SCALPEL
MANCHESTER MEDICS SURGICAL SOCIETY

Disorders of the Bone

Scalpel Surgical Teaching Series

Trauma & Orthopaedics: Session 3

27 August 2020

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What Will Be Provided

- Assessment – Pre-Module
- Basic Science – Bone
- Physiology
- Clinical Knowledge – Benign & Malignant Conditions
- Assessment – Post-Module

What You Will Need

Pen/keyboard

Paper/word document

Thinking cap

Session Info

- Q&A at end
- Post questions throughout
- Slides will be available
- Recording will be available
- Use MCQs for active recall
- Traffic light system for level

Phase 1
Basic Science

Introductions | Osteoblast

Hint...

It’s in the name:

Osteo = bone

Blast = blast cell

Blastos (Greek) = *“to germinate or sprout”*

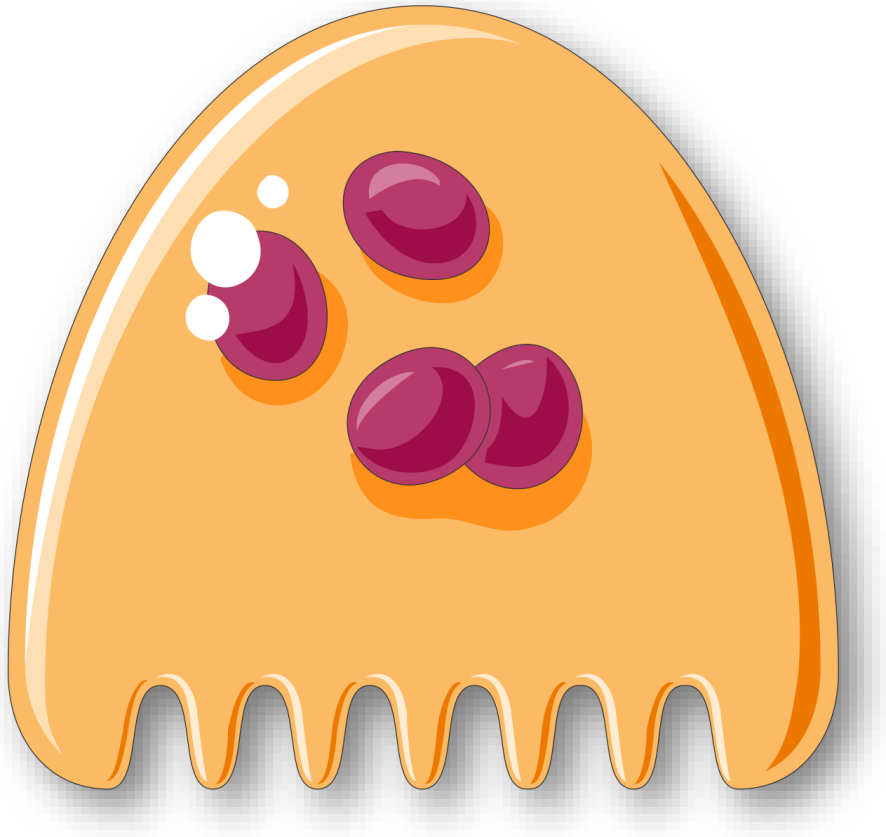
Differentiates into osteocyte

Introductions | Osteoclast

Osteo = bone

Clast = *clastos*

(Greek) = *“broken”*



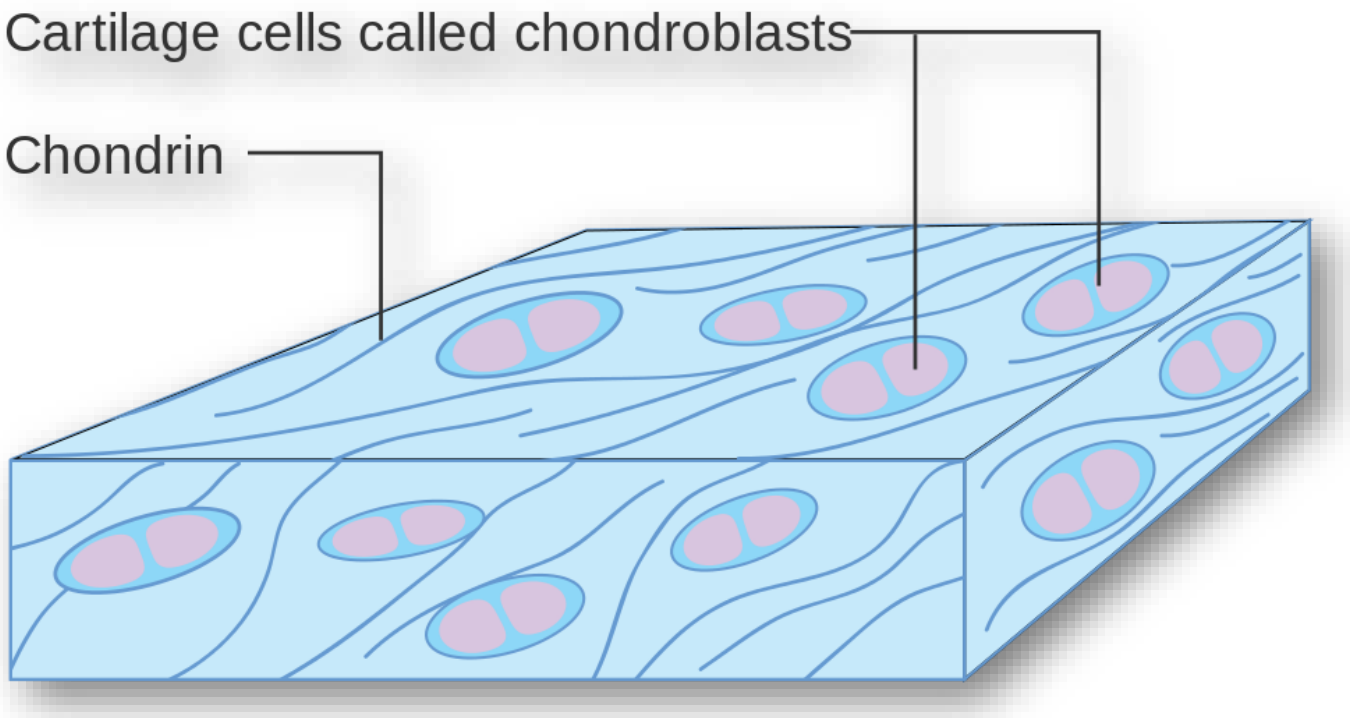
Introductions | Chondroblast

Chondro = cartilage

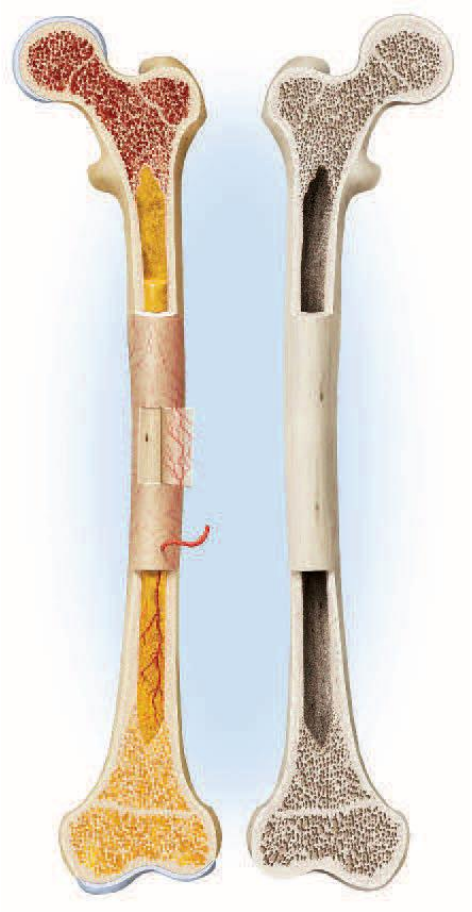
Blast = *blastos*

(Greek) = *“to germinate or sprout”*

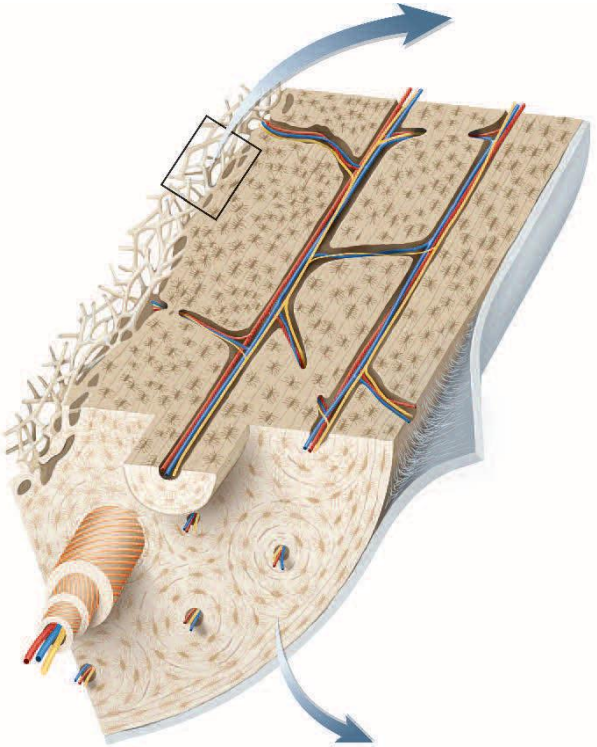
Differentiates into chondrocyte



How to Make Bone | Ingredients

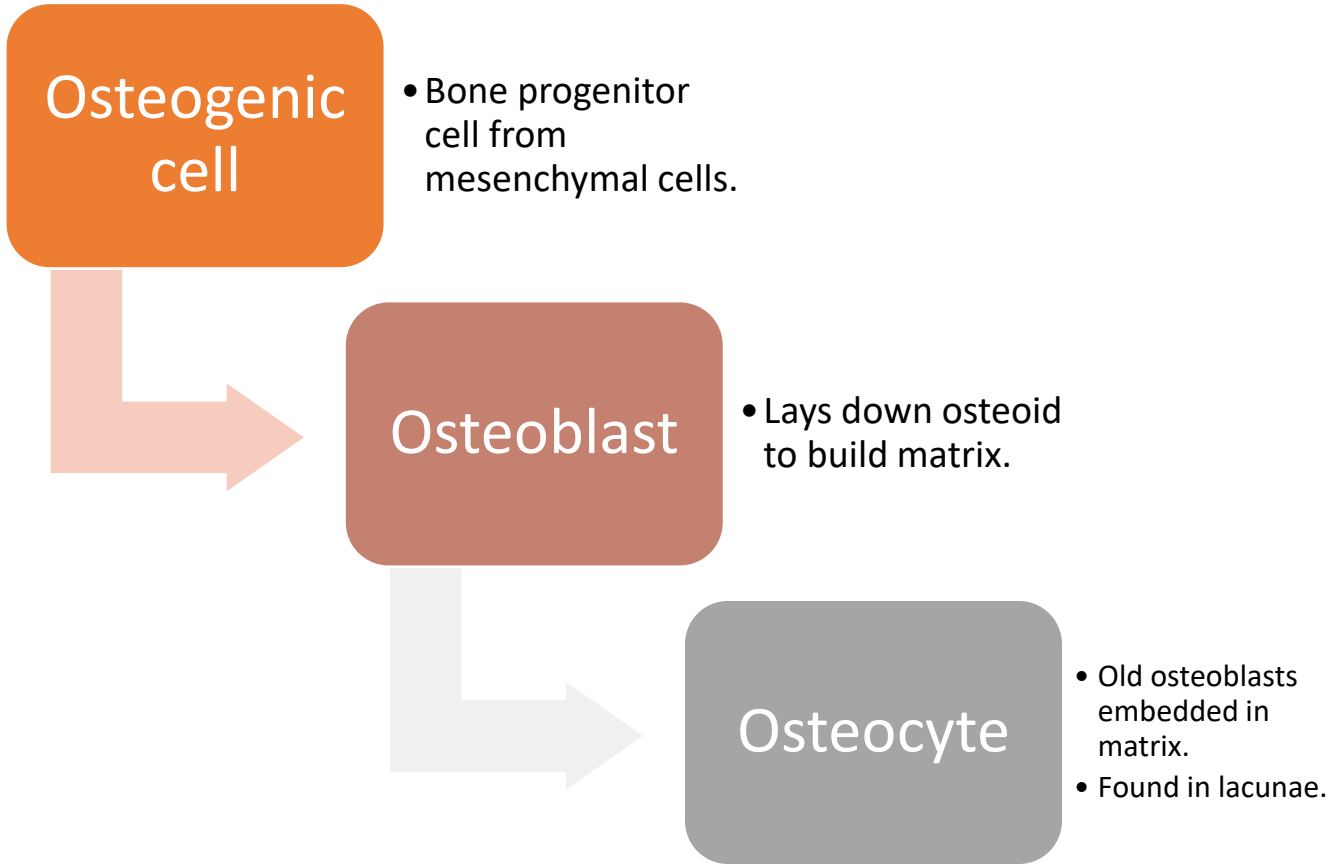


- Osteogenic cell
- Osteoblast
- Osteoclast
- Calcium
- Phosphate

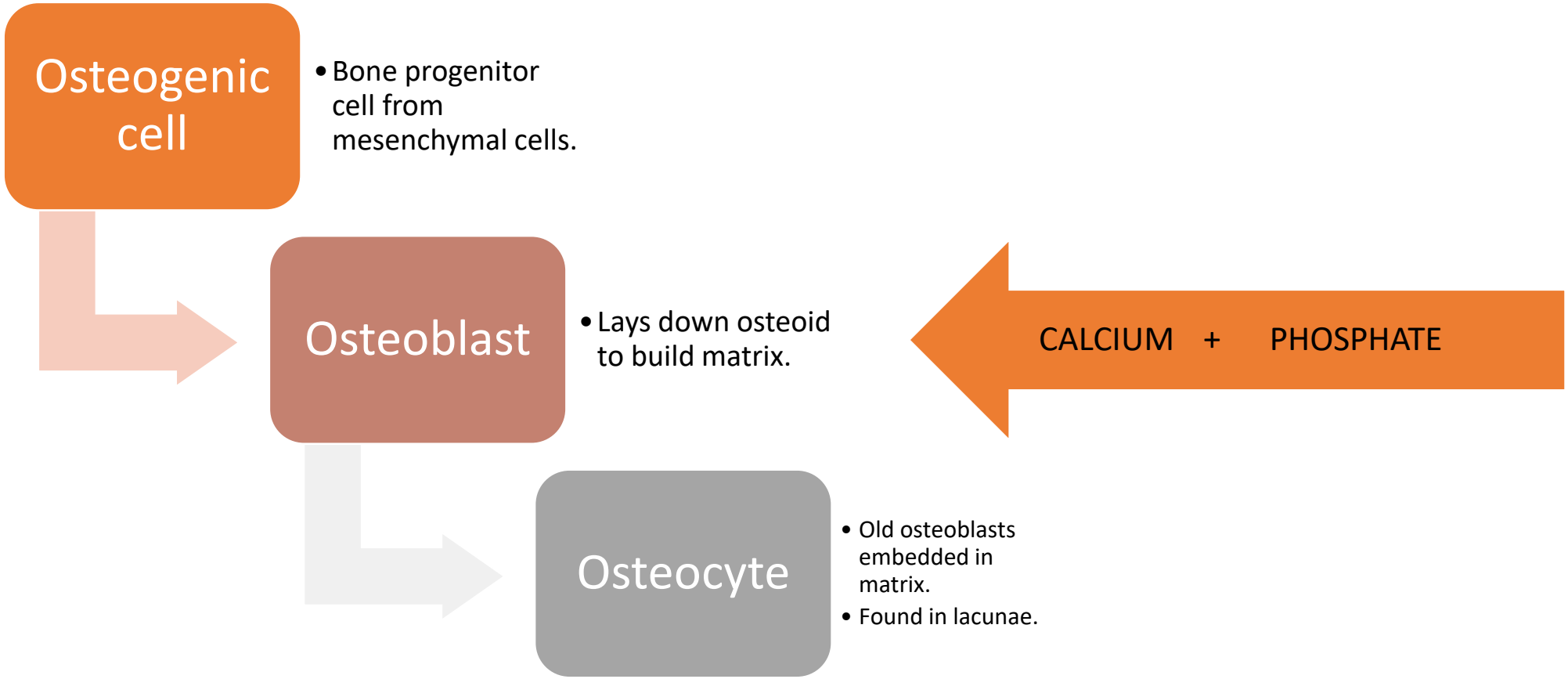


Images adapted from: Saladin: Anatomy & Physiology: The Unity of Form and Function, Fifth Edition; Chapter 7 Bone Tissue (Pages 215, 202)

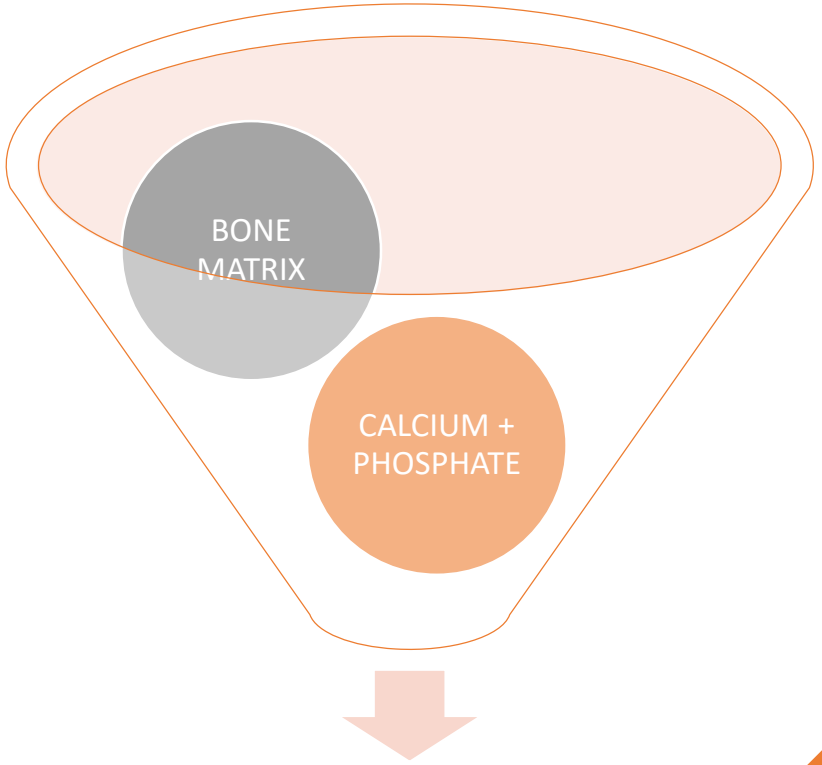
How to Make Bone | Ingredients



How to Make Bone | Ingredients



How to Make Bone | Ingredients



OSSEOUS TISSUE

OSTEOCLAST

How to Make Bone | Wolff's Law

- Osteoclasts = macrophages of bone
- Resorb osteoid
- Determined by Wolff's Law:

Bone remodelling is determined by the mechanical stress placed on the bone.

Phase 2
Clinical Knowledge

Disorders of the Bone | Overview

Benign	Benign Tumour	Malignant Tumour
Osteoporosis	Osteoblastoma	Metastasis (most common)
Osteopetrosis	Chondroblastoma	Osteosarcoma
Osteopaenia	Chondroma	Chondrosarcoma
Osteomalacia	Osteochondroma	Giant cell (mainly benign)
Osteogenesis imperfecta	Osteoid osteoma	

Nomenclature

- If ever in doubt, look at the name
- For example, osteoporosis:

OSTEO = BONE

POROS = PASSAGE/PORE (Greek)

OSIS = STATE/ABNORMAL CONDITION

Disorders of the Bone | Benign

	Osteoporosis	Osteopaenia
Definition + aetiology	Decrease in bone mass related to increasing age due to unsynchronised osteoclast-osteoblast activity – good mineralisation but reduced osteoid	
Epidemiology	Women > men (men secondary OP more common)	
Presentation	Usually presents as pathological fracture – pain at fracture site (post-menopausal = distal radius, senile = hip)	
Classification	More severe form WHO classification	Less severe form WHO classification
Imaging	Plain film Xray – thinned cortices, loss of trabecular bone, kyphosis, codfish vertebrae DEXA is gold standard – T score (based on bone mineral density) determines which one it is	
Treatment	Calcium + Vit D Bisphosphonates Calculate FRAX score for 10 year osteoporotic fragility fracture risk	

Image courtesy of Dr Mohammad Taghi Niknejad, Radipaedia.org.

Disorders of the Bone | Benign

	Osteoporosis/Osteopaenia	Osteomalacia
Definition + Aetiology	Decrease in bone mass – good mineralisation but reduced quantity of osteoid – reduced quantity of bone Osteoclast vs osteoblast desynchrony	Good quantity of osteoid but poor mineralisation – reduced quality of bone Rickets is paediatric equivalent
Epidemiology	Women > men (men secondary OP more common)	Vitamin D deficiency secondary to poor sunlight exposure or poor absorption
Presentation	Pathological fracture – pain at fracture site (post-menopausal = distal radius, senile = hip)	Mainly generalised bone and muscle pain, proximal muscle weakness (varus or valgus deformity in Rickets)
Classification	WHO classification	
Imaging	Plain film Xray – thinned cortices, loss of trabecular bone, kyphosis, codfish vertebrae DEXA is gold standard – T score (based on bone mineral density) determines which one it is	Plain film Xray – Looser's zones (fractures due to bony insufficiency), fractures (proximal femur/femoral neck), trefoil pelvis
Treatment	Calcium + Vit D Bisphosphonates Calculate FRAX score for 10 year osteoporotic fragility fracture risk	Large doses of oral vitamin D 1000 IU/Day

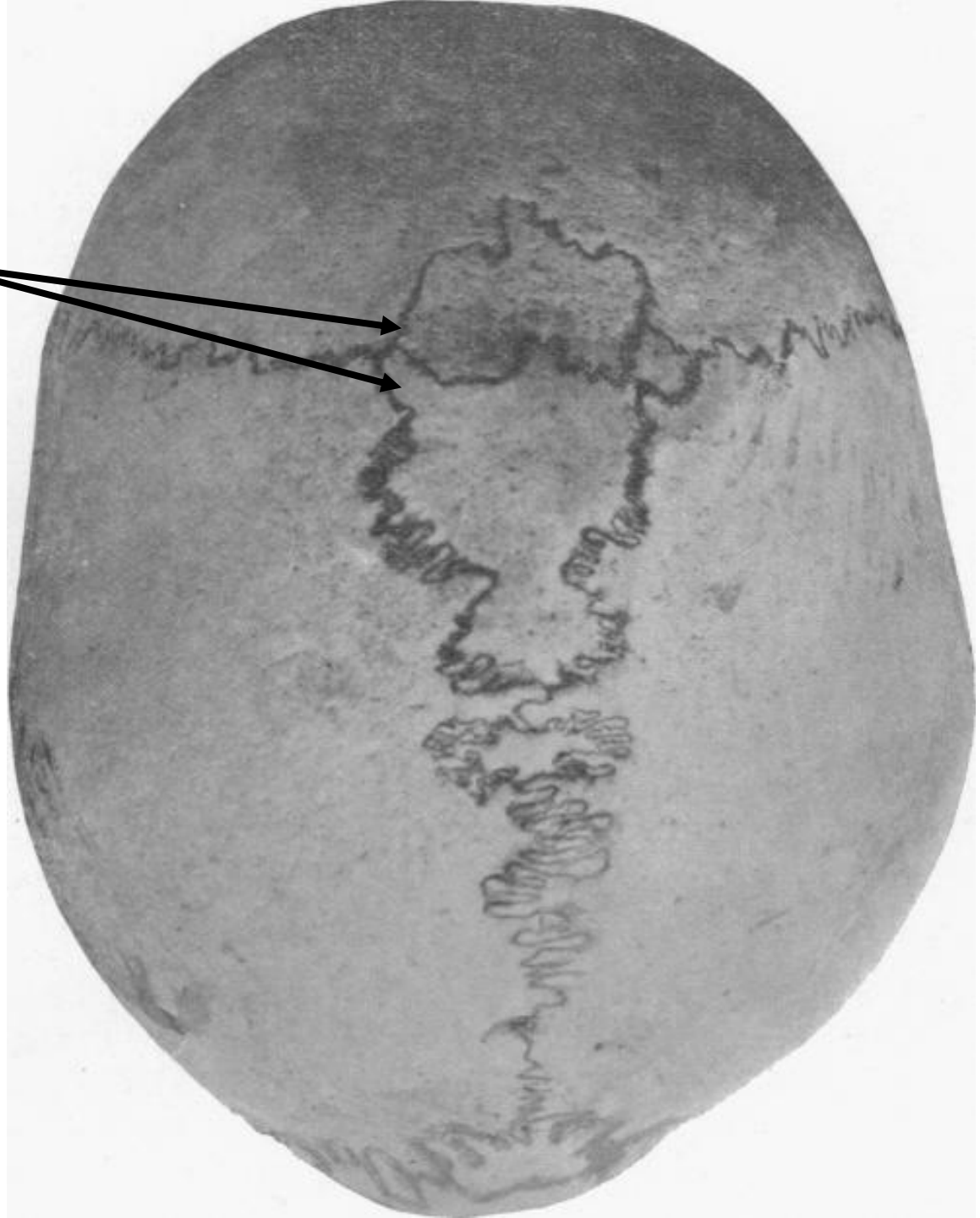
Looser’s zone (stress fracture due to bony insufficiency)

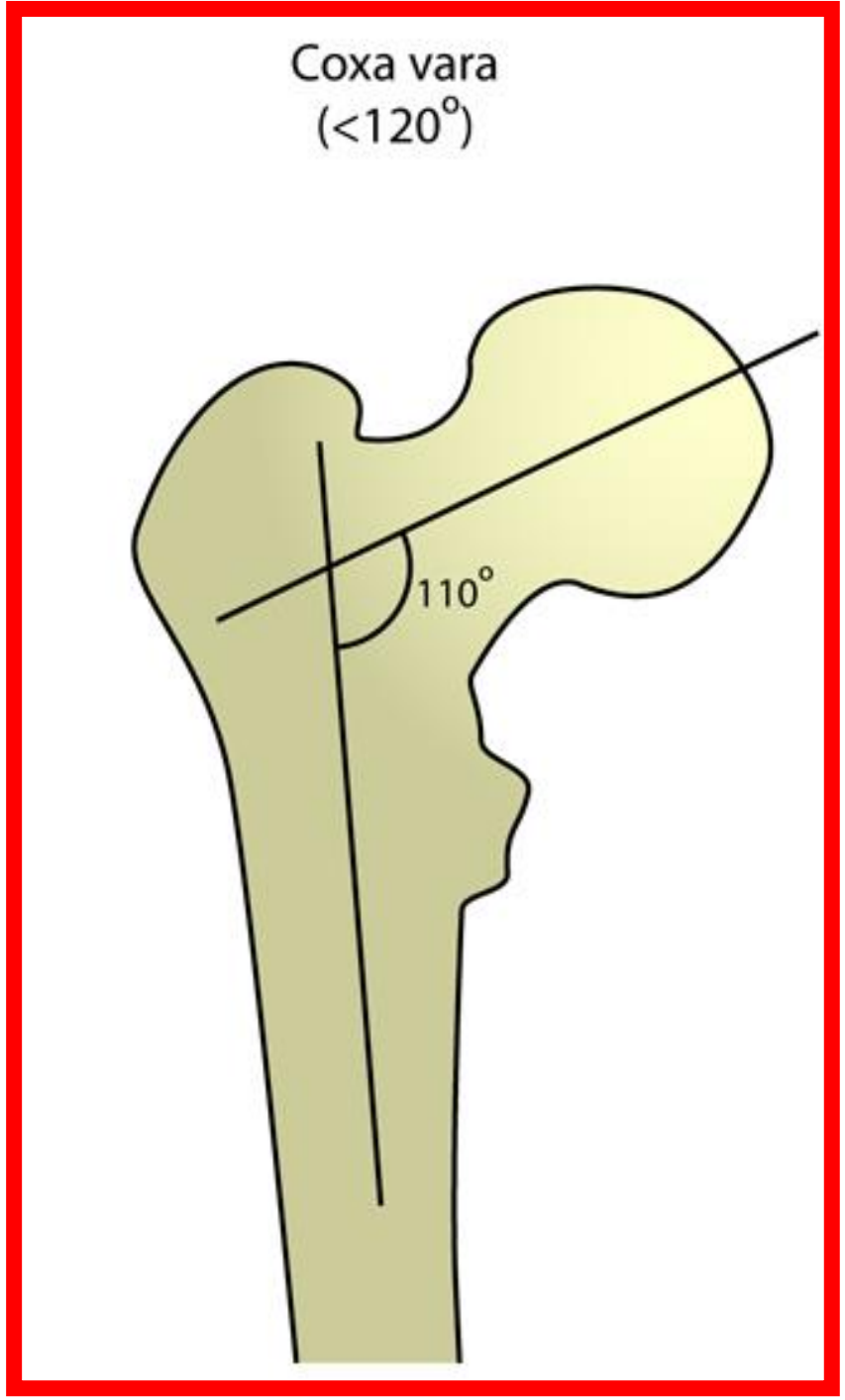
Image courtesy of Colin Woon, Orthobullets.com.

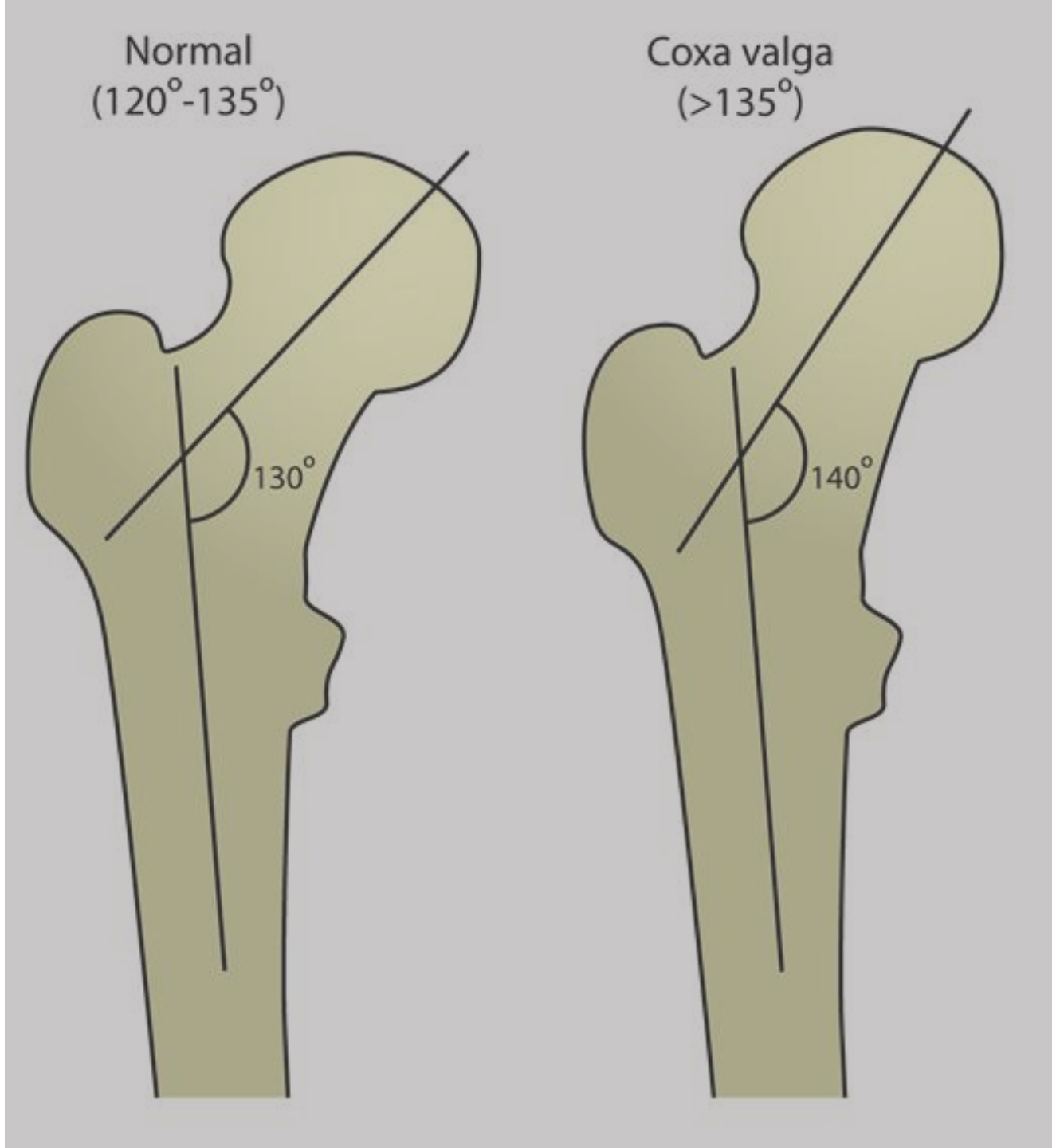
Disorders of the Bone | Benign

	Osteopetrosis	Osteogenesis Imperfecta
Definition + Aetiology	Metabolic bone disease involving a defect in osteoclast activity causing failure in normal levels of bone resorption – dense bone. Also known as *"marble bone disease"*	Disorder of Type 1 collagen production Due to decreased production of collagen or production of abnormal collagen – leads to deformed bone development
Epidemiology	Genetic inheritance – malignant autosomal recessive, benign autosomal dominant (most common) 1 in 3.3 million	Genetic in 90% of individuals
Presentation	Malignant – frequent fractures, progressive deafness and blindness Benign – often asymptomatic but can px with fractures	Bone fragility fractures, ligamentous laxity, short stature, scoliosis, extra-skeletal manifestations
Classification	Nil	Silence classification of 4 types, 4 more types have since been added onto original classification
Imaging	Plain film Xrays – increased cortical thickening, increased overall bone density, loss of medullary canal diameter	Plain film Xray – thin cortices, generalised osteopaenia, Wormian bones on skull XR, coxa vara
Treatment	Autosomal dominant – bone marrow transplant Autosomal recessive – interferon gamma-1beta Fracture management, neurosurgical decompression	Early bracing to lessen deformity Bisphosphonates to reduce fracturability Surgical intervention for fracture repair and realignment

Wormian skull bones (extra bones in sutures of skull)

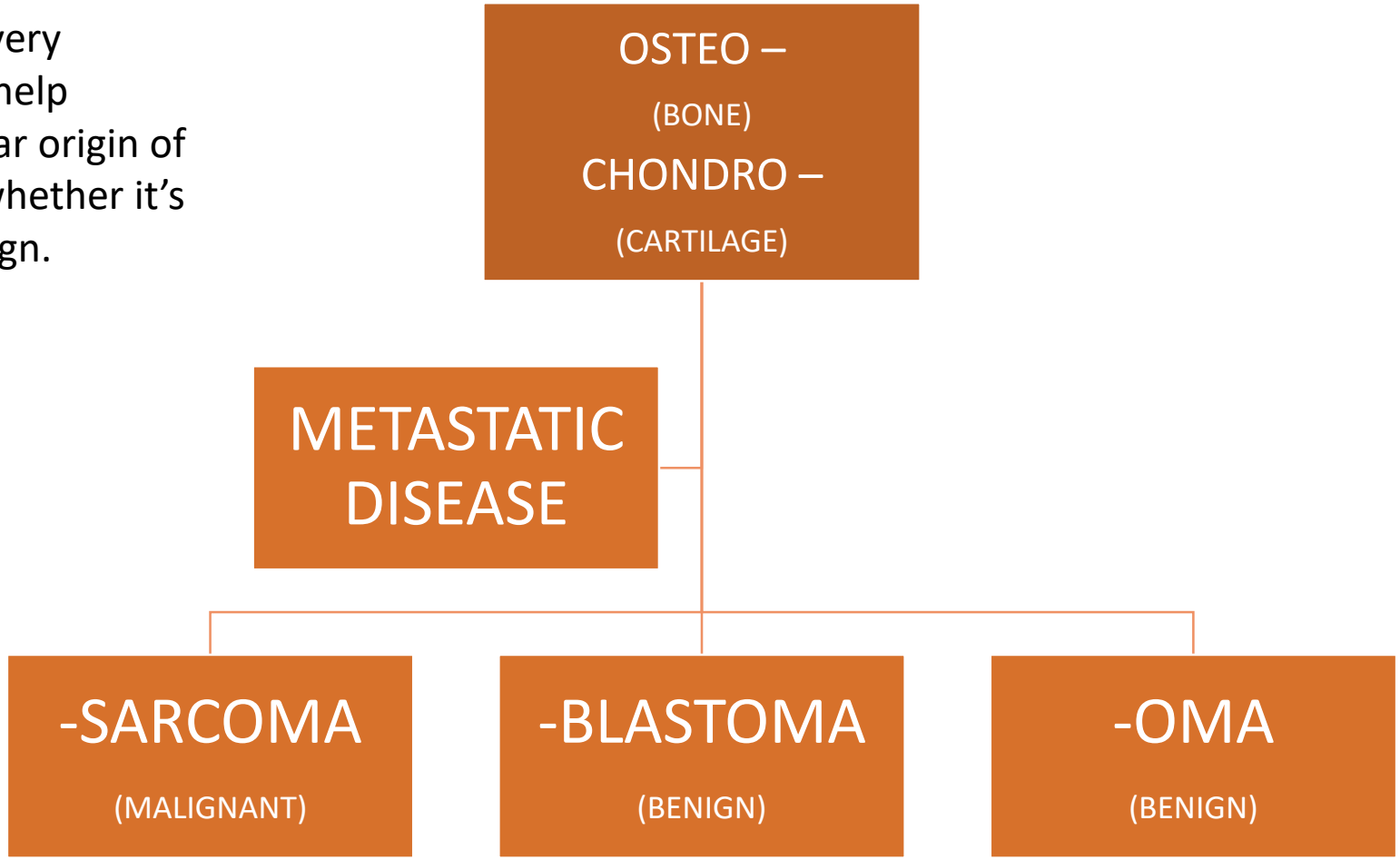






Disorders of the Bone | Tumour

Nomenclature is very important. It can help identify the cellular origin of the tumour and whether it's malignant or benign.



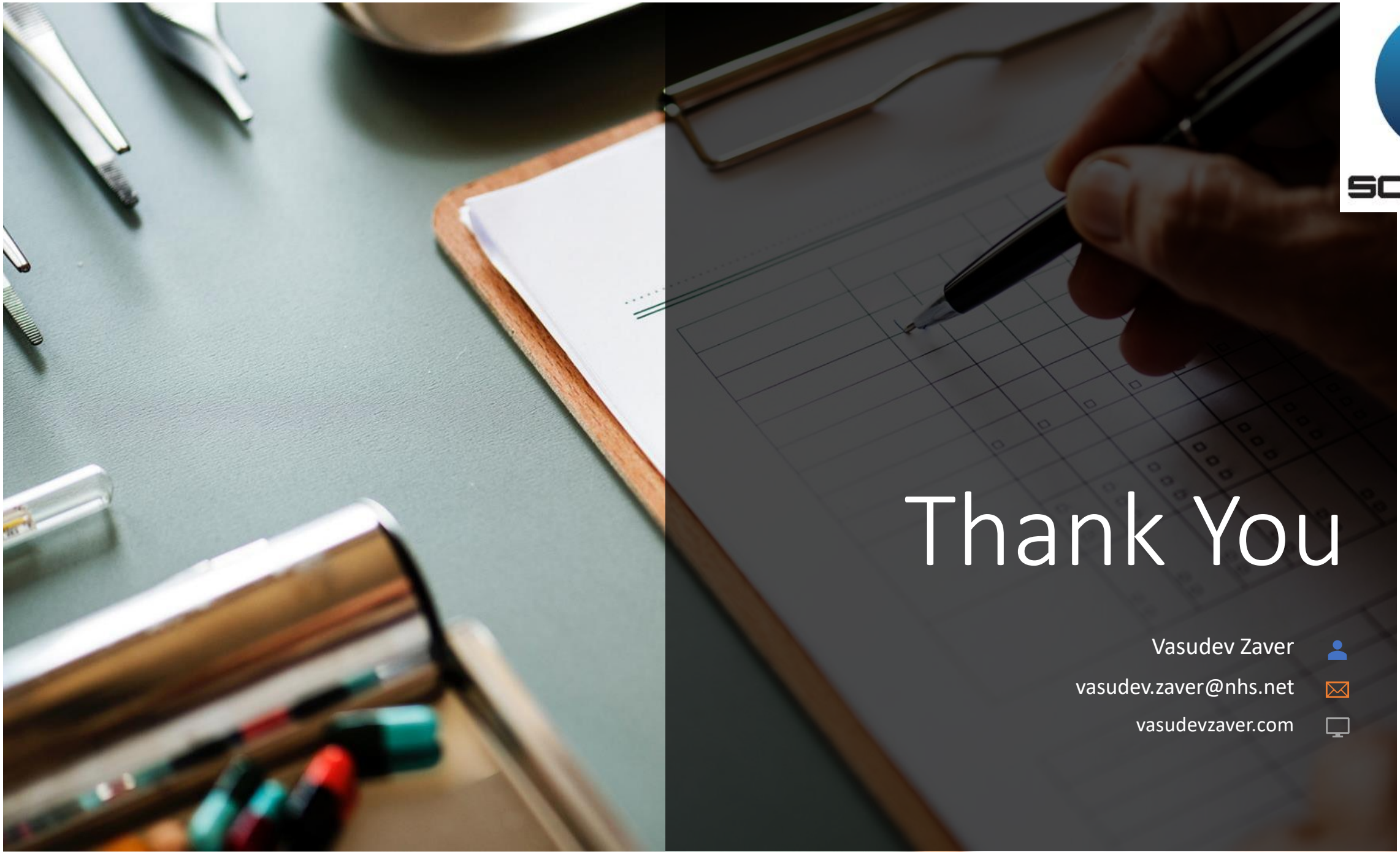
Disorders of the Bone | Tumour

- Differentiation is multifactorial
- Location, histology, imaging
- Treatment is with excision +/- neoadjuvant or adjuvant chemotherapy
- Metastatic lesions are classified using the Mirel Scoring System
- Treatment is dependent upon score:

- >/= 9 = impending risk of fracture therefore prophylactic fixation
- 8 = borderline therefore consider fixation
- 7 = not impending fracture therefore manage non-operatively

Summary

- Osteoblasts build matrix through deposition of osteoid
- Osteoclasts remove osteoid through phagocytic action
- Calcium and phosphate form hydroxyapatite to mineralise bone
- Osteoblast and osteoclasts = bone remodelling – dictated by Wolff's Law
- Osteopaenia (less severe) and osteoporosis (more severe) = reduced osteoid – give bisphosphonates to maintain osteoid
- Osteomalacia = poor mineralisation – replace Vit D to boost mineralisation
- Osteopetrosis = osteoclasts asleep so bone density ++
- Osteogenesis imperfecta = poor/too little collagen
- Bone tumours = excision +/- chemotherapy



Thank You

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