FRCS(Tr&Orth) Vivas

Summer Term 2005
The diagnostic criteria for NF1 were established by The Consensus Development Conference on Neurofibromatosis at the National Institutes of Health in 1987:

- Six or more café-au-lait spots, at least 15 mm in diameter in adults and 5 mm in children.
- Two or more neurofibromas of any type or one plexiform neurofibroma.
- Freckling in the axillae or inguinal regions (Crowe sign).
- Two or more iris hamartomas (Lisch nodules).
- A distinctive osseous lesion, such as sphenoid dysplasia or thinning of long bone cortex, with or without pseudarthrosis.
- A first-degree relative with NF1 by the above criteria.
How do you check for a L4 level?

• Sensation on the medial side of the ankle, the patellar tendon reflex, and plantar inversion are associated with the L4 neurologic level.

• (Sensation on the lateral side of the ankle and the Achilles tendon reflex are associated with the S1 neurologic level).
Which foot bones are ossified at birth?

- Metatarsals are ossified at birth, along with the talus and the calcaneus.
- The cuboid ossifies at 1 month, followed by the third, second, and first cuneiforms.
- The navicular does not ossify until age 2 or 3 years.
- These facts are useful when interpreting radiographs for congenital foot deformities such as clubfoot. The location of the navicular must often be inferred from the position of the first metatarsal.
When to wt-bear after talar neck #’s

- Thordarson and associates used MRI to establish criteria for allowing a patient to begin weight bearing. Their study suggested that patients with Hawkins types I and II fractures should be allowed protective weight bearing when radiographic evidence of healing at the fracture is present. None of the patients with a type I or II fracture in this study developed late segmental collapse.

For patients with a Hawkins type III or IV fracture, the investigators recommended an MRI at 8 to 12 weeks postinjury to assess for osteonecrosis. The degree of osteonecrosis is then classified based on the percent of talar body affected by osteonecrosis (type A, homogenous bone throughout the body of the talus; type B, signal changes in up to 25 % of the body of the talus; type C, signal changes in up to 25% to 50% of the body of the talus; and type D, signal changes in more than 50 % of the body of the talus). The fracture presented in this question is a type C. Type C fractures are kept non-weight bearing and the MRI is repeated in 6 to 9 months after injury. If no progression of signal changes is noted, protective weight bearing is allowed.
The oblique retinacular ligament connects with what two structures?

- Landsmeer (oblique retinacular ligament) originates from periosteum of prox phalynx, A2 and C1 pulleys.
- Inserts into the terminal tendon
- Function: To link PIPJ and DIPJ extension
Branches of axillary artery

1 (Medial to pec minor)
- Supreme thoracic

2 (below pec minor)
- Thoracoacromial artery (deltoid, acromial, pectoral and clavicular branches)
- Lateral thoracic

3 (Lat to pec minor)
- Subscapular
- Anterior humeral circumflex
- Posterior humeral circumflex
Greater sciatic foramen

- **7 nerves**
  - Sciatic
  - Sup gluteal
  - Inf gluteal
  - Posterior femoral cutaneous nerve
  - Nerve to quadratus femoris
  - Nerve to obturator internus
  - Pudendal
- **3 vessels**
  - Sup gluteal artery +v
  - Inf gluteal artery +v
  - Internal pudendal artery +v
- **1 muscle**
  - Piriformis


Pudendal and n to obturator internus leave greater sciatic foramen and re-enter pelvis via lesser foramen
Acetabular screw danger zones

• Posterior superior SAFE
• Posterior inferior SAFE

• Anterosuperior External iliac A & V
• Anteroinferior Anteroinferior obturator N Obturator A & V
Difference between UBC and ABC

- Unicameral bone cysts have a typical radiographic appearance:
  - Metaphyseal
  - Purely lytic
  - Expand the bone in a symmetric fashion
  - Often border the growth plate
  - May have trabeculations in them once they have fractured

- ABC = Eccentric
  - Unicameral bone cysts do not expand the bone beyond the width of the physis
  - ABC may markedly expand the cortex.
  - As ABCs expand into the soft tissues, there is generally a thin rim of periosteal bone that outlines the expansion. With aneurysmal bone cyst, the lesion is eccentric. Normal bone is present bordering the lesion. In contrast, in unicameral bone cyst the entire medullary cavity is symmetrically involved.
Suprascapular nerve

- The suprascapular nerve is a branch of the upper trunk of the brachial plexus at Erb’s point. The suprascapular nerve receives branches primarily from the fifth cervical nerve root. The nerve follows the omohyoid muscle laterally and passes beneath the anterior border of the trapezius muscle to the upper border of the scapula where it joins the suprascapular artery. It passes through the suprascapular notch deep to the transverse scapular ligament. The artery and vein pass superficial to the ligament and join the nerve distally in the suprascapular fossa. After innervating the supraspinatus muscle, the nerve passes around the lateral free margin of the scapular spine (spinoglenoid notch) to innervate the infraspinatus muscle.
Delbert classification

• Type I: Transphyseal fracture
• Type II: Transcervical fracture
• Type III: Basicervical fracture
• Type IV: Intertrochanteric fracture
What is this?

- CVT
- Note the equinus of the hindfoot, calcaneus of the forefoot, and the crease in the sinus tarsi. In patients with a calcaneovalgus foot, the hindfoot is in calcaneus, not equinus.
What level myelodysplasia?

- This patient has active quadriceps (which are innervated through L2-L4) and adductors (which are innervated through L1-L3). Because the patient’s knees are slightly hyperextended there is no hamstring function. The patient’s right foot has some dorsiflexion. The lesion is rated as L4. However, the patient’s right side may be rated as L3.
Boundaries of Hunter’s canal

- Hunter’s canal (adductor canal) is bound anterolaterally by the vastus medialis, posterolaterally by the adductor longus, and medially by the sartorius
<table>
<thead>
<tr>
<th>Syndrome</th>
<th>Glycosaminoglycans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hurler syndrome</td>
<td>Dermatan and heparan sulfate</td>
</tr>
<tr>
<td>Hunter syndrome</td>
<td>Dermatan and heparan sulfate</td>
</tr>
<tr>
<td>Sanfilippo syndrome</td>
<td>Heparan sulfate</td>
</tr>
<tr>
<td>Morquio syndrome</td>
<td>Keratin sulfate</td>
</tr>
</tbody>
</table>
FLK causes

- FGFR3 mutation: Achondroplasia
- Type IX collagen mutation: Multiple epiphyseal dysplasia (MED)
- WISP3 mutation: Spondyloepiphyseal dysplasia with progressive osteoarthropathy
- Type II collagen mutation: Stickler syndrome
- Sulfate transporter gene mutation: Diastrophic dysplasia
- Fibrillin gene mutation: Marfan’s syndrome
- Type V collagen mutation: Ehlers-Danlos syndrome
- Type I collagen mutation: Osteogenesis imperfecta
Osteoporosis

Type 1 osteoporosis
- Postmenopausal
- Female to male ratio is 6:1
- High turnover osteoporosis
- Bone loss rate of 2% to 3% per year for 6 to 10 years following menopause
- Trabecular bone is most affected
- Related to estrogen deficiency rather than calcium intake

Type 2
- >75 age group
- Female : male 2:1
- Low turnover
- Related to lifelong calcium deficiency
- Trabecular and cortical
Nerve compression aetiology

- **SYSTEMIC**
  - Diabetes
  - Alcohol
  - Renal failure
  - Raynauds
- **INFLAMMATORY**
  - RA
  - Infection
  - Gout
  - Tenosynovitis
- **FLUID IMBALANCE**
  - Pregnancy
  - Obesity
- **ANATOMY**
  - Synovial fibrosis
  - Anomolous tendon
  - Fracture deformity
- **MASS**
  - Ganglion
  - Lipoma
  - Haematoma
Radial club hand

- Bilat in 50-72%
- Assoc VATER, Holt-Oram, TAR, Fanconis

- Stage I: Deficient distal radial epiphysis
- Stage II: Complete but short (hypoplasia)
- Stage III: Present proximally (partial aplasia)
- Stage IV: Total aplasia (most common)
Type A

$A_L$: at lesser trochanter

$A_G$: at greater trochanter.

"Example shows type $A_L$ fracture"

Type B₁

around or just below stem - stem well fixed

Type B₂

at or just below stem - stem loose

Type B₃

at or just below stem - poor bone stock in proximal femur

Type C

well below the stem
Radiation doses

- Chest radiograph: 25 mrem
- Hip radiograph: 500 mrem
- Hip computed tomography: 1,000 mrem
- C-arm (in beam): 1,200 mrem/min to 4,000 mrem/min
- Mini C-arm (in beam): 120 mrem/min to 400 mrem/min
Cord syndromes

<table>
<thead>
<tr>
<th>Injury</th>
<th>Functional deficit</th>
<th>Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central (most common)</td>
<td>UL&gt;LL, usually quadriplegic with sacral sparing. Flaccid UL paralysis &amp; spastic paralysis of LL</td>
<td>75%</td>
</tr>
<tr>
<td>Anterior</td>
<td>Complete motor deficit</td>
<td>10% WORST PROGNOSIS</td>
</tr>
<tr>
<td>Posterior</td>
<td>Loss of deep pressure, deep pain &amp; proprioception</td>
<td></td>
</tr>
<tr>
<td>Brown-Sequard</td>
<td>Unilateral cord injury. Ipsilateral motor deficit &amp; contralateral pain and temperature deficit (2 levels below injury)</td>
<td>&gt;90% recovery</td>
</tr>
</tbody>
</table>
# Key neurologic levels

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>MOTOR</th>
<th>REFLEX</th>
</tr>
</thead>
<tbody>
<tr>
<td>C5</td>
<td>Deltoid</td>
<td>Biceps</td>
</tr>
<tr>
<td>C6</td>
<td>Wrist extension</td>
<td>Brachioradialis</td>
</tr>
<tr>
<td>C7</td>
<td>Wrist flex/Triceps</td>
<td>Triceps</td>
</tr>
<tr>
<td>C8</td>
<td>Finger flexion</td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>Interossei</td>
<td></td>
</tr>
<tr>
<td>L4</td>
<td>Tib ant</td>
<td>Patellar</td>
</tr>
<tr>
<td>L5</td>
<td>Toe extensors</td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td>Peroneal</td>
<td>Achilles</td>
</tr>
</tbody>
</table>
## Lumbar disc levels

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>NERVE ROOT</th>
<th>SENSORY LOSS</th>
<th>MOTOR LOSS</th>
<th>REFLEX LOSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1-L3</td>
<td>L2-L3</td>
<td>Anterior thigh</td>
<td>Hip flexors</td>
<td>None</td>
</tr>
<tr>
<td>L3-L4</td>
<td>L4</td>
<td>Medial calf</td>
<td>Quads, tib ant</td>
<td>Knee jerk</td>
</tr>
<tr>
<td>L4-L5</td>
<td>L5</td>
<td>Lat calf, dorsal foot</td>
<td>EHL, EDL</td>
<td>None</td>
</tr>
<tr>
<td>L5-S1</td>
<td>S1</td>
<td>Post calf, plantar foot</td>
<td>Gastrosoleus</td>
<td>Ankle jerk</td>
</tr>
<tr>
<td>S2-S4</td>
<td>S2,3,4</td>
<td>Perianal</td>
<td>Bowel/bladder</td>
<td>Cremasteric</td>
</tr>
</tbody>
</table>

- **LEVEL** refers to the lumbar levels.
- **NERVE ROOT** indicates the root affected by the disc herniation.
- **SENSORY LOSS** lists the sensory symptoms related to the affected nerve root.
- **MOTOR LOSS** indicates the motor symptoms.
- **REFLEX LOSS** notes any absence of reflexes.
What are the scenarios in a L4/L5 disc bulge?

- Normal bulge would hit the traversing L5 root causing
  - + tension signs (decreased SLR)
  - Decreased hip abductors
  - Decreased EHL
  - Pain and numbness lat leg and dorsum of foot

Far lateral disc could hit L4 as it exits
  - + tension (FST)
  - Decreased tib ant
  - Loss of patella reflex
C-spine root compressions

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>ROOT</th>
<th>MUSCLE</th>
<th>SENS</th>
<th>REFLEX</th>
</tr>
</thead>
<tbody>
<tr>
<td>C3-C4</td>
<td>C4</td>
<td>Scapular</td>
<td>Lat neck, shoulder</td>
<td>None</td>
</tr>
<tr>
<td>C4-C5</td>
<td>C5</td>
<td>Deltoid/biceps</td>
<td>Lat arm</td>
<td>Biceps</td>
</tr>
<tr>
<td>C5-C6</td>
<td>C6</td>
<td>Wrist ext, biceps, triceps</td>
<td>Radial forearm</td>
<td>Brachioradialis</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(supination)</td>
<td></td>
</tr>
<tr>
<td>C6-C7</td>
<td>C7</td>
<td>Triceps, wrist flexors</td>
<td>Middle finger</td>
<td>Triceps</td>
</tr>
<tr>
<td>C7-C8</td>
<td>C8</td>
<td>Finger flexors</td>
<td>Ulnar hand</td>
<td>None</td>
</tr>
<tr>
<td>C8-T1</td>
<td>T1</td>
<td>Interossei</td>
<td>Ulnar forearm</td>
<td>None</td>
</tr>
</tbody>
</table>
Tibial #'s – acceptable alignment

- Varus – valgus: 5 degrees
- Sagittal plane: 10 degrees
- Cortical apposition: 50%
- Shortening: 1 cm
- Rotation: 10 degrees
What are these signs?

• Jeanne's sign identifies thumb metaphalangeal joint hyperextension of 10° to 15° with key pinch or gross grip.
• Froment's sign refers to the exaggeration of thumb interphalangeal joint flexion during key pinch by the flexor pollicis longus in ulnar nerve palsies.
• Wartenberg's sign is the inability to adduct the extended small finger due to an ulnar nerve palsy.
• Duchenne's sign refers to clawing of the ring and small fingers.
• Pollock's sign is the inability to flex the distal interphalangeal joints of the ring and small fingers in high palsies.
Blood supply to the physis

- Epiphyseal artery – terminates @ proliferative zone
- Perichondral artery
- Metaphyseal artery
- Nutrient arteries
How do you classify congenital limb anomalies?

• Swanson 1976

• I  Failure of formation   e.g. Fibular deficiency
• II Failure of separation  e.g. Tarsal coalition
• III Hypoplasia           e.g. Hypoplastic digit
• IV Overgrowth            e.g. Macrodactyly
• V  Duplication           e.g. Polydactyly
• VI Constriction ring syn e.g. Amniotic bands
• VII Dysplasias/syndromes e.g. Achondroplasia
Indications for IM nailing tibia

- Unacceptable alignment with closed reduction
- Significant soft tissue injury
- Segmental #
- Polytrauma/ipsilateral #’s
- Morbid obesity
- High energy/instable
Tibial #'s – indications for amputation

- Warm ischaemia > 6hrs
- Absent plantar sensation
- Severe ipsilateral foot trauma
Rheumatoid thumb

- Type 1: Boutonniere
- Type 2: Type 1 + CMCJ subluxation
- Type 3: Swan neck
- Type 4: Gamekeeper
- Type 5: Swan neck with disease @ MPJ, CMC ok
Pseudohypoparathyroidism

- Pseudohypoparathyroidism (PHP) (Albright Hereditary Osteodystrophy [AHO]) - end organ insensitivity; in AHO, germline mutation that leads to loss of function of Galpha S (GNAS1); causes end-organ resistance to PTH.
- PHP - short stature, short metacarpals (4th and 5th), rounded facies
  - Mental retardation, tetany
  - Sex-linked dominant
- Laboratory features
  - Hypocalcemia
  - Hyperphosphatemia
  - Normal PTH
Vitamin D-resistant rickets

- Vitamin D-resistant rickets may occur when there is an inability to convert 25 hydroxy vitamin D into 1,25 dihydroxy vitamin D.
- Patients develop secondary hyperparathyroidism. A low serum calcium level causes an increased parathyroid hormone (PTH) level. Parathyroid hormone causes the kidneys not to reabsorb phosphorus, and the serum phosphate is low. The serum 1,25 dihydroxy vitamin D level is low.
- The metabolic profile is:
  - Serum calcium Low
  - Serum phosphate Low
  - Serum PTH High
  - 25 vitamin D Normal
  - 1,25 vitamin D Very low

Treatment is by dietary 1,25 dihydroxy vitamin D.
DEFINITIONS
Define Spasticity

A motor disorder characterised by a velocity-dependent increase in muscle tone
## Spondylolisthesis

<table>
<thead>
<tr>
<th>Type</th>
<th>Age</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dysplastic</td>
<td>Child</td>
<td>Congenital dysplasia of S1 sup facet</td>
</tr>
<tr>
<td>Isthmic</td>
<td>5 – 50</td>
<td>Predisposn with elongation/# of pars (L5-S1)</td>
</tr>
<tr>
<td>Degenerative</td>
<td>Old</td>
<td>Facet arthroses leading to subluxation (L4-L5)</td>
</tr>
<tr>
<td>Traumatic</td>
<td>Young</td>
<td>Acute # other than pars</td>
</tr>
<tr>
<td>Pathologic</td>
<td>Any</td>
<td>Incompetence of bony elements</td>
</tr>
<tr>
<td>Postsurgical</td>
<td>Adult</td>
<td>Xs resection of neural arches/facets</td>
</tr>
</tbody>
</table>

- Grade I = 0-25% slip, II = 25-50%, III = 50-75%, IV > 75%, V > 100%
Causes of Swan Neck

- “Imbalance of forces @ PIPJ and a lax volar plate”
- e.g. MCPJ volar subluxation (Rheumatoids)
  Mallet finger
  Laceration
  Transfer of FDS
  Intrinsic contracture
Gait

- Stance phase: 62% of cycle
- Swing phase: 38% of cycle

Heel strike to foot flat: Three important points
- Eversion of the subtalar joint
- Unlocking of the transverse tarsal joint
- Internal rotation of the tibia

Heel rise to toe-off
- Inversion of the subtalar joint
- Locking of the transverse tarsal joint
- External rotation of the tibia

Preswing is the only phase of gait in which all muscle groups are silent in the ipsilateral lower extremity. In the next phase (initial swing), internal moments are generated at the hip and ankle to initiate swing.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Muscle</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heel strike</td>
<td>Tib ant Gastroc-soleus</td>
<td>Eccentric contraction Quiet</td>
</tr>
<tr>
<td>Foot flat</td>
<td>Tib ant Gastroc-soleus</td>
<td>Quiet Eccentric contraction</td>
</tr>
<tr>
<td>Heel off</td>
<td>Gastroc-soleus</td>
<td>Concentric contraction</td>
</tr>
<tr>
<td>Toe off</td>
<td>Gastroc-soleus</td>
<td>Concentric contraction</td>
</tr>
</tbody>
</table>
Electrophysiology

• With electrodiagnostic testing, a clinician may find several characteristic features in different disorders:

  • Denervation
    – Fibrillation
    – Positive sharp waves
    – Fasciculations

  • Neurogenic lesions
    – Fasciculations
    – Myokymic potentials

  • Myopathies
    – Complex repetitive discharges
    – Myotonic discharges
## Nerve Injuries

<table>
<thead>
<tr>
<th>Nerve</th>
<th>Presentation</th>
<th>Muscles Lost</th>
</tr>
</thead>
<tbody>
<tr>
<td>High radial</td>
<td>Wrist drop</td>
<td>EDC, EPL, APL, ECRB, ECRL, BR</td>
</tr>
<tr>
<td>Low radial</td>
<td>Wrist drop</td>
<td>EDC, EPL, APL</td>
</tr>
<tr>
<td>High ulnar</td>
<td>Ulnar claw (intrinsic minus)</td>
<td>Adductor poll, Interossei, FDP (ring &amp; little), FCU, Lumbricals (ring &amp; little)</td>
</tr>
<tr>
<td>Low ulnar</td>
<td>Severe ulnar claw</td>
<td>Adductor poll, Interossei, Lumbricals (ring &amp; little)</td>
</tr>
<tr>
<td>High median</td>
<td>Ape hand</td>
<td>PT, FCR, FDP (index &amp; long), FPL, APB, Lumbricals (index and long)</td>
</tr>
<tr>
<td>Low median</td>
<td>Thenar wasting</td>
<td>APB, Lumbricals (index and long)</td>
</tr>
</tbody>
</table>
What are osteocytes?

- Osteoblasts that become imbedded into the bone matrix become osteocytes. Osteocytes are less metabolically active because they do not produce large amounts of protein for export. Thus, osteocytes have a higher nucleus to cytoplasm ratio than osteoblasts. Osteocytes have fewer organelles as they do not need extensive intracellular machinery to export protein products.

- Osteocytes have extensive connections with other osteocytes through the cell processes that travel through the canaliculi. Strain generated signals such as cell deformation, streaming potentials, or shear stress by fluid flow could be perceived by the osteocytes and passed on to other cells.
Knee layers

- **Medial**
  - I Sartorius
  - II Sup MCL, semimembranosus
  - III Deep MCL, capsule

- **Lateral**
  - I ITB, biceps, prepatella bursa, peroneal nerve
  - II Patella retinaculum, patellofemoral lig
  - III Arcuate lig, fabellofibular lig, LCL, pop, pop-fib, capsule
• Activation of osteoclasts a complex.
• Surface receptors on osteoclast precursor cells are called RANK.
• Receptor activator of nuclear factor \( \kappa B \) ligand (RANKL) is expressed on the surface of osteoblasts/stromal cells.
• RANKL proteins leave osteoblast and attach to the RANK receptor on the osteoclast precursor.

• Macrophage colony stimulating factor (MCSF) then facilitates the production of active osteoclasts from the osteoclast precursor.

Osteoprotegerin (OPG) is an inhibitor that is produced on the cell surface of hematopoietic precursor cells and mature osteoclasts. OPG binds to RANK receptor to inhibit the activation of osteoclasts.
Gustillo and Anderson

- Type I fractures have an open wound less than 1 cm in length.
- Type II wounds measure greater than 1 cm but less than 10 cm without contamination, and the wounds can be closed without flap coverage.
- Type IIIA fractures have an open wound greater than 10 cm that can be closed with delayed primary techniques. Segmental fractures and gunshot injuries are also graded IIIA.
- Type IIIB fractures require rotational of free flap wound coverage.
- Type IIIC fractures are any open fractures with an associated vascular injury that requires repair.
#’s: im nails vs plates

- The periosteal blood supply cannot supply the inner two-thirds of the cortex even if the endosteal blood supply has been interrupted, as in intramedullary reaming.
- Blood flow markedly drops at the fracture site at the time of the fracture and peaks at 2 weeks.
- Intramedullary reamed rods destroy the endosteal blood supply. In dog experiments, the blood supply is reconstituted to normal in 120 days.
- In dog experiments, the blood supply is decreased in both plated and rodded tibias at 42 and 90 days. The decrease is greater in the rodded tibias.
- The oxygen tension is low in the fracture hematoma and in the newly formed cartilage and bone. The oxygen tension is highest in the fibrous tissue. The hypoxic state favors cartilage formation.
• In a bowed tibia, the tensile stress during weightbearing is greatest at which point?

• The moment becomes tensile at the apex on the convex side of a tibial bow, in contrast to the normal compressive stress in a straight diaphysis. The moment is equal to load multiplied by distance from the axis of load.
## Silence

<table>
<thead>
<tr>
<th>Type</th>
<th>Inheritance</th>
<th>Sclera</th>
<th>Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>AD</td>
<td>Blue</td>
<td>Mild form, normal teeth</td>
</tr>
<tr>
<td>II</td>
<td>AR</td>
<td>Blue</td>
<td>Lethal form, die early</td>
</tr>
<tr>
<td>III</td>
<td>AR</td>
<td>Normal</td>
<td>Severe, progressively deforming</td>
</tr>
<tr>
<td>IV</td>
<td>AD</td>
<td>Normal</td>
<td>Moderately severe</td>
</tr>
</tbody>
</table>
Layers of the foot

• **First Layer**
  Abductor hallucis MPN (S2,S3) abducts and flexes Flexor digitorum brevis MPN (S2,S3) flexes lateral four digits Abductor digit minimi LPN (S2,S3) abducts and flexes fifth digit

• **Second Layer**
  Quadratus plantae LPN (S2,S3) flexes lateral four digits Lumbricals Medial one: MPN flex MTPJ, ext PIP, DIP Lateral three: LPN

• **Third Layer**
  Flexor hallucis brevis MPN (S2, S3) flex MTPJ Adductor hallucis LPN (S2, S3) abducts first digit Flexor digiti minimi LPN (S2, S3) flex MTPJ

• **Fourth Layer**
  Plantar interossei LPN (S2,S3) adducts digits flex MTPJ Dorsal interossei LPN (S2,S3) adducts digits flex MTPJ
OPG

• Soluble decoy receptor for RANKL
• Blocks osteoclast formation
• Reduces hypercalcemia
• Overexpression induces osteopetrosis
• Loss of expression induces osteoporosis
• Prevents calcification of large arteries
Define Neuropraxia

A physiological conduction block
Define Axonotomesisis

Axonal disruption with an intact nerve sheath
Define Neurotmesis

Axonal disruption with discontinuity of the nerve sheath
What is osteoporosis?

A skeletal disease characterised by a low bone mass with a consequent increase in bone fragility
Describe Newton’s Laws

- FIRST (Inertia) = sum of all external applied forces is zero.

- SECOND (Acceleration) = change in velocity is proportional to the force.

- THIRD (Reaction) = for every action there is an equal and opposite reaction.
What is stress?

Force per unit area (N/m²)
What is strain and what are it’s units?

Change in length/Original length (\(\Delta L/L\) – no units)
What properties does an elastic material demonstrate?

Reversible deformation
What properties does an plastic material demonstrate?

Irreversible deformation
What is the yield point for a biomaterial?

Point at which there is a dramatic increase in strain with little increase in stress (transition from elastic to plastic phase)
What is the yield strength for a biomaterial?

Stress necessary to produce a specific amount of permanent deformation (0.2%)
Define stiffness

Resistance to deformation - a product of stress/strain (Young’s modulus)
What is the difference between stiffness and rigidity in bio-engineering

Stiff = A material that is resistant to deformation
Rigid = A structure that is resistant to deformation
What is hardness?

Scratch resistance
What is fatigue?

Progressive failure due to application of cyclical stresses below the ultimate tensile strength.
What is prevalence in a population?

Total number of affected individuals at a single point in time
What is incidence in a population?

Number of new cases per unit time
What is an odds ratio?

Likelihood of exposure causing disease
Define relative risk

Risk of developing disease without exposure
Define statistical power

The ability of a study to detect a TRUE difference
What types of statistical error do you know? How might it be reduced?

- Type I ($\alpha$) = study detects a difference that DOES NOT exist = “difference by chance alone” (related to study design)

- Type II ($\beta$) = study does not detect a difference when one DOES exist (related to study power)
What is bias? Give an example?

A flaw in impartiality

(Blinding = study technique that minimises bias)
What is a confounding factor? Give an example of how it may be reduced/removed

A variable that affects the validity of the conclusions of a study

(Randomisation = study technique that minimises confounding variables)
• Sens = TP/TP+FN
• Spec = TN/TN+FP
• PPV = TP/TP+FP
• NPV = TN/TN+FN
• Accuracy = TP+TN/All

Disease +  Disease –

Test +       TP  3  FP

Test -       FN  4  TN

1  2
Define sensitivity

Proportion of true positives that are test positive
Define specificity

Proportion of true negatives that are test negative
What is a positive predictive value?

Proportion of test positives that are true positives
What is a negative predictive value?

Proportion of test negatives that are true negatives
What is an intercalated segment?

A segment whose stability depends on the compressive load supplied by adjacent structures.
What is a bone scan?

A radio-isotope imaging investigation
What is a DEXA scan? What are T-scores and Z-scores?

Dual energy x-ray absorptiometry used to evaluate bone mineral density

T-score = comparison with sex/race matched YOUNG ADULT controls

Z-Score = comparison with sex/race and AGE matched controls (not used in osteoporosis!!)
What is a screw?

A device that converts a torsional force into a linear force
What are the drill/screw sizes that you commonly use in fracture surgery?

<table>
<thead>
<tr>
<th></th>
<th>Large Fragment</th>
<th>Small Fragment</th>
<th>Mini Fragment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outer Diameter (Cancellous)</td>
<td>6.5mm</td>
<td>4.0mm</td>
<td>N/A</td>
</tr>
<tr>
<td>Outer Diameter (Cortical)</td>
<td>4.5mm</td>
<td>3.5mm</td>
<td>2.7mm</td>
</tr>
<tr>
<td>Core Diameter</td>
<td>3.0mm</td>
<td>2.4mm</td>
<td>1.9mm</td>
</tr>
<tr>
<td>Drill Size</td>
<td>3.2mm</td>
<td>2.5mm</td>
<td>2.0mm</td>
</tr>
</tbody>
</table>
What is the definition of a massive blood transfusion? What are the indications for transfusion?

Massive blood transfusion = transfusion of TBV <24hrs or 50% TBV <1hr

- Indications
  - Emergency = urgent restoration of blood volume
  - Elective = Hb <8 in fit patients & Hb <10 in patients with C/P disease (NEJM 1999)
DRAWINGS
Draw the anatomy of the quadrilateral & triangular spaces (in the shoulder!!)
Draw the arrangement of flexor sheath pulleys in zone II of the hand.
Draw the extensor compartments at the wrist
Draw the fascial compartments of the hand. How would you perform fasciotomies?
Draw the organisation of tracts in the spinal cord
Meniscus

1. Only the peripheral 25% to 30% of the meniscus has a vascular supply.
2. The medial meniscus functions as a secondary restraint to anterior tibial translation (when the anterior cruciate ligament is cut).
3. Fifty percent of the compressive load of the knee is transmitted through the meniscus when the knee is extended.
4. Eighty-five percent of the compressive load of the knee is borne by the menisci when the knee is in 90° of flexion.
5. Meniscal fibrochondrocytes have the ability to proliferate and synthesize matrix.
6. The medial meniscus is semicircular in shape; the lateral meniscus is circular in shape.
• **Timing**
  
  • Onset of injury site
  
  • 7 to 10 days
  
  • 2 to 5 weeks (fibrillation, positive sharp waves)
  
  • 6 to 8 weeks

• **Electrophysiologic abnormality**

  • Conduction block across nerve injury
  
  • Reduced amplitudes on distal stimulation

  • Denervation changes on electromyographic (EMG) (fibrillation, positive sharp waves)
  
  Re-innervation on EMG
Foot compartments

- Calcaneal compartment
  - Quadratus plantae
  - Posterior tibial nerve, artery, and vein
  - Lateral plantar nerve, artery, and vein
  - Medial plantar nerve (variable)
- *Remember that the calcaneal compartment may communicate with the posterior tibial compartment.
- Interossei—(four separate compartments)
- Adductor muscle
- Medial
  - Flexor hallucis
  - Abductor hallucis
- Lateral
  - Abductor digiti minimi
  - Flexor digiti minimi
- Superficial
  - Flexor digitorum brevis
  - Lumbricals (four)
  - Flexor digitorum longus
  - Medial plantar nerve (variable)
Indications for retrograde i.m femoral nail

- Multisystem injury
- Trauma involving multiple extremity fractures
- Ipsilateral vascular injury
- Fracture in the morbidly obese
- Isolated fracture above a preexisting total knee prosthesis or below a hip prosthesis
- Ipsilateral hip/acetabular fracture
- Spine injury or uncleared spine
- A relative indication is pregnancy as it reduces the amount of radiation directly to the abdomen.

- Contraindications include skeletal immaturity and a history of knee joint sepsis.
How do you do a discectomy

• The traditional surgery for the excision of a herniated posterolateral lumbar disk is by means of a midline incision. This procedure is then performed in a stepwise fashion: The paraspinal musculature is stripped from the lamina of the vertebra; the ligamentum flavum is then excised; portions of the superior and inferior lamina are removed; and the nerve root and dural sac are identified and carefully retracted. This is followed by excision of the herniated disk material and wound closure.
Draw the fascial compartments of the foot. How would you perform fasciotomies?
Draw a cross-section thorough a peripheral nerve
Draw a cross-section thorough skeletal muscle
Draw the microscopic arrangement of a skeletal muscle fibre
Draw a FBD for forces around the shoulder
Draw a FBD for forces around the elbow
Draw a FBD for forces around the knee
Draw the anatomy of Femoral shaft fracture displacement patterns
Draw a cross-section thorough an intervertebral disc. How are the annular fibres organised?
Draw a cross-section of articular cartilage
Describe the molecular structure of the cartilage layers

- **Superficial tangential zone (gliding zone)** Thin collagen fibrils are parallel to the articular surface
- Chondrocytes are elongated with the axis parallel to the surface
- Proteoglycan content is at the lowest level
- Water content is at the highest level

- **Middle zone** Larger diameter collagen fibers/less organization
- Rounded chondrocytes

- **Deep zone** Collagen fibers are large and perpendicular to the articular surface
- Highest concentration of proteoglycans
- Lowest water content
- Chondrocytes are spherical and arranged in columnar fashion

- **Calcified zone** Small cells in cartilage matrix encrusted with apatitic salts
Draw a stress/strain curve for a biomaterial and describe the key areas of the diagram.

- **Stress N/m²**
  - Yield Point
  - Yield Strength
  - Ultimate Tensile Strength
  - Rupture
  - Strain Energy = area under the curve (toughness)

- **Strain**
  - 0.2% Elastic Phase
  - Perfectly Plastic
  - Stress Hardening
  - "Necking"
What is creep? Draw it. Can you give a clinical example?

**CREEP**

A time dependent deformation in response to a constant load (e.g. skeletal traction).

Strain

<table>
<thead>
<tr>
<th>Load On</th>
<th>Load Off</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creep</td>
<td>Elastic recovery but with some permanent deformation</td>
<td></td>
</tr>
</tbody>
</table>
What is stress-relaxation? Draw it. Can you give a clinical example?

**STRESS RELAXATION**

A time dependent decrease in the load required to maintain a material at a constant strain (e.g. corrective splint)

[Graph showing stress relaxation over time]
What is hysteresis? Draw it

**HYSTERESIS**

A material that displays different loading and unloading characteristics, with the strain energy being lost as heat.

[Graph showing stress-strain relationship with hysteresis loop]
What is fatigue? What is a stress-riser? Draw an S/n curve. How might we reduce fatigue?

- **Fatigue** – progressive failure due to application of cyclical stresses below the ultimate tensile strength. It occurs through a process of crack propagation.
- **“Stress riser”** = a point where the concentration of stress exceeds the *mean stress* for the material.

![S/N curve diagram]

- Reduction strategies:
  - implant design (i.e. avoiding sudden changes in geometry).
  - surface treatments (e.g. polishing).
  - correct insertion of implants (to avoid load-bearing a device).
  - control of loading conditions (e.g. partial weightbearing)
What are the pre-requisites for normal gait?

- Gage
  - Stability in stance
  - Clearance in swing
  - Foot pre-positioning
  - Adequate stride length
  - Energy conservation/efficiency
Pronator syn

- Sites of compression
  - Supracondylar process
  - Lig of Struthers (tip of supracondylar process – medial epicondyle)
  - Deep head of p teres
  - Origin of FDS

- Differentiate from CTS by sens disturbance over distributn of palmar cut branch, ant prox forearm pain & tinels. NO night symptoms

- OE: Resisted elbow flexion with forearm supination (bicpital aponeurosis)
  - Resisted forearm pronation with extended elbow (2 heads p teres)
  - Isolated long finger PIPJ flexion (FDS origin)

Rx Non operative, if fails decompress everything!
Describe normal gait
What are the ankle rockers in normal gait?
Describe Vitamin D Metabolism
What is the diagnosis?

### Motor Study *(peak-peak amplitudes)*

<table>
<thead>
<tr>
<th></th>
<th>Right</th>
<th>Left</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Latency (ms)</td>
<td>Duration (ms)</td>
</tr>
<tr>
<td>Median (APB) Wrist</td>
<td>4.2</td>
<td>23.2</td>
</tr>
<tr>
<td>Ulnar (ADM) Wrist</td>
<td>2.4</td>
<td>25.0</td>
</tr>
<tr>
<td><strong>Left</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median (APB) Wrist</td>
<td>3.6</td>
<td>24.3</td>
</tr>
<tr>
<td>Ulnar (ADM) Wrist</td>
<td>2.5</td>
<td>22.3</td>
</tr>
</tbody>
</table>

### Sensory Study

<table>
<thead>
<tr>
<th></th>
<th>Onset lat (ms)</th>
<th>Duration (ms)</th>
<th>Amp (µV)</th>
<th>C.V. (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Right</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digit 3</td>
<td>2.8</td>
<td>1.3</td>
<td>24</td>
<td>34.5</td>
</tr>
<tr>
<td>Ulnar</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digit 5</td>
<td>1.6</td>
<td>1.3</td>
<td>16</td>
<td>53.1</td>
</tr>
<tr>
<td><strong>Left</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digit 3</td>
<td>2.7</td>
<td>1.2</td>
<td>19</td>
<td>35.2</td>
</tr>
<tr>
<td>Ulnar</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digit 5</td>
<td>1.6</td>
<td>1.3</td>
<td>23</td>
<td>53.1</td>
</tr>
</tbody>
</table>
Describe is the microscopic structure of bone

- Cellular Component (10% of cortical bone volume)
  - osteoblasts (mesenchymal stem cells)
    - osteocyte (90%) = osteoblast “trapped” in mineralised osteoid – maintain bone; communicate via cellular processes.
    - bone lining cell = cells lining quiescent bone with cellular processes penetrating matrix to osteocytes. PTH → expose bone surface for o'clasts.
  - osteoclasts (haematopoietic stem cells)
    - produce H-ions = demineralisation.
    - proteolytic enzymes = matrix removal)
- Matrix Component (composite material comprising 90% of cortical bone volume)
  - Organic (40% dry weight) – resists tension forces
    - collagen (type I ..........one = bone)
    - proteoglycans (GAGs)
    - matrix proteins (i.e. non-collagenous) = osteocalcin, -nectin, -pontin
  - Inorganic (60% dry weight) – resists compression forces
    - calcium hydroxyapatite
    - osteocalcium phosphate (brushite)
Describe the blood supply of a long bone. How does it vary between adult/child?

• Endosteal - Nutrient Artery (high pressure system) = inner 2/3
• Periosteal - (low pressure system) = outer 1/3
• Metaphyseal/Epiphyseal – peri-articular vascular plexus
(N.B. Direction)
  – Adult (Normal) = Centrifugal  (Fracture) = Centripetal
  – Child (Normal) = Centripetal – periosteum +++
What factors affect bone healing?

- **Systemic** = age; functional activity; nerve function; nutrition; drugs (NSAIDs++); smoking

- **Local** = severity of local trauma; degree of bone loss; vascular injury; type of bone fractured; immobilisation; infection; local pathology
Describe/Draw wound healing. What cell populations are involved?

- **Inflammation (0.1-10 days):**
  - macrophages (1-2/7) = chemotaxis
  - fibro-/myofibroblasts (2-4/7) = collagen synthesis and wound contraction
  - endothelial cells (4-5/7) = angiogenesis

- **Cell Proliferation and matrix deposition (0.3-30 days)**
- **Matrix re-modelling (3-300 days)**
Describe both the macroscopic & microscopic structure of synovium

• Macroscopic
  – Synovium (intimal layer) = avascular, aneural & arranged into microvilli to ↑ surface area
  – Sunsynovium (fibrous/areolar/adipose) = ↓ cellular & ↑ vascular ↑ innervated with lymphatics
  – Joint capsule/tendon sheath = thick fibrous tissue
• Microscopic
  – Cellular (synoviocytes)
    • A-cells (macrophages) = phagocytosis
    • B-cells (fibroblast-like) = exocrine/synthetic cells
  – Extra-cellular matrix
    • Collagen (I, III, IV, V, VI)
    • Proteins (fibronectin….)
Describe the composition of synovial fluid

- Synovial Fluid = blood ultra-filtrate containing:
  - Hyaluronic acid
  - Lubricin
  - Proteinase
  - Collagenase
  - Prostaglandins
Blood supply to the spine

- Derived from segmental arteries
  - Located @ vertebral midbodies via aorta
  - Primary supply to dura & posterior elements from dorsal branches
  - Ventral branches supply vertebral bodies via ascending and descending branches which are delivered under PLL in 4 separate ostia

- Vertebral artery (from subclavian) ascends through transverse foramina C1-C6 (anterior to and not through C7), posterior to longus coli muscle, posterior to lateral masses, along top of C1, ventromedially around cord, through foramen magnum before uniting at midline basilar artery.
Stages of Kienbocks (Lichtman)

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Normal x-ray, signal changes on MRI</td>
<td>Cast immobilization</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If ulna- radial shortening</td>
</tr>
<tr>
<td>2</td>
<td>Sclerosis</td>
<td>Ulna – radial shortening</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ulna + vascularized bone graft, distal radius osteotomy</td>
</tr>
<tr>
<td>3a</td>
<td>Fragmentation &amp; lunate collapse Normal carpal alignment</td>
<td>Ulna – radial shortening</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ulna + vascularized bone graft, distal radius osteotomy</td>
</tr>
<tr>
<td>3b</td>
<td>Fragmentation &amp; lunate collapse Loss of carpal height</td>
<td>Prox row carpectomy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intercarpal arthrodesis</td>
</tr>
<tr>
<td>4</td>
<td>Lunate collapse with arthrosis</td>
<td>Prox row carpectomy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wrist arthrodesis</td>
</tr>
</tbody>
</table>
Hawkins classification

- Type 1  Undisplaced  13% AVN
- Type 2  Displaced neck # + Subluxation/dislocation subtalar joint  20-50%
- Type 3  Displaced neck # + Subluxation/dislocation subtalar + ankle joint  ~100%
- Type 4  Displaced neck # + Dislocation subtalar + ankle + talonavicular joints  ~100%
Blood supply to the talus

• Extraosseous
  – Posterior tibial a
    • Artery of tarsal canal, calcanael branches
  – Dorsalis pedis
    • Medial tarsal branches, artery to tarsal sinus
  – Peroneal
    • Also contributes to artery of tarsal sinus

• Intraosseous
  – Talar head supplied by dorsalis pedis and tarsal sling (arteries of tarsal canal and sinus)
  – Talar body supplied by anastomosis of tarsal sling
Describe the microscopic structure of articular cartilage

- Cellular (5%)
  - Chondrocytes
- Extracellular (95%)
  - Water (75%)
  - Proteoglycans (20%) – function = trap and hold water
  - Collagen (5%)
    - Type II – predominantly
    - Type IX – lies on surface of type II and acts as an interfibrillar glue
    - Type X – calcified zone
  - Adhesives
    - Chondronectin
    - Fibronectin
Describe the microscopic structure of tendon/ligament

- Cellular Component (20%)
  - Fibroblasts
- Matrix Component (80%)
  - Solid (30%)
    - collagen (type I)
    - elastin (ligaments > tendons)
    - ground substance (proteoglycans, plasma proteins, glycoproteins) = cement
  - Water (70%)
Describe the macroscopic structure of tendon/ligament

- Collagen fibres → fibrils →
  - Tendon = parallel fibres
  - Ligament = “crimped” fibres
- Bundles (surrounded by endotenon) →
- Fascicles (surrounded by epitotenon) →
  (loose areaolar tissue between fascicles = peritenon)
Draw/Describe the biomechanics of tendon/ligament failure

1 = “toe” region = “uncrimping” of relaxed collagen fibres
2 = elastic region
3 = yield point
4 = ultimate tensile strength → failure (tendon)
5 = ultimate tensile strength → failure (ligament - microfailure)
6 = macroscopically intact ligament with intra-substance failure (e.g. ACL)
What are the important features of a screening programme? What problems may occur?

• The Disease
  – documented natural history
  – validated therapeutic protocol →
  – treatment benefit

• The Test
  – accurate (product of sensitivity(TP’s) and specificity(TN’s))
  – safe
  – acceptable
  – cheap

• Problems = ? population to be screened; compliance; interval lesions; lead-time bias
Describe the pain pathway

- **Transduction** = nocioceptors produce AP in response to noxious stimulus (inf)
- **Transmission** = via delta-A (myelinated) & C (unmyelinated) fibres to spinal cord
- **Modulation** = spinal modification of relays to higher centres
- **Perception** = interpretation of stimulus by higher centres
What are the general principles of managing a soft-tissue defect?

- General principles = dirty wound $\rightarrow$ clean wound. Open wound $\rightarrow$ closed wound using the reconstruction ladder

- Reconstruction ladder = direct closure/granulation $\rightarrow$ skin graft (SSG/FTG) $\rightarrow$ local flaps $\rightarrow$ distant flaps
## MRI Weightings

<table>
<thead>
<tr>
<th>T1 Weighted</th>
<th>T2 Weighted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat</td>
<td>High</td>
</tr>
<tr>
<td>Tend/Lig</td>
<td>Low</td>
</tr>
<tr>
<td>Cortical bone</td>
<td>Low</td>
</tr>
<tr>
<td>Muscle</td>
<td>Mod</td>
</tr>
<tr>
<td>Marrow</td>
<td>High</td>
</tr>
<tr>
<td>Sarcoma</td>
<td>Low</td>
</tr>
<tr>
<td>Fluid</td>
<td>Low</td>
</tr>
</tbody>
</table>
GAG synthesis

- The proteins for glycosaminoglycan synthesis are synthesized in the ribosomes.

- *The* glycosaminoglycan *chains are added in the Golgi apparatus.*

- Protoeglycan aggregates are formed in the extracellular matrix where link protein, hyaluronate, and aggrecan come together.

- Glycosaminoglycan chains are formed intracellularly, whereas large proteoglycan aggregates are formed outside the cell in the extracellular matrix.
<table>
<thead>
<tr>
<th>Tumor Type</th>
<th>Chromosome Translocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well-differentiated liposarcoma</td>
<td>giant marker and ring chromosomes</td>
</tr>
<tr>
<td>Myxoid liposarcoma</td>
<td>translocation between 12 and 16</td>
</tr>
<tr>
<td>Ewing's/primitive neuroectodermal tumors</td>
<td>translocation between 11 and 22</td>
</tr>
<tr>
<td>Synovial sarcoma</td>
<td>translocation between X and 18</td>
</tr>
<tr>
<td>Myxoid chondrosarcoma</td>
<td>translocation between 9 and 22</td>
</tr>
</tbody>
</table>
How does diathermy work? What types are there? List some safety issues

“...passage of high-frequency alternating current through body tissue with a point of concentration producing heat.” Frequency >50,000Hz removes neuromuscular response to current. Surgical diathermy = 400kHz – 10MHz.

• Types:
  – Bipolar = generator → both limbs of diathermy forceps
  – Monopolar = generator → active electrode (point) → plate electrode.
    • Cutting = continuous current → cell vaporisation
    • Coagulation = pulsed current → cell dessication & sealing of vessels

• Safety:
  – properly checked / maintained equipment
  – plate continuity alarm
  – plate application (at least 70cm2)
  – patient protection from contact with metal objects
  – appropriate use of diathermy
  – pacemaker – recently checked; avoid/reduce use; consider bipolar
Describe how you would design a study

- Identify clinical problem to be studied
- Literature search - ? work done already ? weaknesses in other studies
- Propose a hypothesis
- Study design
  - Ethical approval
  - Power calculation
  - Recruiting study population
  - Randomisation
  - Observation/Measuremets
  - Methods/Sources for data collection
- Data Collection
- Statistical analysis
- Interpretation of results & conclusions
What types of study do you know?

- Meta-analysis
- Observational studies
  - Cross-sectional studies = prevalence
  - Cohort studies (prospective)
  - Case-control studies (retrospective)
- Interventional studies
  - Randomised, controlled trials (prospective)
  - Case reports/series
In studying a newly recognized disorder using a large population of affected individuals, geneticists discover that although the disorder often affects siblings, it was rarely, if ever, detected in their ancestors. This disorder most closely follows which pattern of inheritance: (A) Autosomal dominant (B) Autosomal recessive (C) Sex-linked (D) Multifactorial (E) Anticipation

Autosomal recessive conditions classically show “horizontal” inheritance. Ancestors do not display the gene because they would likely have only one copy of the mutant allele. Only when two carriers reproduce is the phenotype manifest in approximately one-fourth of their offspring.

Autosomal dominant inheritance is characterized by vertical transmission. Many generations manifest the trait because it takes only a single copy of a mutant allele to display the phenotype.

Sex-linked conditions are often traced back in a family. Normally the males are affected and the females are carriers.

Multifactorial conditions are thought to result from the combination of different genes. Although the risk of recurrence in kindred is somewhat greater than the population as a whole, it is still quite low (only a few percent). It is rare for siblings to be affected.

Anticipation refers to the phenomenon in which successive generations are likely to display more severe forms of a given disorder. Myotonic dystrophy is a classic example of this phenomenon.
Define Congenital Vertical Talus

- Irreducible dorsal dislocation of the navicular on the talus with a fixed equinuous hindfoot deformity
<table>
<thead>
<tr>
<th>Compartment</th>
<th>Muscles</th>
<th>NV structures released</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior</td>
<td>Tib ant, EHL, EDL, PT</td>
<td>DPN, Ant tib art</td>
</tr>
<tr>
<td>Lateral</td>
<td>PL, PB</td>
<td>SPN</td>
</tr>
<tr>
<td>Sup post</td>
<td>GSC, Plantaris</td>
<td>Sural</td>
</tr>
<tr>
<td>Deep post</td>
<td>Tib post, FDL, FHL, Pop</td>
<td>Post tibial A, V. Tibial N. Peroneal A, V</td>
</tr>
</tbody>
</table>
**Modes of femoral stem loosening**

<table>
<thead>
<tr>
<th>Mode</th>
<th>Mechanism</th>
<th>Cause</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ia</td>
<td>Pistoning</td>
<td>Subsidence of stem within cement</td>
<td>RLL between stem &amp; cement zones 1 &amp; 2&lt;br&gt;Distant cement #&lt;br&gt;&lt;br&gt;Sem displaced distally in cement</td>
</tr>
<tr>
<td>Ib</td>
<td>Pistoning</td>
<td>Subsidence of stem &amp; mantle within bone</td>
<td>RLL all 7 zones</td>
</tr>
<tr>
<td>II</td>
<td>Medial stem pivot</td>
<td>Lack of supermedial &amp; inferolateral cement support</td>
<td>Medial migration prox stem&lt;br&gt;&lt;br&gt;Lat migration distal tip&lt;br&gt;&lt;br&gt;Cement # zones 2 &amp; 6</td>
</tr>
<tr>
<td>III</td>
<td>Calcar pivot</td>
<td>Medial &amp; Lat toggle of distal stem&lt;br&gt;Hang up of stem collar on medial cortex&lt;br&gt;Windshield wiper rxn at distal stem</td>
<td>Sclerosis &amp; thickening of bone @ stem tip&lt;br&gt;&lt;br&gt;RLL zones 4 &amp; 5</td>
</tr>
<tr>
<td>IV</td>
<td>Cantilever bending</td>
<td>Loss of prox cement support leaving distal stem still fixed; allows for proximal cantilever bending</td>
<td>Stem crack or #&lt;br&gt;&lt;br&gt;RLL zones 1 &amp; 2, 6 &amp; 7</td>
</tr>
</tbody>
</table>
How is syndactyly classified?

- Complete: Involves entire length of involved digits
- Incomplete: Fenestrations (skin bridges)
- Simple: Involves only soft tissues
- Complex: Soft tissues and bone
What is camptodactyly & how’s it classified?

- Nontraumatic painless PIPJ flexion contracture
- Usually little finger
- Unknown aetiology
- Imbalance of forces between FDS and intrinsics (lumbricals and interossei)

- Type 1 Most common, uni or bilat PIPJ contracture in healthy infant
- Type 2 Same as above but seen adolescence esp girls
- Type 3 Assoc with syndromes
Radial clinodactyly

- Congenital curvature of digit in radioulnar plane
- Type 1 Minor angulation, normal length v. common
- Type 2 Minor angulation, short (3% and 25% Downs)
- Type 3 Marked delta phalynx (c shaped epiphysis)
What is the AIS?

- Head
- Face
- Neck
- Thorax
- Abdo, pelvis
- Spine
- UL
- LL
- External

The ISS is the sum of the squares for the highest AIS grades in the 3 most severely injured ISS regions. >18 = polytrauma
What are the MESS variables?

- Skeletal and soft tissue injury
  - Low, med, high, very high energy

Limb ischaemia (score doubled if >6hrs)
Shock
Age

Score >7 = Amputate
Antibiotics 1

- **Penicillins**: Bactericidal, inhibit peptidoglycan synth. Bind to membranes (aka Beta lactams)
- **Cephalosporins**: Bactericidal. Inhibit cell-wall synthesis (also beta lactams)
- **Aminoglycosides**: e.g. Gentamicin. Bactericidal. Inhibit protein synthesis by binding to cytoplasmic rRNA 30s subunit
- **Macrolides**: e.g. erythromycin: Inhibit dissociation of tRNA from ribosomes during translocation by binding to 50s subunit
- **Quinolones**: Inhibit DNA gyrase, stops supercoiling
- **Glycopeptides**: e.g. vanc/teic. Inhibit cell membrane synthesis (hit glycan subunits in the cell wall)
- **Tetracyclines**: Bacteriostatic. Identical action to aminoglycosides, just doesn’t kill them!
- **Rifampicin**: Bactericidal. Prevents RNA transcription
Antibiotics 2

- Penicillin: Gram + cocci. Inactivated by bacterial beta-lactamases
- Fluclox: Staph
- Augmentin: Amoxicillin+beta-lactamase inhibitor clavulanic acid. Staph, E.coli
- Gent: Gram – and pseudomonas
- Erythromycin: Strep, chlamydia
- Cipro: Gram-
- Vanc: excellent vs S. aureus, epidermidis, enterococcus, MRSA
- Tetracycline: Gram+
- Ceph: 1st gen = cefalexin (v. good gram+)
  - 2nd gen = cefuroxime
  - 3rd gen = ceftazidime
  - 4th gen = cefepime (v. good gram -, rubbish gram +)
## Common bacteria

<table>
<thead>
<tr>
<th>Gram+ cocci</th>
<th>Gram- cocci</th>
<th>Gram+bacilli</th>
<th>Gram-bacilli</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. aureus</td>
<td>N. meningitidis</td>
<td>C. perfringens</td>
<td>Pseudomonas</td>
</tr>
<tr>
<td>S. epidermidis</td>
<td>N. gonorrhoea</td>
<td>C. tetani</td>
<td>Eikenella</td>
</tr>
<tr>
<td>Strep</td>
<td></td>
<td></td>
<td>E. coli</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Salmonella</td>
</tr>
</tbody>
</table>
What do interossei do?

- 4 dorsal Abductors (DAB)
  - Insert index, middle (both ways) and ring
- 3 palmar Adductors (PAD)
  - Adduct index, ring and little fingers

These muscles flex the MCPJ and extend the PIPJ via the lateral bands
What do lumbricals do?

- Originate on FDP
- Insert on radial lateral band of extensor expansion
- Pass volar to transverse metacarpal ligament
- Median n supplies radial 2 lumbricals (unipennate)
- Ulnar n supplies ulnar 2 (bipennate)
## Stages of Charcot arthropathy

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
<th>Treatment</th>
</tr>
</thead>
</table>
| 0     | Unilateral oedema, erythema  
No break in skin  
Negative x-ray | Cast immobilization, NWB |
| 1     | Unilateral oedema, erythema  
X-ray = osseous destruction, joint subluxation/dislocation |  |
| 2     | Decreased oedema, erythema and warmth  
X-ray shows coalescence of fracture fragments | WB immobilization until tissue homeostasis is evident then AFO with locked or limited motion ankle |
| 3     | No or limited oedema, erythema or warmth  
X-ray = consolidation and remodelling | AFO used on limited basis |