphyseal regions
- Vascular invasion also occurs
- Endochondral ossification occurs in the growth plate.
- A central zone is then formed in the epiphysis.

Endochondral ossification = formation of bone within hyaline cartilage.
Intramembranous ossification = forms directly from mesenchymal tissue
and does not require cartilage to be present first. No growth plates.
= flat bones
horizontal phys = longitudinal growth
sphenial phys = circumferential growth

→ at sphenial growth plate.

PHYSIS = chondrocytes arranged in layers
= each layer has a different function + density destiny.

epiphysis

zone of reserve
zone of proliferation
zone of hypertrophy

metaepiphysis

zone of reserve = sphenial chondrocytes
few in number
large extracellular matrix for storage
high concentration of lipids and glycogen
produces matrix
low PO2

zone of proliferation = flattened chondrocytes and stacking of them
become columnar
less extracellular matrix than above case
longitudinal growth occurs
acellular proliferation
increased circulating proteoglycans inhibits calcification
increasing PO2 as metabolically active
Zone of hypertrophy = 3 zones = zone of maturation (A)
zone of degeneration (D)
zone of provisional calcification
- spherical chondrocytes ×5 enlarged
- increasing vacuolation
- nuclear fragmentation
- decreasing cytoplasmic components
- calcification of intercellular matrix - reducing proteoglycan levels
- chondrocyte death
- very low PO₂
- no blood supply

Metaphysis
- expands with skeletal growth
- primary spongiosa - calcified cartilage bone
- secondary spongiosa - remodelled bone

Longitudinal growth
- different physis grow at different rates
- growth in the lower limb occurs in the lower end of the femur and the upper part of the tibia, but the opposite is true in the upper limb.

Factors affecting growth:
- Growth hormones
- Sex hormones
- Thyroid hormones (stimulates growth)
- Parathyroid hormones
- Previous trauma
- Blood supply
- Vit C (collagen synthesis)
- Vit D (mineralization of osteoid)
Physical Pathologies

Gaucher's Disease
- Autosomal recessive
- Abnormal lysosomal storage
- Acts at zone of rescue
  - leukocytes
  - Metaphysical enlargement
  - Motrin-eaten trabeculae

Achondroplasia
- Autosomal dominant
- Mutation in fibroblast growth factor receptor 3
- Failure in zone of proliferation
- Abnormal bone formation
- Disproportionate dwarfism of long bones

Dwarfism/Agathonism
- Action of GH
- Mainly affects zone of proliferation
- Proportional changes in size

Mucopolysaccharidoses
- Hydrolase enzyme deficiency
- 4 Syndrome types: Morquio's
  - Hunter's
  - Hunter's
  - Sanfilippo's
- Proportate dwarfism
- Complex sugars found in urine
- Abnormality in zone of hypertrophy

Rickets
- Deficiency of D/calcium
Lower Limb joints

hip - ball + socket joint
- deepened by labrum acetabulum
- strong ligaments + capsule
- strong large muscles

dislocation - posteriorly, leg short, internally rotated, high energy

You get tension, force, and compression

the main blood supply to the femur is from the circumflex artery.

3 compartments in the knee joint:
- medial tibiofemoral
- lateral tibiofemoral
- patellofemoral

Knee joint - synovial hinge joint
- articular cartilage - vascular - nutrition through synovial fluid
- capsule - lined completely by synovial membrane
- inflamed = synovitis = swollen, red, painful

Q angle 14° in males
17° in females

genu varum "$\gapprox" bow legs"
genu valgum "$\gapprox" knock knees"

Arthroscopy to look in knee.
Menisci
2 - medial + lateral
\[\text{larger}\]
C-shaped semilunar cartilages
Fibroelastic cartilage - avascular
Function: load distribution, lubrication
\[\text{NOT a shock absorber}\]
Medial is more common than lateral menisci damage.

Rotation
Flexion
Weight-bearing knee
‘pop’ or crack, delayed swelling.
Locked knee - soft, painful block to full extension, tender on affected side, sometimes feel a click.

\[\text{Sensory to weightbearing} \]
\[\text{L} \text{ocked knee} \]
Scleroderma
30-50 yo. M:F 1:3
diffuse. pulmonaray hypertension.

Sjogren's syndrome
40-50 yo. M:F 1:9
arthritis, Raynaud's renal tubular acidosis

Caucasian female patients
+4%
*30 yo at onset
  + new headache
  + temporal artery tenderness
* ESR > 50
  + abnormal temporal artery biopsy

endochondral ossification = formation of bone within cartilage
intramembranous ossification = forms directly from unossified tissue and does not require cartilage to be present first, i.e. newborn places flat bones

Achondrogenesis
  autosomal dominant
  mutation of fibroblast growth factor receptor
  failure in zone of proliferation
  abnormal bone formation
  lack of postural deficiency of ligaments

Multiple hereditary exostoses
  hereditary disease
  autosomal dominant
  collagenous tissue in metaphyseal elongation
  metadiaphyseal elongation

Hydroxyapatite deposition in bones
  causes:
  + upper and lower respiratory tract
  + small and medium vessels
  + granuloma
  + inflammation
  + generalized skeletal pain

TREATMENT of multi-gene autoimmune diseases:
  + hydroxychloroquine
  + methotrexate
  + cyclophosphamide
  + ribavirin

Rickets
  vitamin D deficiency
  calcium deficiency
  phosphorus deficiency
  osteomalacia
  rachitic changes in bone
  rickets
  bow legs
  knock knees
  genu varum
  genu valgum
  knock knees

check: bow legs, knock knees

ankylosing spondylitis = heal arthritis

early onset = hemarthrosis
fast swelling = fracture or blood vessel burst
fat comes out in a fracture.
Neural injury = not a rich blood supply so slow swelling (quicker in the young), painful to weightbear.

ACL tear = forward movement, ‘pop’, quick swelling
able to weightbear, ACL reconstruction

collateral tears = feeling of ‘tear’, sharp pain, bruising to one side, warm joint,
under quads, no or minimal effusion.

US = good for tendon rupture and some medial tears
MRI for confirmation.

Management: surgery, analgesia, rest, fluid, physio, swelling reduction.

Secondary = partial meniscectomy, meniscal transplantation.

Orthopaedics

Flexion + tripping

1. Metatarsus adductus - 90% resolve by year
   Stretched, 5% have it still in adulthood.
   NEVER operate before age 10 years

2. Internal talar torsion - increased high foot angle
   90% resolve spontaneously, splints or wedges or markers

3. Femoral anteversion - when child is lying on his front
   You make their hips turn completely forwards, 10° at birth, 30% reach 10° by 16 yr.

Spasticity

Cerebral palsy: not progressive due to brain damage before birth or up to the age of 2.

* Spasticity insufficiency
  * Spastic nursing, bedside passive
  * Prematurity (most common)
  * Anoxic injury
  * Head injury.

Many classifications:

- Spastic - pyramidal system, motor cortex
- Athetoid - extrapyramidal system, basal ganglia
- Ataxia - cerebellum + brainstem
- Rigid - basal ganglia and motor cortex
- Mixed - spasticity + ataxia
- Anatomical
  * Monoparesis - one limb involved
  * Hemiparesis - one side of body
  * Diplegia - lower limbs
  * Quadriplegia

Goals = sitting balance, standing posture, gait

Gait is analyzed by observation + videos.

Hip problems = early surgical intervention leads to better long-term outcome.

Bracing, leg braces, pelvic obliquity.

GMFCS:

- Level I = walks without limitations
- Level V = in wheelchair

The higher the GMFCS the higher the risk of dislocation.
management:
physic backfen diazepam botolinum toxin surgery

deformity management = soft tissue release of adductors + hamstrings
- bone realignment pelvic osteotomy + varus derotation osteotomy

congenital talipes equinovarus (clubfeet)
3:1 M:F 50% bilateral genetic environmental factors

Material:
- strapping

Several casting - 5 casts over a period of time to soften them out.
then cut activities tend to release the pressure, it needs quality in children.

Devis-brown boots -
Surgery - Ilizarov frame - metal frame, painful, uncomfortable and needs to be worn for a long time.

Major recurrence due to failure of compliance with splints.

Recurrent
- deviation laterally
- 12yo at presentation

Female

Back pain in children should be taken seriously; do a bone scan if pain
if there is a severe case you can get cardio-respiratory compromise, pain from rib
pelvis touching, difficulty sitting

Management = surgery complications = nerve root damage, vascular injury

New prenatal diagnosis of the hip
6:1 boys: girls were common in left hip than right hip

Issues:
- first born
- breech presentation
- proton motion sign, obturator's sign
- right weight

Head of the femur doesn't ossify till 3 months

Treatment: splint, closed reduction, open reduction
Scanty can be done for it on examination only.

Fetal's disease
- males usually short stature nipple systemically well soft lump joint knee pain normal
- females low social status younger do better

Treatment = maintain hip motion analgesia, restrict painful activities, osteotomy

in select group

SLFE = supra upper femoral epiphysis
- short painful to weightbear boys 7-7yo, overweight chronic abnormalities
Children's fractures heal quickly as long as there is adequate blood supply.

Fracture types:
1. Complete fracture
2. Greenstick fracture
3. buckle fracture (Tons)
4. Plastic deformity

Children's fractures usually happen where growth plates are present, weaker than ligaments. There is risk of growth arrest with this fracture.

Addition of ACL pulled away from its point of insertion.

The growth plates close at age 13-14.

Flexible nailing: 2 years of predicted growth remaining, allow early range of movement, wires out when healed.

Osteomyelitis: Infections must be gradual, subtle.

NIGHT PAIN think INFECTION or TUMOUR

KNEE PAIN think tears

Lips

5 S's
- Symptomatic
- Swelling
- Stiffness
- Soreness
- Systemic illness

Spine + Disk Prolapse
- Internal disc pressure. Compressed vein not arterial disc prolapse.
- Compressed roots with muscle spasm.
- Prolapses in LUMBAR or CERVICAL spine.

Disks are largest anatomical structure in the body.

Nucleus pulposus = cartilage
- Intervertebral discs - secondary cartilaginous discs
- Annulus may tear & nucleus pulposus is tense & compression.

Lumbar spondylolisthesis = anterior vertebral slip of above vertebra.

Spine pain is usually due to pain.

Spinal stenosis is painful condition of the spine resulting from degeneration of the intervertebral discs.

Spinal cord compression resulting from degeneration of the intervertebral discs.
Nerve root pain

- Radicular pain
- Neuropathic pain
- Musculoskeletal pain

Root tension sign: straight leg raise makes pain worse.

Positive straight leg raise test: most settle in 3 months.

Disc problems
- Herniation = annulus weakened but still in tact
- Radicular pain = radiculopathy
- Spinal cord compression

Central disc prolapse may cause pain in both legs or may only be back pain.

Pertoneal - lateral and transverse perineum

Herniation = annulus weakened and spinal cord exposed

Symptomatic myelopathy is an indication for taking out a damaged disc.

Cauda equina syndrome

Surgical emergency - usually due to central herniated disc

Autonomic failure
- Bilateral buttock pain + weakness + dysesthesia (touch sensation distorted)
- Loss of anal tone + anal reflex

Treatment = operation within 48 hours

MRI or lumber CT or myelogram

Degenerative + lumbar spondylolisthesis

Spondylolisthesis = forward slippage of vertebra may get stuck in a neural spondylolisthesis is a patient may lose leg weakness

Non-operative treatment: facet joint manipulation allow flexion + extension.

Spinal claudication

Usually bilateral, dysesthesia, foot drop, takes several minutes to ease after walking, worse walking downhill as the spinal cord becomes smaller in extension, better walking up hill or cycling on the spine is flexed + spinal cord has more space.

Spinal claudication causes: cauda equina takes weeks to occur, slight worsening of symptoms not sudden onset.

Spinal stenosis + lateral nerve roots, central stenosis, foraminal stenosis + non-operative, nerve root injection, epidural injection, surgery.
Bone + Soft Tissue Infections

Acute hematogenous osteomyelitis
- mainly children, boys, girls
- history of minor trauma
- sources of infections: local spread of trauma - open fracture, surgery ORIF, joint replacement
- septicemia, septic arthritis
- infants: infected umbilical cord
- children: bones, tonsillitis, skin abrasions
- adults: UTI's
- infection via diabetic foot = mixed infection, including anaerobes
- sickle cell disease = Salmonella sp.
- starts at metaphysis = acute inflammation = ↑ pressure, then suppuration (formation of pus) = release of pressure into the joint = necrosis of bone (sequestrum), new bone formation (involucrum) = resolution or chronic osteomyelitis
- investigations:
  - X-ray = normal in first 10-14 days, then later shows metaphyseal destruction
  - MRI
  - blood cultures in hematogenous osteomyelitis
- complications:
  - chronic osteomyelitis (altered bone growth)
  - septic arthritis
  - sepsis
  - investigations:
    - radioactive bone scan
    - MRI
    - blood cultures in hematogenous osteomyelitis

Differential diagnosis of osteomyelitis:
- acute septic arthritis
- trauma
- transient synovitis

TREATMENT:
1. Supportive - analgesia, IV fluids
2. Rest + splintage
3. Antibiotics - 4-6 weeks, needs to be able to penetrate bone
4. Fusidic acid
5. Surgery - infected joint replacement
- aspiration of pus, drainage

Soft Tissue Infections:
- cellulitis
- erysipelas
- necrotizing fasciitis
- gas gangrene
- toxic shock syndrome

Subacute osteomyelitis
- weeks or months
- x-ray
- tenderness
- bone scan
- local swelling, warmth
- biopsy

Brodie's abscess = well defined, cyst-like, cancellous bone painful lump
- treatment = antibiotics, long course
- surgery "curettage"
Chronic osteomyelitis

- After an operation, immunocompromised, elderly, drug abusers.
- Usually mixed organism infection, same organism for each flare up through.
- Treatment: long term antibiotics, surgically remove bone infection, reconstruction, amputation.

Acute septic arthritis

- Route of infection: penetrating wound, arthroscopy, haematogenous, erosion of bone.
- If in joint = septic arthritis
- If inside bone = osteomyelitis
- Staph aureus = E. coli
- Strep pyogenes = haemophilus influenza.
- Complete destruction of articular cartilage.
- Adult = knee, ankle, wrist

Widely acute pain in single large joint, reluctant to move.
- Tenderness
- Temperature
- Swelling

Treatment: supportive antibiotics 3-4 weeks.
- Surgical drainage.
- Infected joint replacement is the most common cause of acute septic arthritis.
- Staph = most common organism.

Tuberculosis bone + joint

- Multiple lesions in 1/3rd of patients.
- Ill health, pain esp at night.
- Weight loss, fever, night sweats.
- Joint swelling, limited movement.
- Decreased ROM.

Spinal injury

- C1/2 dislocation = dead.
- Compression fracture = only get wedge compression fracture in osteoporosis.
- If have 1 spinal fracture = 10% chance of having another.
- If found one, look for more.

T12, L1 = most common fractures.

ALWAYS remember distracting injuries.

- Pain in 'whiplash' without neurological loss.
- If jump and land on your feet you will fracture a vertebrae, not rupture a disc as it compensates.
- Paraplegia:
- Flaccidity, paralysis, weakness, pain, hyper-reflexia, paresthesia, priapism.
SPINAL SHOCK: reflexes start to come back, can last a few days and can completely resolve.

Neurogenic shock: blood pressure drops, bradycardia, vasodilation, and hypotension, perhaps because blood goes into the injury.

Wound shock - immobilise spine, be careful of pressure sores in immobilisation.

A = complete spinal cord injury
B = incomplete + motor loss
c = incomplete + weak motor function
D = complete + stronger motor function
E = normal, motor, sensory but neurological defect.

Spinal concussion: complete or incomplete, lasts hours to days.

Unstable if:
- >30 degrees kyphosis
- 75% loss of vertebral height
- Both anterior and posterior columns involved
- Pedicles spay.

Pseudosubluxation - anterior displacement of C2 in children, normal in children < 8yrs.

Jefferson fracture - adult - C1 fracture, always breaks in 2 pieces.
Clay shoveler's fracture - spinous process broken.
Atlantoaxial peg fracture.
C1/C2 rotary subluxation - if you tear the transverse ligament.

Subdural hematoma = bleed from cerebral artery.

Management
- collar or brace
- limit activity
- can extend up to level 2 due to swelling

DON'T give steroids.

Surgical management: kyphoplasty.

Central cord syndrome: weakness + paralysed arms and legs, sensory loss, legs less affected.

Brown-Sequard syndrome:
- pain + paresis or paralyse on one side
- paresis on opposite side
- loss of sensibility below injury
- loss of pain + temp on opposite side

Unilateral dislocation on AP view will be out of alignment.

Pediatric spinal injuries:
- very rare, spine pretty flexible.
- children have a relatively larger head than adults.
- pediatric spinal injuries = mainly cervical.
- children have 2 ossification centers in their vert, not 3.
- not fractures.

TRAUMA
The golden hour = seek as soon as possible to minimise chance of death.

Trauma management = restore adequate tissue oxygenation.
- primary survey - find life threatening injury & labelled
- secondary survey - densely every injury may have definitive treatment.
- 1: primary survey - find life threatening injury & labelled
- 2: neon resuscitation - intubation, O2, resuscitation
- 3: secondary survey - densely every injury may have definitive treatment.
MECHANISM OF INJURY

An **INJURY** (WOUND) is a disruption of the integrity of the tissues resulting from the application of an external force. Injuries may involve the skin and internal tissues and organs.

Injury is the consequence of transfer of energy, and the greater the energy transferred, the greater the disruption of the tissue, and so the greater the injury.

⇒ the greater the force, the deeper the injury.

Energy may be:

- mechanical
- mainly mechanical energy causes injurious trauma.
- (including pressure)
- thermal
- electrical
- radiation
- chemical

Newtonian physics indicates that energy cannot be created or destroyed, but can only be transferred; in inflicting trauma, it may be dissipated in various additional ways (consider sound, deformation, friction, heat)

⇒ description of location, type, size of site of injury when first noted is in A + E because the superficial mark may disappear.

\[
\text{K.E.} = \frac{1}{2} m v^2
\]
(Kinetic energy = \( \frac{1}{2} \times \text{mass} \times \text{velocity}^2 \))

For an injury to occur, there must be:

- a **victim**
- a **weapon** (including instruments, feet, fists, vehicles, etc.)
- an **interaction** between them
Further determinants of the nature of any resultant injury include:

**PHYSICAL FACTORS**

- Force
- Area
- Duration is usually instantaneous. But the greater the duration the greater the injury.
- Direction

**BIOLOGICAL FACTORS**

- Mobility, e.g. pushed back, dispersion of energy, loose clothing absorbs some of the energy.
- Anticipation, Co-ordination and Reaction
  - If you move to protect yourself, put your arms over your head to protect your vital parts.
- Biomechanical properties of the tissue (e.g. elasticity, plasticity and viscosity)
2 black eyes (bruised eye).

NATURE OF INJURIES

BLUNT FORCE INJURY - energy delivered over a wide area
- bruise (contusion) - those anaerobic-anaerobic bruise easier.
  - blood vessels damaged.
  - you don’t bruise when you leave no blood pressure
to force the blood into tissues.
  - b) blood moves to the area with the least resistance
    moves under gravity.
  - abrasion
    - does not involve the full thickness of the skin, epidermis
    and upper dermis. 
    - usually not serious and heal without a scar.
    - friction abrasion can be associated by large fluid
      and blood loss i.e. arm off a motorbike or cut a car.
  - laceration
    - a break in the full thickness of the skin.
    - the application of a blunt force over a large area.
    - skin/dermis tears, splits skin at the point of the maximum
      weakness of the skin.
    - doesn’t tell you where or what blunt force object
      caused the laceration.
    - laceration = automatically blunt force injury = has implications
      for the weapon = not a knife.
    - avascular tissue on either side of the laceration = amenable
      to infection/inflammation = can’t just stitch up.
    - laceration has ragged edges but strong structures bridge
      across the gap.

SHARP FORCE INJURY - energy in a very localised area.

- incision
  - a cut caused by a sharp weapon on a small area =
    point of a knife into a person; small area applied to the skin.
  - the sharper it is, the less energy required.
  - force does not equal wallace.
  - where the energy was applied.
  - bone cutting as it will cut everything in its path until
    it reaches something (can’t cut) = equal depth.
OTHER INJURIES

- BLUNT PENETRATING (PUNCTURE) - via bullets

- FIREARM INJURIES

- THERMAL INJURIES (BURNS and SCALDS) - high heat energy injuries

- ELECTRICAL BURNS

FRACTURES

HAEMORRHAGE

is a dangerous consequence of injury,

usually internal bleeds e.g. in pleural or abdominal cavity =) large
depth internal bleed due to penetration.

ASPHYXIA

- Anoxic Anoxia (Mechanical asphyxia)
- Anaemic Anoxia
- Stagnant Anoxia
- Historic Anoxia
How much force?

Sufficient energy in causing force to cause injury.

Pain, Survival Time and Acting Capacity after Wounding

- No way of predicting any of these things.
- Adrenaline kicks in, fight or flight -> may not feel pain.
- Pain cannot be measured pathologically post mortem.

**MODE OF DEATH** (INJURY)

- NATURAL
- UNNATURAL

  - HOMICIDE (ASSAULT)
  - SUICIDE (SELF INFLICTION)
  - ACCIDENT (ACCIDENT)

Any individual injury may be interpreted as inflicted by another, inflicted by self or accidental. We attempt to distinguish which mode by considering:

- Pattern of Injury (ies)  (e.g. Position; Defence -v- Tentative)
- Circumstances
- Common Sense

Think about whether the following deaths are most likely to be homicidal, suicidal or accidental: Hanging, ligature strangulation, shotgun injury from 3 metres, repeated stab wounds to the back, aspiration of food causing choking, ruptured MI, etc.
ABCDE:
- Airway + cervical spine control
- Breathing
- Circulation + hemorrhage control
- Disability (mini neuro test)
- Exposure + environment + keep them warm

Primary surveys:
- ATLB = advanced trauma life support (course)
- walk towards trauma patient and ask them what happened; if spying you know forget; alert, breathing + perfused!!

B = expose chest
- check tracheal position

Life threatening conditions affecting breathing:
- ATOMIC
- Airway obstruction
- Tension pneumothorax
- Open pneumothorax
- Massive hemotoma
- Intercostal disruption
- Cardiac tamponade

DEFO,
- Don’t Ever Forget Alcogol:
- blood gases
tells you of their perfusion.

Only yes any unstable go straight to surgery.

Tendons + muscle + bone
- Tendons are covered by epitenon, collagen bundles are covered by endotenon. Collagen bundles together are called fascicles. Fascicles are covered by peritenon, tendons are covered by fibrocartilage.
- The network of blood vessels in peritenon.
- Tendons are connected to the muscle by vincula.
- Fibrillar + strong in tension

Injury:
- Degeneration = acellueles tendon - intrasubstance matrix degeneration, swollen, painful, tender
- Inflammation = de Quervain's tenovaginitis: tendons of EPB + APB pass through common tendon sheath at wrist; swelling, tenderness, red-hot
- Finkelstein's test
- enthesisopathy = more common at muscle origin than tendon insertion a lateral humeral epicondylar lesion (elbow)
- tradition apophyses = osgood schlatter's disease: adolescent active boys. Insertion of patellar tendon into anterior tibial tubercle.
- avulsion = bone fragment + muscle fibers - avulsion of extensor tendons are dorsum of base of distal phalanx of finger forced flexion of extended finger.
bear - intramuscular - Achilles tendon rupture. tibialis anterior (squeezes) test - plantarflexed tendon back.


bear - musculotendinous junction = i.e. medial head of gastrocnemius, musculotendinous junction with Achilles tendon.

laceration (incision) = fingers, flaps, FDS + FDP common injury adults repair surgically, restricted movement post op.

Healing: tendon healing is mediated by fibroblasts from epitenon + macrophages. 3 phases: 1. Inflammatory
2. Fibroplastic (i.e. collagen Producing)
3. Remodelling.

Rehab early movement + P strength + healing

<table>
<thead>
<tr>
<th>Type</th>
<th>Diameter (mm)</th>
<th>Myelination</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10-20</td>
<td>heavy</td>
<td>fast</td>
</tr>
<tr>
<td>B</td>
<td>&lt; 3</td>
<td>intermediate</td>
<td>medium</td>
</tr>
<tr>
<td>C</td>
<td>&lt; 1.3</td>
<td>none</td>
<td>slow</td>
</tr>
</tbody>
</table>

nerve entrapment = prolapsed vertebral disc (nerve root) caused wrinkle syndrome (nerve root), Morton's neuroma (digital nerve).

Sensory:
- Hypalgesia = disorder of sensation
- A-lothesia = numb
- Parasthesia = pins + needles

Motor:
- Paralysis = weakness

Sensory
- Sensation returns faster than motor.

Nerves are surrounded by myelin sheath and Schwann cells in the periphery: example injury - compression ANS (trauma)

Neuropathy = temporary failure of nerve conduction in absence of structural changes musculoskeletal block axonolysis = disruption of axon and myelin sheath but can regenerate.

Neuropathies = complete destruction of a nerve: no recovery.

Repair: microsurgery, sutures to each epitenon together.

Healing: very slow, distal to site of injury initial desire for surgery, proximal around budging occurs after trauma, regeneration proceeds 1 mm/day. Pain is first modality to return.

Tinel's sign = tap over site of nerve and parasthesia will be felt as distally as regeneration has occurred.

Injury assessed + recovery monitored by electrophysiological nerve conduction studies

Osteoarthritis:
- Higher fat content in bone
- locomotor joint disease
- Osteoporosis = noninflammatory disease
- People don't tend to get both.
- Range > 65 yo.
- Obesity
- Genetic
- Excessive joint loads

2. Chronic condition of synovial joints, focal cartilage loss and accompanying subchondral bone repair: essentially "joint failure." Bone, cartilage, tissue, muscles, ligaments
Classifications:
- Primary: Hip and ankle
  • Early onset <60yo
    • Familial trauma
- Congenital
  • Metabolic: Osteopenia, osteomalacia, rickets
  • Inflammatory: Sepsis, arthritis, psoriasis
- Vascular: AVN: Riedel's disease
- Occupational: Repetitive trauma

Articular cartilage:
1. Formation: Horizontal + vertical filters
2. Water content = Swelling
3. Softening
4. Erosion = Loss of articular cartilage
5. Chondrocytes: Produce IL-1 + TNF-α
   - These cytokines stimulate synthesis of matrix-degrading enzymes + inhibit synthesis of type 2 collagen + proteoglycans

Osteophytes:
- Small bump outgrowths forming above cartilage, proliferates from ossicles
- Small piece or bone or cartilage can dislodge and fall into the joint space ("octic bodies"

Subchondral bone cysts = Synovial fluid being forced under pressure into cracks in subchondral bone

Possible in Ankle, multiple joints
- Hips 20% = Hands 30% = 1st MPJs of foot
- Knees 40% = Spine

Hands + Knees = Females
  - Hips = Males

1. Heberden's nodes
  • DIPJ osteophytes

Bouchard's nodes PIPj osteophytes

No correlation of severity of X-ray and clinical symptoms.
No treatment prevents progression

Cervical + lumbar spondylosis = osteoarthritus of the spine

Hallux rigidus = osteoarthritus of 1st metatarsophalangeal joint

OSTEOARTHRITIC JOINT
- Carilage is worn away, spurs grow out from the edge of the bone and synovial fluid ↑ = joint feels stiff + sore

Lose remaining cartilage = osteophytes
- High thickened capsule
- Inflamed synovium
- Loss of articular cartilage
- Often get loose articular cartilage seen on arthroscopy

Osteoarthritus:
- Bouchard's nodes

Diagnosis of osteoarthritus:
- Pain = poorly localized, dull ache
  - Slow onset
  - Occurs after period of activity AND after period of inactivity
  - Pain at rest
  - Pain that disturbs sleep may be affected knee pain to hip
- Joint stiffness localized, rarely extends to pain
  • Tenderness on joint line
  • Muscle wasting + weakness
  • Multiple joints affected
  • Crepitation on motion
  • No systemic features
  • Square hand

Possible lack of joint

"Rusty gate" stiff to move at first but wears off
Conditions of the foot

1. Hallux valgus = bunions
   - metaatarsalgia over-riding toes
   - problems with shoes
   - angle between 1st and 2nd metatarsals should be <10°
   - treatment = bring metatarsals closer together to normalise the shape of foot.
   - common problem

2. OA of 1st HTPJ = painful surgical fusion of joint done.
   - narrowing of joint space
   - osteophyte formation

Ankle arthritis
   - usually secondary problem unlike knees/hips
   - athletic people = people who have fractured their ankle
   - surgical fusion but still = loss of movement
   - ankle replacement = skill some movement

metatarsalgia
   - pain around metatarsal heads
   - symptom NOT a diagnosis
   - treatment = cushioned insoles, surgery less reliable

Fractures + dislocations
   - complications = fat emboli, compartment syndrome
   - # occurs due to: high energy transfer injuries
   - repetitive stress on normal bones
   - low energy transfer into abnormal bones = osteoporosis or osteomalacia, tumour

Flat foot sign. Pes Planus
   - knock knee, joint locking
   - Achilles tendon rupture
   - "too many toes" sign
   - "too few toes"

High arches syn. Essex-Lopresti:
   - often bilateral
   - metatarsalgia
drawn toes
Describing a fracture:
- mechanism of injury
- site
- shape
- comminution
- deformity
- associated injury

Severe soft tissue injuries in a fracture require urgent treatment as severe tissue injury will delay fracture healing.

Bone healing:

1. Inflammatory 24-72 h - necroinflammatory
   - haematoma, forming 
   - release of vascular mediators 
   - cells 
   - osteoclasts releasing pro-inflammatory 
   - microangiogenic 
   - cartilage in 
   - osteoprogenitor 
   - osteoclasts forming osteoclasts forming a mass 

2. Reparative - from 2 days - chondral and osseous differentiation
   - differentiation into osteoblasts 
   - bone matrix repair and formation of new bone 
   - woven bone 
   - secondary callus (heterotopic) 
   - osteoblasts forming a mass 

3. Remodelling - long process
   - woven bone 
   - lamellar bone 
   - bone density 
   - bone remodelling at the fracture site

Problems with fracture healing:
- avascular necrosis
- delayed union - healing taking longer than average
- non-healing - atrophic, hypertrophic, infected
- malunion - fracture heals but not in anatomical position so can cause problems
- in fingers it may mean loss of fine movement and may cause problems
NON-UNION types

atrophic - gap at site, bone loss, no attempt at healing
hypertrophic - trying to heal but environment is too unstable to heal properly e.g. horses hooves or elephants foot.
infected non-unions - contaminated open fracture, remove dead tissue, treat infection + stabilise fracture.

Avascular necrosis - loss of blood supply

Treatment of ANY fracture

aim = relieve pain + restore function, MDT

early active movement but NO sports
rest + elevation as swelling causes pain
rest + elevation + sling if clavicle #
rest + gravity + cold + cuff if humeral neck #
semi-rigid splintage in coloured stuff
immobilisation by external rig if splint or plaster cast
functional brace - plastic case with elastic straps to fit snugly around it to squeeze the soft tissue and that becomes the stabiliser.

Skeletal traction - shell range for cervical spine
external fixation - pins through bone + external bar or frame on outside
internal + external fixation - key to + risk of post traumatic osteoarthritis.
ORIF with screws/wires/tension band (humerus & patella)/plate (radius & ulna)
internal fixation < screw/plate/nail.
spinal rods
prosthetic replacement
amputation.

Mangled Extremity Severity Score (MESS) for limb salvage vs amputation.

Open fracture = direct communication with fracture + external environment usually broad through skin but can be pelvic fracture through rectum.

High infection risk

Lauge-Hansen + Anderson grading (I → IIIA/B/C)

management:
ATLS - tetanus + antibiotic prophylaxis over + stabilise limb + surgical emergency - operate within 6 hours.
DO NOT CLOSE WOUND - leave skin open,
review wound daily 1-2 days, at 5-7 days definitive skin cover, bone graft.

Complex regional pain syndrome - late complication of an open fracture, rare in children.

A strange neurological findings after an injury.

Pain
Oedema
Reduced ROM
Temperature + colour change

Symptoms: pain (severe, constant, worse with movement), swelling, skin change, occupation, hot.

•ectomy
• muscle wasting • osteopenic bone

• graft
• muscle wasting + osteopenic bone + osteoarthritis joints
alodynia - painful stimulus can cause pain
asyncen - abnormal response to painful stimuli
- early active movement
- regular analgesia
- phlego regularly
- biapar acetaminophen
- gabapentin - neuropathic pain or seizures
- quinidine
- IV bisphosphonates

Hyperalgesia shock + hypokalemia
due to release of K+ from injured cells.

Acute Compartment Syndrome
Local problem with threatening damage from fracture.
Exertional compartment syndrome = dragging injury
on one side for too long a period of time.

↑ in pressure in soft tissues compartments and they can't expand = ↑ pressure makes venous return hard.
Mechanism: Lower leg forearms most at risk.
Soft tissue injury backs hematoma reaction off trauma.
Chronic exertional crush injury.
Low energy fractures as fascial compartments more likely to be affected.

QPs
Pain - pain level is out of proportion to level you find.
Fascial compartment of the digits made cause by division.
Anesthesia or paralgesia - weakness or paralgesia.
Fluor.
Electrolytes
Resting cold
Pressure
Prompt decompression.

Crush Syndrome
Syn traumatic rhabdomyolysis
any soft tissue injury
major shock + renal failure after a crushing injury to skeletal muscle.

Ischemic: perfusion to limb when released from crush
myoglobin is normally low but if this lots can leak into circulation and it is nephrotoxic can cause acute tubular necrosis + acute renal failure.

WATCH FOR METABOLIC ACIDOSIS!

Acute Compartment Syndrome
Management = IV fluids
- protect kidneys
- fluid expansion + vesicle diuretics
- high urine flow rate followed by alkalinization
- sodium bicarbonate make urine alkaline to "bicarbonate precipitation of myoglobin."

Threshold for fasciotomy = Delta P 430mmHg

Fat Embolism Syndrome
Systemic problem rare - life threatening.
2 criteria to diagnose fat embolism syndrome:

1. Schonfeld's criteria - score > 5 = fat emboli
2. Curtis & Wilson criteria ie symptom from head and or other minor problems ie anaemia, ↑ ESR, fever, jaundice etc...

Prompt decompression: leave open for 48 hours before skin graft closure.

FES = lower limbs > upper limbs. Emergency fasciotomies to release pressure and allow reperfusion of compartments.

CXR - hypoxia or arterial blood gases

Treatment: 100% O2. Supportive management. Auto maintain arterial pulmonary perfusions = LAO.

Prevention: fixation of long bone fractures
Steroid prophylaxis
Monitor pulse oximetry

Fat emboli & by fractures fixed in 24 hours