Introduction

The A to Z of Bone & Joint Failure

When the A to Z of Bones, Joints & Ligaments was first written, I received requests to add an additional section dealing exclusively with the BACK. Hence, the A to Z of the Bones, Joints, Ligaments & the Back was written. This was well received, and generated an interest in the common features & failings of bones & joints. Normal bone re-models itself constantly and this feature is the cause of osteoporosis and other bone/joint pathologies, when it goes awry. This is the first time the A to Z format has been applied to a purely pathological topic. The title was in part suggested by Prof John Eisman who is very concerned with the devastating problem of Osteoporosis. After discussions with him, and also with Prof Barry Wren, and feedback - the idea of a book on the failure of aspects of the skeletal system was born, hence this small volume. It is the first in a series of the A to Z of ….. failure. The next one planned is a discussion on the failings of the cardiovascular system, The A to Z of Cardiovascular failure.

Acknowledgement

Thank you Aspenpharmacare Australia for your support and assistance in this valuable project, particularly Greg Lan, and Rob Koster, and everyone who provided feedback. It is always greatly appreciated.

Dedication

I am lucky to have a small group around me who are supportive and loyal. Thank you. You know who you are!!! and of course to my A to Z darlings, who may be far away but are always on my mind. You know, I love you.

How to use this book

A basic anatomical knowledge of the Bones Joints & their associated structures is assumed in this book, and summarized in the A to Z of Bones Joints, Ligaments & the Back. There are 2 main sections in this book: a consideration of the normal tissues and the latter green section - a consideration of their pathological processes. The Appendix summarizes the major bone diseases as a table. The Common Terms section also includes a number of pathological terms and diagrams.

This book is cross-referenced with all the other A to Zs. The A to Zs may be viewed on 2 sites – www.amandasatoz.com and http://www.aspenpharma.com.au/atlas/student.htm

Thank you

Amanda Neill
BSc MSc MBBS PhD FACBS
ISBN 978-1-921930-03-4
# Table of contents

**INTRODUCTION** 1

**ACKNOWLEDGEMENT** 1

**DEDICATION** 1

**HOW TO USE THIS BOOK** 1

**TABLE OF CONTENTS** 2

**ABBREVIATIONS** 5

**COMMON TERMS IN OSSEOLOGY & PATHOLOGY** 8

**BONE CLASSIFICATION** 35

**BONE COMPONENTS** 36

  - Bone Tissue Cell types
    - cell – overview 36
    - cells - bone cell lines 38
  - Bone Marrow Cell types 40
    - Development of - Haemopoetic lines 40
  - BM – in situ 42

**BONE FORMATION** 44

  - Flat bones – intermembranous ossification 44
  - Long bones – endochondrial ossification 48

**BONE – FRACTURES (#) breaks, cracks** 52

  - Healing 52
  - Types 54

**BONE MATURATION & GROWTH** 56

  - Bone growth and alignment
    - Lower limb (LL) 56
  - Stages of Ossification 58
    - Elbow joint 60
    - Foot & Ankle joints 62
    - Hand & Wrist joints 64
    - Hip joint 66
    - Knee joint 68
    - Shoulder joint 70

**BONE STRUCTURE** 72

  - Flat bone / Cancellous bone 72
  - Long bone / Compact bone 74
  - Mineralization – from CT – osteoid GS 78
  - Remodelling 80

**BONES of the HUMAN SKELETON** 84

  - Anterior / Posterior 84
Table of Contents

CARTILAGE
  Articular cartilage  88
  Epiphyseal plate  90

JOINTS
  Classification of Joints  92
  Diarthrosis AKA SYNOVIAL Joint  94
  Summary and range of Movements  96

GENERAL OSTEOPATHIC EXAMINATION TECHNIQUE  102

Regional Bone / Joint failures  108
  The Ankle & Foot
    anatomy schema & radiological features  108
    inspection  116
    palpation  120
    movement  128
  The Elbow
    anatomy schema & radiological features  130
    inspection  136
    palpation  138
    movement  142
  The Hand, Wrist & Fingers
    anatomy schema  144
    inspection & radiological features  146
    palpation  158
  The Hip – Pelvis & Femur
    pattern of disease presentation  160
    anatomy schema & radiological features  162
    inspection – shortening  168
    palpation – movement  170
  The Knee, Patella & Tibia
    anatomy schema & radiological features  172
    effusions of the knee  182
    extension failure  184
    meniscal failure  186
    Patella failure  188
    Stability failure  192
      anterior  194
      lateral – varus  196
      medial – valgus  198
      posterior  200
      tibial tenderness  202
The A to Z of Bone & Joint Failure

The Shoulder & Humerus
  pattern of disease presentation 204
  anatomy schema & radiological features 206
  inspection 212
  examination 214
  movements 216

The Vertebral Column – Spine
  anatomy schema & radiological features 218
  spondylolithesis 226

PATHOLOGICAL PROCESSES
  Lucent bone lesions 228
  Necrosis = Cell / Tissue death 230

BONE & JOINT FAILURE index

CONGENITAL / GENETIC FAILURES
  Osteogenesis Imperfecta AKA Brittle Bone Disease 234
  Spina Bifida 236

FAILURE DUE TO INFECTION
  Osteomyelitis 238

FAILURE DUE TO INFLAMMATION
  Osteoarthritis 240
  Rheumatoid Arthritis 240

MECHANICAL FAILURE / TRAUMA
  Biomechanics of weight-bearing joints 242

METABOLIC FAILURES
  Calcium & Phosphate regulation 244
  Hyperparathyroidism / Hypoparathyroidism 248
  Osteomalacia (& Rickets) 254
  Hypercalcaemia 256
  Osteoporosis – OP (& Osteopenia) 257
    OP – minerals & vitamins 262
    OP & Peak Bone Mass 264
  Paget’s disease AKA Osteitis Deformans 266
  Vitamin deficiencies see Osteomalacia, Osteoporosis

FAILURE DUE TO NECROSIS (LACK OF BS)
  Avascular (aseptic) bone necrosis AKA Osteonecrosis 270

FAILURE DUE TO NEOPLASIA
  common sites of primary bone cancers 272
  Table of bone cancers – benign & malignant 274

APPENDIX
  Bone Diseases – their names & aetiologies 277

© A. L. Neill
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>actions / movements of a joint</td>
</tr>
<tr>
<td>a</td>
<td>artery</td>
</tr>
<tr>
<td>aa</td>
<td>anastomosis (ses)</td>
</tr>
<tr>
<td>AA</td>
<td>alopecia areata</td>
</tr>
<tr>
<td>Ab</td>
<td>antibody = IL</td>
</tr>
<tr>
<td>Ab/Ag</td>
<td>antigen antibody complex</td>
</tr>
<tr>
<td>ABC</td>
<td>aneurysmal bone cyst</td>
</tr>
<tr>
<td>ACF</td>
<td>anterior cranial fossa</td>
</tr>
<tr>
<td>Alm</td>
<td>autoimmune</td>
</tr>
<tr>
<td>adj.</td>
<td>adjective</td>
</tr>
<tr>
<td>Ag</td>
<td>antigen</td>
</tr>
<tr>
<td>AKA</td>
<td>also known as</td>
</tr>
<tr>
<td>ALL</td>
<td>anterior longitudinal ligament</td>
</tr>
<tr>
<td>alt.</td>
<td>alternative</td>
</tr>
<tr>
<td>ANF</td>
<td>anti nuclear factor</td>
</tr>
<tr>
<td>ANS</td>
<td>autonomic nervous system</td>
</tr>
<tr>
<td>ant.</td>
<td>anterior</td>
</tr>
<tr>
<td>AP</td>
<td>alkaline phosphatase</td>
</tr>
<tr>
<td>A / P</td>
<td>anterior/posterior</td>
</tr>
<tr>
<td>AR</td>
<td>allergic reaction</td>
</tr>
<tr>
<td>art.</td>
<td>articulation (joint w/o the additional support structures)</td>
</tr>
<tr>
<td>AS</td>
<td>Alternative Spelling, generally referring to diff. b/n UK &amp; USA</td>
</tr>
<tr>
<td>assoc.</td>
<td>associated (with)</td>
</tr>
<tr>
<td>B-</td>
<td>bone marrow derived -</td>
</tr>
<tr>
<td>B-AP</td>
<td>bone specific alkaline phosphatase</td>
</tr>
<tr>
<td>bc</td>
<td>because</td>
</tr>
<tr>
<td>BCC</td>
<td>basal cell carcinoma</td>
</tr>
<tr>
<td>BCR</td>
<td>B-cell antigen receptor</td>
</tr>
<tr>
<td>BM</td>
<td>bone marrow</td>
</tr>
<tr>
<td>bm</td>
<td>basement membrane</td>
</tr>
<tr>
<td>BMD</td>
<td>bone mineral density</td>
</tr>
<tr>
<td>b/n</td>
<td>between</td>
</tr>
<tr>
<td>br(s)</td>
<td>branch(es)</td>
</tr>
<tr>
<td>BS</td>
<td>blood supply / blood stream</td>
</tr>
<tr>
<td>BV</td>
<td>blood vessel</td>
</tr>
<tr>
<td>Bx</td>
<td>biopsy</td>
</tr>
<tr>
<td>C</td>
<td>carpal / carpo</td>
</tr>
<tr>
<td>c</td>
<td>cytoplasm</td>
</tr>
<tr>
<td>CD</td>
<td>cluster of differentiation</td>
</tr>
<tr>
<td>c.f.</td>
<td>compared to</td>
</tr>
<tr>
<td>CFU</td>
<td>colony forming unit</td>
</tr>
<tr>
<td>Cf</td>
<td>chronic inflammation</td>
</tr>
<tr>
<td>CIN</td>
<td>carcinoma in situ</td>
</tr>
<tr>
<td>cm</td>
<td>cell membrane</td>
</tr>
<tr>
<td>CMC</td>
<td>carpometacarpal</td>
</tr>
<tr>
<td>CMF</td>
<td>chondromyxoid fibroma</td>
</tr>
<tr>
<td>CN</td>
<td>cranial nerve</td>
</tr>
<tr>
<td>CNS</td>
<td>central nervous system</td>
</tr>
<tr>
<td>Co</td>
<td>collagen</td>
</tr>
<tr>
<td>collat.</td>
<td>collateral</td>
</tr>
<tr>
<td>CP</td>
<td>cervical plexus</td>
</tr>
<tr>
<td>Cr</td>
<td>cranial</td>
</tr>
<tr>
<td>CSF</td>
<td>colony stimulating factor</td>
</tr>
<tr>
<td>CT</td>
<td>connective tissue</td>
</tr>
<tr>
<td>D</td>
<td>dermis / diaphysis</td>
</tr>
<tr>
<td>Dd</td>
<td>deep dermis / reticular dermis</td>
</tr>
<tr>
<td>DD</td>
<td>differential diagnosis</td>
</tr>
<tr>
<td>DE</td>
<td>dermo-epidermal junction</td>
</tr>
<tr>
<td>diff.</td>
<td>difference(s)</td>
</tr>
<tr>
<td>DIP</td>
<td>distal interphalangeal joint</td>
</tr>
<tr>
<td>dist.</td>
<td>distal</td>
</tr>
<tr>
<td>DLE</td>
<td>discoid lupus erythematosus</td>
</tr>
<tr>
<td>DM</td>
<td>Diabetes Mellitus</td>
</tr>
<tr>
<td>Du</td>
<td>upper dermis / papillary dermis</td>
</tr>
<tr>
<td>Dx</td>
<td>diagnosis / diagnoses</td>
</tr>
<tr>
<td>E</td>
<td>epiphysis / epidermis</td>
</tr>
<tr>
<td>EA</td>
<td>epidermal appendages</td>
</tr>
<tr>
<td>EAM</td>
<td>external acoustic meatus</td>
</tr>
<tr>
<td>EAS</td>
<td>external anal sphincter</td>
</tr>
<tr>
<td>EC</td>
<td>extracellular (outside the cell)</td>
</tr>
<tr>
<td>e.g.</td>
<td>example</td>
</tr>
<tr>
<td>EP</td>
<td>epiphyseal growth plate</td>
</tr>
<tr>
<td>ER</td>
<td>extensor retinaculum</td>
</tr>
<tr>
<td>er</td>
<td>endoplasmic reticulum</td>
</tr>
<tr>
<td>ES</td>
<td>Ewing's sarcoma</td>
</tr>
<tr>
<td>Ex</td>
<td>examination</td>
</tr>
<tr>
<td>ext.</td>
<td>extensor (as in muscle to extend across a joint)</td>
</tr>
</tbody>
</table>
ext. = extension
F = fat
f = fluid
Fab = antibody binding fragment
FB = fibroblasts
FC = fibrocytes
Fc = fragment –crystal region
flex. = flexor
flex. = flexion
FR = flexor retinaculum
GF = growth factors
GH = growth hormone
gld = gland
GIT = gastro-intestinal tract
Gk. = Greek
grp = group
GS = ground substance
H = hormone
HA = hydroxapatite
Histo = Histology
HP = high powered magnification
Hx = history (of the disease)
IAS = internal anal sphincter
IC = intercarpal / intercarpo
If = inflammation
IfR = inflammatory response / reaction
Ig = immunoglobulin
IL = interleukins = immunoglobulins = Ab
Im = immune
In = infection
INF = interferon
inf = inferior
IP = interphalangeal
IR = immune response / reaction
Ix = investigation of
Iy = injury
jt(s) = joints = articulations
l = lymphatic
L = lesion / left
lat = lateral
LB = long bone
LBP = low back pain generally assoc with prolapsed disc
LL = lower limb
lig = ligament
longit. = longitudinal
LOF = loss of function
LP = low powered magnification
Lt. = Latin
M = meta
m = muscle
MC = metacarpal / metacarpo
MCF = middle cranial fossa
MCP = metacarpophalangeal
med = medial
mito = mitochondria
MM = mucous membrane
MNC = mononuclear cells
MO = microorganisms
MP = medium magnification
M/P = medial / lateral
MRC = medical research council
MT = metatarsal
mΦ = macrophage
N (s) = nerve(s)
NA = nucleic acids
NAD = normal (size, shape)
NAD = no abnormality detected
NK = natural killer
No = nucleolus
NOF = neck of Femur
NR = nerve root origin
NS = nervous supply / nerve system
NT = nervous tissue
Nu = nucleus (nuclei)
nv = neurovascular bundle
OA = osteoarthritis
OB = osteoblasts
OC = osteoclasts
OG = osteoprogenitor cells = bone stem cells
OP = osteoporosis
OS = osteosarcoma
P = pressure / pus
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAD</td>
<td>peripheral arterial / vascular disease</td>
</tr>
<tr>
<td>PaNS.</td>
<td>parasympathetic nervous system</td>
</tr>
<tr>
<td>ParaNs</td>
<td>parasympathetic nerves ± fibres</td>
</tr>
<tr>
<td>partic</td>
<td>particular(ly)</td>
</tr>
<tr>
<td>PBM</td>
<td>peak bone mass</td>
</tr>
<tr>
<td>PCF</td>
<td>posterior cranial fossa</td>
</tr>
<tr>
<td>PH</td>
<td>parathyroid hormone</td>
</tr>
<tr>
<td>pH</td>
<td>a measure acidity</td>
</tr>
<tr>
<td>ph</td>
<td>phalangeal / phalanges / phalange</td>
</tr>
<tr>
<td>PIP</td>
<td>proximal interphalangeal joint</td>
</tr>
<tr>
<td>pl.</td>
<td>plural</td>
</tr>
<tr>
<td>PLL</td>
<td>posterior longitudinal ligament</td>
</tr>
<tr>
<td>PMNs</td>
<td>polymorphonuclear cells = polymorphs</td>
</tr>
<tr>
<td>PN</td>
<td>peripheral nerve</td>
</tr>
<tr>
<td>post.</td>
<td>posterior</td>
</tr>
<tr>
<td>proc.</td>
<td>process</td>
</tr>
<tr>
<td>prox.</td>
<td>proximal</td>
</tr>
<tr>
<td>PS</td>
<td>pubic symphysis</td>
</tr>
<tr>
<td>PSU</td>
<td>pilo-sebacious unit</td>
</tr>
<tr>
<td>PVD</td>
<td>peripheral vascular disease</td>
</tr>
<tr>
<td>Px</td>
<td>progress</td>
</tr>
<tr>
<td>R</td>
<td>right / resistance</td>
</tr>
<tr>
<td>RA</td>
<td>rheumatoid arthritis</td>
</tr>
<tr>
<td>ROM</td>
<td>range of movement</td>
</tr>
<tr>
<td>RSTL</td>
<td>relaxed skin tension lines</td>
</tr>
<tr>
<td>RT</td>
<td>respiratory tract</td>
</tr>
<tr>
<td>S</td>
<td>strata/stratum / sacral</td>
</tr>
<tr>
<td>SC</td>
<td>spinal cord</td>
</tr>
<tr>
<td>SCC</td>
<td>squamous cell carcinoma</td>
</tr>
<tr>
<td>sing.</td>
<td>singular</td>
</tr>
<tr>
<td>SE</td>
<td>side effects</td>
</tr>
<tr>
<td>SLE</td>
<td>systemic lupus erythematosus</td>
</tr>
<tr>
<td>SN</td>
<td>spinal nerve</td>
</tr>
<tr>
<td>SP</td>
<td>spinous process / sacral plexus</td>
</tr>
<tr>
<td>SPF</td>
<td>sun protection factor</td>
</tr>
<tr>
<td>SS</td>
<td>signs and symptoms</td>
</tr>
<tr>
<td>STL</td>
<td>skin tension lines</td>
</tr>
<tr>
<td>Su</td>
<td>subcutaneous T / fat</td>
</tr>
<tr>
<td>subcut.</td>
<td>subcutaneous (just under the skin) as a site</td>
</tr>
<tr>
<td>sup</td>
<td>superior</td>
</tr>
<tr>
<td>supf</td>
<td>superficial</td>
</tr>
<tr>
<td>SyNS</td>
<td>sympathetic nervous system</td>
</tr>
<tr>
<td>T</td>
<td>tissue</td>
</tr>
<tr>
<td>TCR</td>
<td>T cell receptor</td>
</tr>
<tr>
<td>TJC</td>
<td>tight junctional complex</td>
</tr>
<tr>
<td>Tm</td>
<td>tumour(s)</td>
</tr>
<tr>
<td>TNF</td>
<td>tumour necrosis factor</td>
</tr>
<tr>
<td>TP</td>
<td>transverse process</td>
</tr>
<tr>
<td>Tx</td>
<td>treatment / therapy</td>
</tr>
<tr>
<td>UL</td>
<td>upper limb, arm</td>
</tr>
<tr>
<td>v</td>
<td>very</td>
</tr>
<tr>
<td>V</td>
<td>vertebra / vein</td>
</tr>
<tr>
<td>VB</td>
<td>vertebral body</td>
</tr>
<tr>
<td>VC</td>
<td>vertebral column</td>
</tr>
<tr>
<td>VDRL</td>
<td>Venereal Disease Research Laboratory (test for syphilis)</td>
</tr>
<tr>
<td>vv</td>
<td>visa versa</td>
</tr>
<tr>
<td>w</td>
<td>with</td>
</tr>
<tr>
<td>WBCs</td>
<td>white blood cells</td>
</tr>
<tr>
<td>w/n</td>
<td>within</td>
</tr>
<tr>
<td>w/o</td>
<td>without</td>
</tr>
<tr>
<td>wrt</td>
<td>with respect to</td>
</tr>
<tr>
<td>&amp;</td>
<td>and</td>
</tr>
<tr>
<td>∩</td>
<td>intersection with</td>
</tr>
<tr>
<td>#</td>
<td>fracture</td>
</tr>
</tbody>
</table>

© A. L. Neill
Common Terms in Osteology & Pathology

A

**Abcess (AB-sess)** localized collection of pus

**Ablation (AB-lay-shon)** the removal of part of the body, generally a bony part, most commonly the teeth

**Achilles (Achilles’) tendon** AKA Calcaneal tendon, Tendo Calcaneus posterior tendon posterior leg tendon – longest & strongest in the body – 15 cm long up to 4cm wide – joins the posterior muscles to the heel bone

**Acro (AK-roh) (adj acral)** Gk akron = extreme end, extremity, peak, tip, denoting something at the extremities ankles / fingers / wrists

**Acromegaly (AK-roh-meg-al-ee)** adult form of hyperpituitarism – the ends of the long bones continue to grow: coarsen the facial features and digits

**Acute (AK-yewt)** sudden onset + short course – used to describe a condition generally pathological ≠ chronic

**Adaptive immunity = Adaptive IR = Aquired IR** the response of Ag-specific lymphocytes to Ab, including the development of immunologic memory. Adaptive IRs are distinct from the innate & non-adaptive phases of immunity, which are not mediated by clonal selection of Ag-specific lymphocytes see also Immunity

**Adnexa (AD-nex-uh)** appendage, limb extras pl adnexae (AD- nex-ee)

**Ala (AY-lar)** a wing, hence a wing-like process as in the Ethmoid bone pl. - alae.

**Alkaline Phosphatase (ALK-u-lyn FOS-fat-ayz)** – an enzyme responsible for cleaving the phosphate ion in ATP – ie as a marker of energy consumption – as such it is present on all cells – but specific iso-enzymes may be distinguished – so that bone specific – alkaline phosphatase (B-AP) measures the bone energy activity & is specific to the activity of OBs – bone being formed.

**Allergy (AL-er jee)** abnormal IR to a substance

**Alta Lt. on high** elevation

**Alveolus (AL-vee-oh-lus)** air filled (bone - tooth socket) adj - alveolar (as in air filled bone in the maxilla)

**Amorphous (AY-mor-fuss)** shapeless, structure less

**Amputation (AM-pew-tay-shon)** to cut off, to prune, to cut off a limb or appendage

**Amyloid (AM-uh-loyd)** proteinacous substance of varying composition, which appears similar histologically

**Amyloidosis** – group of diseases characterized by extracellular deposition of the amyloid (3) in Ts & organs – displacing the normal structure e.g. the renal glomerulus (2) or the sinusoids of the liver (4), causing cell & T death (5) & leaving protein casts of their presence (1).

**Anaphylaxis (AN-uh-fill-ax-sis)** exaggerated reaction to a foreign body = acute severe IR

**Anatomical position** the reference position, in which the subject is standing erect with the feet facing forward, arms are at the sides, & the palms of the hands are facing forward (the thumbs are to the outside).
**Anaesthesia** loss of sensation

**Anatomy** *(ah-NAH-to-mee)* the study of the structure of the body.

**Ankle** bend = angle usually referring to the bend just above the foot, hence the ankle is the joint b/n the foot & LL

*aniso* unequal

*ankyllos* – *(an-KEE-los)* stiff / stiffening – often referring to something becoming calcified

**Ankylosis** a fixed bending of the jt – unable to straighten – always pathological

**Anlage** *(AN – lag)* Ger act of laying = primordium – a clustering of embryonic cells to form an organ or structure

**Annulus fibrosis** the peripheral fibrous ring around the intervertebral disc

**Anteversion** – leaning forward

**Antibiotic** *(ant-EE-BYE-o-tic)* a substance which can be ingested & used to kill MOs specifically bacteria in the body.

**Antibody** / **Antigen** proteins involved in the immune system – antibodies Abs are produced by the body in reaction to antigens Ags proteins or materials found on the surface of foreign bodies introduced to the body forming the antibody-antigen complex

*anti– against*

**Antibodies** *see also Immunoglobulin* self molecules which are synthesized by the Im cells after being exposed to Ags

**Antigen (Ag)** usually a foreign macromolecule that triggers the IR & the production of Abs & other immune active molecules e.g. TNF.

**Antigen** – presenting cells *see Dendritic cells.*

**Anti-inflammatory** anything which /* If by acting on body responses

**Aperture** *(a-PET-tyuu-a)* an opening or space b/n bones or w/in a bone.

*apo– away from / detached*

**Apophysis** *(APO-fe-sis)* = tuberosity / tubercle cartilage which connects bone to bone or tendon to bone, in young bones (1) but not a true EP (2) – does not function to ↑ LB length. It is subject to tearing – and separation in overtraining of the young

**Apoptosis** *(a-POP-toe-sis)* Gk aptos = to drop out individual cell death – programmed cell death due to organ conditions – natural cell death – ≠ Necrosis

**Appendicular** refers to the appendices of the axial i.e. in the skeleton, the limbs upper & lower which hang from the axial skeleton, this also includes the pectoral & pelvic girdles.
Arbor Gk treelike branches – arborizing, branching
Areola small, open spaces as in the areolar part of the Maxilla may lead or develop into sinuses.
Arth- to do with joints hence…
Arthritis (AR-thrye-tis) Inflammation of a joint
Arthrogryposis joint contractures
Arthrodesis complete loss of movement in a joint due to surgical ablation – i.e. fusing of the joint – used for pain and loss of mobility – an artificial ankylosis or syndesis
Arthropathy diseases of the joints
Arthroplasty – surgical manipulation of a joint – i.e. its removal or remodeling
Arthrosis AKA arthritis – lower if involvement in the disease process
Articulation joint, description of the bone surfaces joining w/o the supporting structures = point of contact b/n 2 opposing bones hence the articulation of Humerus & Scapula is the articulation of the shoulder joint. adj articular
Artifact (AH-te-fact) AS Artefact – any distortion seen in the histological or radiological processing of material
Atopy (AY-toe-pee) – out of place adj atopic
Atrophy (a-TROH-fee) Gk a = lack of, trophe =nourishment wasting away deterioration of a T or organ from lack of use or food
Atypical not normal, unusual presentation of a phenomenon or structure
auto- (OR-toh) - self
Autoimmune (Alm) pertaining to cells & Abs that arise from & are directed against the individual’s own tissues i.e. against “self”
Attrition tooth wear & tear
Atypical (AY-tip-i-cal) not usual –often used to describe possible cancerous cells or tissue
audio (OR-dee-oh) pertaining to hearing, or to the ear.
Auditory exostosis = a bony growth on the walls of the EAM (swimmer’s ear)
Autolysis (OR-tol-e-sis) – the process of self destruction of a cell or tissue
Autopsy (OR-top-see) the examination ± dissection of a body after death – usually to Ix cause of death / verify the diagnosis
Avulsion (AY-vul-shon) forcible tearing away of a structure or part of a structure as in an avulsed fracture where a fragment bone is torn away from the main bone
Axis (AK-sis) adj axial (AK-see-el) refers to the head & trunk (VC, Ribs & Sternum) of the body – not arms or legs

B
B cells = B lymphocytes 1 of the 2 major types of lymphocyte. B means the cells come originally from the BM see also Plasma cells, T cells
Ball and Socket generally referring to a joint which resembles a ball sitting tightly in a socket - very stable, limited range of movement e.g. hip joint
Basement membrane (bm) a thin layer of extracellular fibrillar protein matrix & CT stroma that underlies all epithelial cells
baso- base (as in acid / base; as in the bottom – the basal layer) adj basal
Basophils – granulocytes of the Im system which take up base staining because of high acid cytoplasmic granules see also Acidophils, Neutrophils & PMNs

Basocranium bones of the base of the skull

Basophil (BAS-oh-fil) a type of WBC that is characterized by large cytoplasmic granules that stain blue with basic dyes.

Benign (BEE-nine) not harmful or dangerous, ≠ malignant, indicating a mild disease. In cancer it is used to describe a mild & non-metastasizing cellular growth.

Biopsy (Bx) (BY-op-see) a piece of T removed for microscopic examination – usually from a live person

-blast immature cell / undifferentiated cell

Blount’s disease see Tibia Vara

Bone (BOH-n) a CT that contains a hardened matrix of mineral salts & collagen fibers.

Bone cells include: osteoblasts, osteocytes, & osteoclasts.

Bone Mineral Density (BMD) AKA Bone density a score indicating the amount of bone mineral g/cm². It is used as a direct measure of the risk of # & OP. Sites measured are generally high risk # sites of OP – the hip and lumbar spine but any bone is possible to measure. Results are expressed in g/cm², note this is not a volumetric measure & so the bone measured is very relevant. T & Z scores determine the type of bone normal osteopenic or osteoporotic

T-score, the number of standard deviations above or below the mean for a healthy 30 year old adult of the same sex & ethnicity as the patient.

normal > -1.0 / osteopenia -1.0 to – 2.5 / OP < -2.5

Z- Score, the number of standard deviations above or below the mean for the patient’s age, sex & ethnicity.

Bone spur see osteophyte

Boss a smooth round broad eminence - mainly in the frontal bone ♂ > ♀

Bowlegged see Genu Varus note there is some confusion here as the term Vargus is also used – but for clarity it is not used here - if this is due to tibial malformation & not a disease of the knee jt per se see Tibia Vara

Brachial (BRAY kee-al) arm, mainly to do with the upper arm

Bregma refers to a junction of more than 2 bones in a jt as in the Bregma of the skull, junction b/n the coronal & sagittal sutures which in the infant is not closed & can be felt pulsating

Buccal pertaining to the cheek

Bunion Gk bounion = turnip abnormal prominence on the inner aspect of the 1st MT head + a bursa & valgus (lat) displacement of the Hallux (big toe)

Bunionette AKA Taylor’s bunion enlargement of the lat aspect of the 5th MT head

Bursa (BER-suh) a flattened sac containing a film of fluid (B), found around jts to allow for movement.

pl bursae e.g. the Elbow jt bursa.

b/n Humerus (H) & Ulna (U)

Bursitis If of the bursae

Calcaneus (KAL-kan-ee-us) heel, hence the bone of the heel adj calcaneal.

Calcaneal tendon see Achilles tendon

Calcar a spur adj calcaneal.
The A to Z of Bone & Joint Failure

Calcinosis (KAL-sin-oh-sis) deposits of Calcium in body Ts &/or organs

Calcitonin H secreted by the parafollicular cells of the thyroid gland (1) opposing Ca mobilization – it ↓ Ca being absorbed in the GIT – being reabsorbed in the renal tubules and being mobilized from bone by ↑ OC activity, and ↑ OBs. Its activities are generally not significant as they are over-ridden by PH secreted by the parathyroid gland (2).

Calculus (KAL-que-lus) mineral deposit in T see also stone

Callus (KAL-us) hard T formed in the osteogenic layer of the periosteum as a # repair, replaced over time with compact bone

Calotte (KALoh-tee) the Calotte consists of the Calvaria from which the base has been removed.

Calvaria the Calvaria are the bones of the Cranium w/o the facial bones, attached.

Camptodactyly congenital flexion disorder of the PIP, generally affects the little finger

Canal tunnel / extended foramen as in the carotid canal at the base of the skull

adj canular

Canaliculus small canal

Cancellous bone = Trabecular bone a spongy, porous bone, lightweight with bone spicules or trabeculae parallel to lines of force found at the ends of LBs (epiphyses) with surrounding BM, found sandwiched b/n lamellae of compact bone, in the VBs & in areas of ↑ bone thickness

Carcinogen (KAR-sin-oh-jen) material which leads to cancer formation

Carcinoma (KAR-sin-oh-mah) a malignant growth originating from epithelial cells ≠ Sarcoma

Carcinoma – in situ pre-invasive cancer still lying in the confines of normal tissue not having broken through the bm but with neoplastic changes

Carpal Tunnel the tunnel formed by the wrist bones (carpal bones) to allow the passage of the flexor tendons & Ns to the hand & fingers, bound superiorly by the palmar fascia

Carpo wrist

Carpometacarpal generally referring to the jt b/n hand & the wrist bones

Cartilage (KAR-tih-lehj) a type of CT characterized by the presence of an extensive matrix containing a dense distribution of proteins & a thickened GS.

Caseous (KAY-zee-us) cheeselike – a form of necrosis
Cavity (KAV-it-e) an open area or sinus w/in a bone or formed by 2 or more bones *(adj cavernous)*, may be used interchangeably with fossa. Cavity tends to be more enclosed fossa a shallower bowl-like space (e.g. Orbital fossa-Orbital cavity).

**Cavum** a cave *adj cavis*

**Cell** *(SELL)* the basic living unit of multicellular organisms.

**Cephalic** pertaining to the head

**Cerebral Palsy** brain disorder generally from birth or post-In which results in poor muscle control & so leads to bone deformities due to poor coordination & limbs being held in abnormal positions

**Cervico-** pertaining to the neck

**Charcot jt** =neuropathic jt

**chondro-** *(KON-droh)* referring to cartilage

**Chondrium** *(KON-dree-um)* the cartilage *adj chondria, chondral*

**Chondrocyte** *(KON-droh-site)* a mature cartilage cell.

**Chondrocalcinosis** *(KON-droh-kal-sin-oh-sis)* metabolic disorder where calcium deposits are found in its leading to their destruction - much like gout with uric acid

**Chondroitin sulphate** *(kon-DROI-tin SUL-fate)* a semisolid material forming part of the EC matrix in certain CT.

**Chondroma** *(KON-droh-mah)* benign Tm of cartilage T origin

**chromo-** *(KROHM-oh)* referring to colour *adj chromatic*

**Clinoid** like a bed-post, part of a 4-poster bed so that clinoid process looks like a bed post (generally with other posts) as in the Sphenoid bone.

**Clavicle** little key = S-shaped bone = collar bone

**Clivus** a slope hence in the ACF referring to a slope on the base of the cavity.

**Clones** series of cells which are identical to each other; in the IR these are lymphocytes which all produce the same Ags &/or cytokines

**Club foot AKA Talipes equinovarus**

downward inward pointing foot deformity

**Clusters** descriptive term for multiple cells seen to be together but not orientated in any particular manner as opposed to *nests*

**Clusters of differentiation (CD)** immune cells which express glycoproteins on their surfaces & are seen to act together — specific molecules may be referred to as numbers as in CD4 cells (used to be called leu-3)

**Clusters of PMNs** used to indicate areas of AI filled with PMNs (neutrophils which have left the BS)

**Coagulation** *(KOH-ag-you-lay-shon)* process of clotting turning from a liquid to a solid or semi-solid

**Cochlea** *(KOK-lee-uh)* a snail hence snail-like shape relating to the Organ of Corti in the ear.

**Codman’s triangle** subperiosteal bone reaction to aggressive bone cancers e.g. osteosarcoma — (1). As the periosteum (2) lifts new bone T forms a triangle (2) b/n the bone & the periosteum via sunray spicules (4). These normal bone spicules develop in reaction to the detached periosteum, from the normal bone (5) underneath not replaced yet by Tm.
Collagen (KOL-a-jen) the major fibre of the body; in CT, tendons ligaments & extracellular substances of many Ts

Colles Fracture AKA Colles' fracture # of the distal Radius at the cortico-cancellous junction – looks like a bent fork & sometimes called the fork #. Initially this # excluded Ulna involvement but now this is not always the case & loosely the # may be used to describe any distal forearm #. Common result of falling with an outstretched arm – common # of OP.

Compact bone = Cortical bone = Dense bone bone found in the shafts & on external bone surfaces. The structure is variable & constantly being remodeled throughout life. It may consist of osteons &/or lamellae.

ComplementLt to fill up or fill out an entire protein cascade in the BS activated by the presence of bm &/or necrotic cell components, may also be activated in the Ts by allogens – allergic Ag

Complex in IR the combining of 2 factors involved in the IfR or the IR e.g. an Ag & Ab complex which combines to activate or further develop the process

Concha (KON-kuh) a shell shaped bone as in the ear or nose (pl. conchae adj chonchoid) old term for this turbinate.

Condylar resorption AKA idiopathic condylar resorption process where the condyle of the TMJ is spontaneously resorbed reducing the size of the mandible & affecting the bite – generally seen in adolescent females

Condyle (KON-dial) a rounded enlargement or process — used in ref to a number of bones — commonly the TMJ jt

Congenital (KON-jen-it-al) present from birth

Connective tissue (kon-EK-tiv Tish-ew) (CT) one of the 4 basic types of tissue in the body. It is characterized by an abundance of EC material with relatively few cells & functions in the support & binding of body structures.

Cornu a horn (as in the Hyoid)

Corona a crown. adj coronary, coronoid or coronal; hence a coronal plane is parallel to the main arch of a crown which passes from ear to ear (c.f. coronal suture).

Cortex the rind or the bark of the tree

Costo/Costa — pertaining to the ribs

Coxa hip

Coxa Plana AKA Perthes disease

Coxa Valga, Norma, Varga with the changing of the femoral angle the Femur exits differently — leading to hip displacement & a limp

CoxAlgia hip disease

Cranium the cranium of the skull comprises all of the bones of the skull except for the mandible.

Crepitus (Krep-i-tus) a grating sensation on jt movement, often present in arthritis; described as bone-on-bone rather than on the articular cartilage

Crest prominent sharp thin ridge of bone formed by the attachment of muscles particularly powerful ones e.g. Temporalis/Sagittal crest

Cribiform / Ethmoid a sieve or bone with small sieve-like holes.

Crown = Vertex the top of the organ or body

Crura adj cruris leg

Cuneate / Cuneus a wedge / wedge-shaped (bone)

cyst- (SIST) bladder / fluid filled sac
Cyst nodule/tumour filled with liquid semi-solid material lined by epithelium – as opposed to unlined fluid in the pseudocyst adj cystic
-cytes (SYTS) mature cell types
cyto- cellular
Cytokine (SY-to-kyn) any substance – generally small proteins made by a cell that affects the behaviour of other cells. Substances made by lymphocytes, act via specific cytokine receptors on the cells that they affect see also Lymphokines, Interleukins (IL).
Cytotoxic poisonous to cells – may cause cell death

D

Dactyly – digits

Dendritic (stromal) cells AKA Langerhans cells AKA Antigen presenting cells BM-derived star-shaped/treelike tissue resident phagocytic cells – potent T cell stimulators using Ags attached to stimulate activity, from the monocyte line.
dendro- tree-like formation

Dens a tooth hence dentine & dental relating to teeth, denticulate having tooth-like projections adj dentate see also odontoid

Depression a concavity on a surface

Dermatome section of skin (3) supplied by a single NR (2) as opposed to myotome (1) – which is the area of muscle supplied by a single NR – skin & muscle supplied by the same NR are generally closely associated

Diaphysis (DY-af-i-sis) the shaft or body of a LB. In the young this is the region b/n the growth plates & is composed of compact bone.
pl. = diaphyses adj. = diaphyseal
Diarthrodal jt = synovial jt = moveable jt
Dislocation when a bone is “out of place” out of its socket – or joint position see also Subluxation

Diastasis separation – may mean separation of a muscle from its original position as in pregnancy; or a bone from its original position w/o # – as in tendon rupture

Differentiation the changing of cells to become increasingly specialized

Diploë the cancellous bone b/n the inner & outer tables of the skull, adj diploic.

Distal further away from the axial skeleton (opposite of Proximal)

Dolor pain 1 of the 5 cardinal signs of IF
dorsi- back
dys- (DIS) Gk bad sign abnormal, bad, difficult, disorganized, painful (opposite to eu)

Dysplasia (DIS-play-zee-yah) abnormal growth of T or cells

Dysraphism any spinal abnormality of incomplete closure or malformation including spina bifida
**E**

**Eburnation** 2º thickening of the bony end plate (often due to OA)

**Edentulous** w/o teeth

**Effector cells** describes those lymphocytes which develop from naïve lymphocytes after initial activation by Ag. They mediate the removal of pathogens from the body w/o further differentiation. Naïve lymphocytes & memory lymphocytes must differentiate &/or proliferate before they become effector lymphocytes.

**Effusion** excess synovial fluid – in the jt

**Elbow** any angular bend, e.g. in the UL, referring to the jt b/n the arm & forearm

**Eminence** a smooth projection or elevation on a bone as in iliopubic eminence.

**Enchondroma** benign cartilaginous Tm growing on the inside of the bone – surrounded by a bony case – located in the BM, may be a lump of T which never ossified rather than a new cartilage growth *see also chondroma*

**Endocranium** refers to the interior of the “braincase” *adj endocranial* divided into the 3 major fossae anterior (for the Frontal lobes) middle (containing Temporal lobes) and posterior (for the containment of the Cerebellum).

**Endogenous** growing from w/in tissues or cells

**Endostium** a mesodermal CT which lines the inner surface of all bones & is the conduit for the NS & BS of the bone. Lifting of the endosteum causes cancellous bone to be laid down to fill the gap b/n the bone & the cellular layer & this device may be used to encourage bone growth/repair.

**Enostosis** = boney island a boney growth of compact bone w/in a bone – generally on the internal surface in the trabecular bone harmless incidental finding – DD prostatic metastasis

**Epiphysis** the end of a LB beyond the growth plate or EP. Generally develops as a 20 ossification centre. There are 2 epiphyses to each LB. Of a LB the shafts are generally compact bone & the ends = epiphyses are trabecular bone with a compact bone covering

*pl. = epiphyses* *adj epiphyseal*

**Excrescence** outgrowth from a surface – e.g. normal fingernail / abnormal wart or exostosis

**Exostosis** a bony outgrowth from a bony surface, often due to irritation (as in Swimmer’s ear) & may involve ossification of surrounding Ts such as muscles or ligaments.

**F**

**Facet** a face, a small bony surface (occlusal facet on the chewing surfaces of the teeth) seen in planar joints.

**Falciform** *(FAL-see form)* relating to shapes that are in a sickle shape so falciform ligaments curve around & end in a sharp point

**Fascia** *(FASH-ee-ah)* Lt =a band a sheet or band of fibrous T deep in the skin covering & attaching to deeper tissues

**Fascicle** *(FAS-ih-kul)* small bundle

**Fc receptor** the section of the cm which binds the Fc portion of the Ab (IL).

**Fever** a generalized ↑ in body temperature due to an ↑ BF, which may be due to the body’s IrR

**Femoral angle** the angle b/n the femoral head & the shaft normal 120º – 135º, Valgus >135º, Varus < 120º
**Femoral anteverision** a leaning forward of the femoral head so that the Femur is rotated & the child becomes knock-kneed ± Patella rotation ± Tibial rotation – developmental rotation which generally spontaneously corrects itself in infancy with re-alignment of the LL – common sitting position is the W – a position preferred by the child.

**Fibrino-inflammatory** exudates due to IIFR with both fibrin & inflammatory components

**Fibroblast** an immature progenitor cell found in all CT, capable of mitosis, migration, movement. Among other pathways they develop into fibrocytes.

**Fibrocyte** mature fibre producing cell = mature fibroblast spindle shaped cell producing either collagen (coll) or elastin (e) fibres via secretion of monomer units (m) which assemble outside the cell into long fibres, which are then maintained by the fibrocytes. Note with age the number of fibrocytes & hence the fibres hence compromising the integrity & strength of their CT. See also bone development / structure main text.

**Fibrocartilagenous stroma** background T of cartilage with high collagen fibre component

**Fibromatosis** fibrosis w/n a fascial sheath

**Fibrosis** (FY-broh-sis) fibrous T, generally collagen fibres as in scars; can occur in all organs

**Fissure** a narrow slit or gap from cleft.

**Fontanelle** a fountain, associated with the palpable pulsation of the brain as in the anterior fontanelle of an infant. These soft spots on the skull are cartilaginous CT coverings “joints” which allow for skull cranial expansion & then become the mould for the bone development & shape joining long the sutural lines, later becoming the Bregma.

**Foramen** a natural hole in a bone usually for the transmission of BVs &/or Ns. pl. foramina

**Fornix** an arch

**Fossa** a pit, depression, or concavity, on a bone, or formed from several bones as in temporomandibular fossa. Shallower & more like a “bowl” than a cavity

**Fovea** a small pit (usually smaller than a fossa) - as in the fovea of the occlusal surface of the molar tooth.

**Fracture (#) = break** hence … see main text

**Fusiform** spindle-shaped – many CT cells are of this shape particularly fibrocytes.

**Gallus/Galli** a cock, hence, crista galli, the cock’s comb (i.e. possessive form of gallus)

**Gamma** Gk letter shaped like a “Y” and used to describe shapes of immunoglobulins

**Ganglion** a cystic swelling associated with jts &/or tendon synovial sheaths generally on the dorsal surface of the hand or wrist – fibrous capsule containing viscous fluid herniated from the jt/tendon capsule – may press on a N or jt & cause pain

© A. L. Neill
Gene (*JEEN*) a functional unit of heredity that occupies a specific place on a chromosome & directs the formation of a protein.

Genu (*JEN-you*) knee adj *genio* referring to the knee

**Genu Recurvatum** – hyperextension of the knee jt

**Genu Valgus** – knock-kneed (“G” knocking together)

**Genu Varus** – bow-legged (AR – AIR in b/n)

**Genu Norma**

**Genu Varus**

**Genu Valgus**

**Gigantism** – overgrowth of the length of the LBs due to excess GH before the fusion of the LBs see also Acromegaly

**Gomphosis** (*GOM-foh-sis*) jt b/n the roots of the teeth & the jaw bones *pl – gomphoses*

**Gout** (*gowt*) initially a metabolic disorder – accumulation of uric acid crystals in one or several jts – later leading to an arthritis & jt degeneration

**Granulocytes** cells with granules 2 types in the BS / Immune system - WBCs with granules see Neutrophils

**Granuloma** (*Gran-YOU-low-mah*) a smooth jelly orange-yellow papule nodule which microscopically appears as an aggregation of MNCs; a collection of modified macrophages – epitheloid cells, histiocytes surrounded by lymphocytes ± GCs & fibrocytes – attempting to wall off the area from the surrounding T, a granuloma is a feature of CIf see also Granulomatosis

**Granulomatosis** – the process of forming granulomae a response in CIf when there is no resolution of the process.

**Groove** long pit or furrow

**Ground substance AKA Extrafibrillar matrix** – refers to the material in T which is not fibrous or cellular & found outside the cells – v prominent in all CTs.

**Growth factors** natural substances produced by the body or obtained from food that promote growth & development by directing cell maturation & differentiation and by mediating maintenance & repair of Ts.

**H**

**Haemarthrosis** blood in the jt cavity

haemo (*HEEM-oh*) AS hemo- referring to blood

**Hallux** the big toe = the first toe

**Hamus** a hook hence the term used for bones which “hook around other bones or where other structures are able to attach by hooking - hamulus = a small hook.

**Harris lines AKA growth arrest lines** lines of ⬆ bone density due to pathological assault or sudden growth spurts. They indicate the position of the EP at the time of the event but they may change the shape of the bone & affect its length. Only seen in Xrays
Haversian canals = osteons see Osteons

Heberden’s nodes OA of the DIP of the hand resulting in swellings & deformities of the joint

Heterotopic ossification formation of bone outside the skeleton – occurs around joint replacement – partic the hip, #s & after paralysis, ectopic bone forms & immobilizes the joint – graded by the amount of movement limitation, progresses until the joint is immobilized - Grade IV no mobility.

Hinge joint joint with movement in one plane e.g. elbow or knee

Histamine vasoactive amine stored in mast-cell granules – basophilic histiocytes

histio-/hist-/histo Gk histos = web tissues

Histioyte (hist-EE-oh-site) Gk histio- tissue = phagocytic tissue cell a cell in the tissues which is immunologically active, derived from the BM mononuclear line. In Clf they may undergo epithelioid transformation see also Granulomatosis

Hormone Gk hormaein = to spur on a substance secreted in the body having a regulatory affect on organs & Ts

Hyaline Gk – glassy smooth glassy generally refers to hyaline cartilage found on the surface of synovial joints to facilitate movement of the 2 bones over each other; but may indicate T changes in which the T takes on a glassy – hyaline appearance

Hydroxyapatite = Hydroxlapatite (HA) = bone mineral, is a naturally occurring mineral form of calcium apatite Ca$_5$(PO$_4$)$_3$(OH), but is usually written Ca$_{10}$(PO$_4$)$_6$(OH)$_2$ to denote there are 2 entities. The OH$^-$ can be replaced by: carbonate, chloride or fluoride as in fluridated water. Up to 50% of bone by weight is a modified form of hydroxylapatite.

Hyoid U-shaped

Hyperostosis abnormal bone growth, thickening, generally overgrowth or ectopic growth

Hyperthyroidism condition of an overactive thyroid gland which may affect the bone and cause OP see also Thyroid hormone & Calcitonin

hyp,o- underneath / below

Hypoxia (Hy- poks-ee-uh) – lack of Oxygen but not the absence of it ≠ anoxia

Ideopathic of unknown origin

Immune (IM-youn) Lt – immunis = to free, to exempt free from the possibility of acquiring a certain disease or infection

Immune Complexes Ab/Ag combinations used to stimulate the IR

Immune response (IR) any response made by an organism to defend itself against pathogens.
## Summary of Joint movements – cephalo-caudally (head to toe)

### Lower body

<table>
<thead>
<tr>
<th>Location</th>
<th>Degrees of movement</th>
<th>Summary – Main screening tests</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Thoraco-Lumbar spine</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexion – lumbar / thoracic</td>
<td>60 / 45</td>
<td>14</td>
</tr>
<tr>
<td>Lat flexion – R+L</td>
<td>30 + 30 = 60</td>
<td>15</td>
</tr>
<tr>
<td>Rotation (Thoracic only) R + L</td>
<td>40 + 40 = 80</td>
<td>16</td>
</tr>
<tr>
<td><strong>Hip</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>abduction / adduction</td>
<td>40 / 25</td>
<td>17</td>
</tr>
<tr>
<td>Extension / Flexion</td>
<td>5–20 / 120</td>
<td>limited by abdomen contacting thigh if done with a flexed knee</td>
</tr>
<tr>
<td>Rotation @ 90º flexion – external/ internal</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Rotation in extension – external / internal</td>
<td>45 / 35</td>
<td>19</td>
</tr>
<tr>
<td><strong>Knee</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexion</td>
<td>135 +</td>
<td>limited by heel contacting buttock</td>
</tr>
<tr>
<td><strong>Ankle</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexion – dorsi/ plantar</td>
<td>15 / 55</td>
<td></td>
</tr>
<tr>
<td><strong>Foot</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forefoot pronation/ supination</td>
<td>20 / 35</td>
<td></td>
</tr>
<tr>
<td>Heel eversion / inversion</td>
<td>10 / 20</td>
<td></td>
</tr>
<tr>
<td><strong>The Big Toe / Great Toe</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IP jt extension / flexion</td>
<td>0 / 60</td>
<td></td>
</tr>
<tr>
<td>MP jt extension / flexion</td>
<td>65/ 40</td>
<td></td>
</tr>
</tbody>
</table>
General Principles in the Orthopaedic Examination

**INSPECTION**

1 **Shape / Posture changes**

Shape and posture changes (including shortening or uneven limbs) may demonstrate – congenital abnormalities, metabolic disturbances, destructive bone / joint changes with age/time, including incorrect use of the bones as in poor posture, a form of chronic wear & tear trauma, acute trauma or a combination of all these factors.

1. poor posture
2. round shoulders
3. Dowager’s hump – gen. developing from OP
4. Barrel Chest – gen. due to underlying lung disease
5. Valgus = Knock knees – gen. related to metabolic disease / or congenital
6. Vargus = Bow legs - gen. related to metabolic disease / or congenital
2 Swelling

Swelling may be confined to a localized region of a bone or joint (as in effusions) as in: infective/inflammatory conditions, neoplastic conditions, traumatic events, or become diffuse.

These conditions may be due to a combination of any of the previously listed aetiologies

7 diffuse swelling – gen. an infection over the whole region
8 localized swelling – confined to the joint – gen. post-traumatic
9 localized swellings – present on the bones not necessarily related to the joint – gen neoplastic
10 coloured swellings – as in bruising – gen. post-traumatic or bleeding disorders

3 Wasting

Wasting may indicate disuse, from pain or disuse, 2º to N damage, which may come from neoplasia or trauma.

11 muscle wasting in upper leg – asymmetrical disuse
**PALPATION**

1. Heat in the area (which may be observed as a redness) – either localized or diffuse – both often indicate an infective inflammatory process
2. Cold particularly in distal acral regions – may indicate poor BF due to PVD or asymmetrical atherosclerosis
3. Tenderness either local or diffuse usually always indicates an inflammatory process

11. Palpation for heat, maybe over a joint ± red due to BF in the area
12. Palpation for tenderness – local or diffuse with swelling may be due to pus or other inflammatory effusion

**MOVEMENT**

Nearly all orthopaedic conditions involve at least 1 jt – hence their movements need to be evaluated.

1. **Test the Range of Movements (ROM) – normal**
   - **active** performed by the patient - unassisted
   - **passive** performed by the examiner w/o patient input
**Generally active ROM < or = passive ROM**

This needs to be recorded – ideally with the “Normal“ limb – otherwise with ROM tables. “Fixed flexion deformities” – are indicative of contracting joint capsules, muscles, tendons – generally degenerative or infective processes; or of inserted masses in the region either extra-articular – indicative of neoplastic processes, or intra-articular indicative of congenital, degenerative &/or traumatic events.

**2 Test the Range of Movements (ROM) – abnormal**

Examiner movement of the limb / jt in abnormal planes

This often indicates, structural changes – possibly due to congenital or degenerative factors

13 measuring the normal ROM of the joint
14 examination of movements in abnormal planes

**3 Detect any abnormal “clicks” or crepitus on jt movement**

if this is extra-articular – it maybe soft tissues moving over the joint – clicks, if this is intra-articular – it may indicate displaced intra-articular bodies – i.e. the meniscus, or irregular joint surfaces 2º to degeneration or acute trauma

15 detection of crepitus – or a grating on movement of the jt
4 Evaluate the strength of contraction over the jt

Although not technically orthopaedic – this measurement not only determines the muscle strength but the health & strength of the underlying jt.

In the LL this is particularly relevant and used to assess gait – contraction strength is determined not only by muscle strength/wasting, but by joint pain & innervation.

on the MRC scale – strength of a contraction is scaled as

<table>
<thead>
<tr>
<th>M0</th>
<th>no active contraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>palpable contraction – but no movement</td>
</tr>
<tr>
<td>M2</td>
<td>weak contraction – not strong enough to counter gravity</td>
</tr>
<tr>
<td>M3</td>
<td>contraction can overcome gravity</td>
</tr>
<tr>
<td>M4</td>
<td>contraction – enables function but is not full strength</td>
</tr>
<tr>
<td>M5</td>
<td>full strength</td>
</tr>
</tbody>
</table>

Hence it is also useful to test the sensory levels in the defined region.

MRC sensory scale

<table>
<thead>
<tr>
<th>S0</th>
<th>absence of all sensory modalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>deep pain sensation</td>
</tr>
<tr>
<td>S2</td>
<td>recovery of protective sensation, generalized – heat, pain, touch</td>
</tr>
<tr>
<td>S3</td>
<td>recovery of localized sensation / and recognition of objects</td>
</tr>
<tr>
<td>S4</td>
<td>normal sensation</td>
</tr>
</tbody>
</table>

16 examination of the sensory modalities
Notes:
The Ankle

**Anatomy** – simple hinge joint – movements in a single plane plantar / dorsiflexion + axial rotation around the Tibia up to 18° (eversion / inversion)

**Weight load** – through the Tibia & Talus

**Stability** – +++++

**A/P** – curved tibial bony prominences & ligs + weight bearing forces.

**M/L** – medial (tibial) & lateral (fibular) malleoli & ligs. includ. tibiofibular ligs. which bind the Fibula & Tibia together*

**S** – superior view. When the foot dorsiflexes (df) the Talus moves backwards (see red arrows) so the wider anterior surface fits b/n the malleoli and the jt becomes more secure – the opposite is true of plantar flexion (pf)

Fractures/tears to any of these stabilizing structures will result in failure of the ankle joint

1. weight load –load bearing forces in standing
2. Tibia – articular projections from the articular surface
   a = ant / p = post
3. Talus
4. malleolus m= medial L = lateral
5. inf. tibiofibular ligs (ant & post)
6. interosseus lig
7. Fibula
8. Calcaneus
9. lateral lig – 3 parts = External lig
10. medial lig = Deltoid lig
11. Navicular
12. Spring lig

* More details of the structure of the ankle can be found in *The A to Z of the bones joints & ligaments and the Back*
The Foot

**Anatomy** – The foot acts as a tripod with the force direction from the Tibia going through to the triangular base - of the 1st (1) & 5th (5) MTs & the Calcaneus(2). It moves in 3 axes – X, Y & Z which use the many jts in the foot to facilitate this. Flexion & Extension in the X axis allows the foot to accommodate slopes; Abduction & adduction or turning out & in the Y axis with the feet is limited and mainly in the midtarsal jt (3) in the Y axis and Inversion & Eversion in the Z axis which allows for balance in uneven surfaces is mainly in the subtalar jt (4).

**Stability** – ++++++
Good with the many interlocking bone surfaces and limited range of movement along with the broad base of the foot

**XYZ** tripod of the foot schema

X movements in the X plane
Y movements in the Y axis
Z movements in the Z axis

1 1st metatarsal bone
2 Calcaneus
3 midtarsal jt
4 subtalar jt
5 5th metatarsal bone

* More details of the structure of the foot can be found in The A to Z of the bones joints & ligaments and the Back
Examination
The Ankle – Radiological features

**Schema A/P**

A the amount of tibiofibular overlap (1) can be used to determine the extent of diastasis, while the EP (2) should not be mistaken for a Hx of #, although the small “os fibulae” (3) can be a sign of lig &/or bone avulsion & ankle instability.

B if the gap b/n the medial malleous & the Talus (4) > the gap of the Tibia & Talus (5) it also indicates diastasis & ankle instability

C the presence of any defects or foreign bodies on the articular surfaces (6) indicate arthropathy – osteochondritis tali is the commonest seen in the ankle

D note any deformaties on the bony points indicating past avulsions (7)

E congenital deformities show up as gross deformities of the bone shape (8) – generally with a compensatory in bone density
The Ankle – Radiological features

Schema – Lateral views

A  the small os trigonum (1) is a normal bony feature of the ankle not a sign of previous avulsion.

B  if the gap b/n the talar & tibial articular surfaces (2) are not circular & parallel even with careful positioning then there is subluxation & surface irregularities which may indicate arthropathy

C  anterior exostoses (3) on the Talus or Tibia are signs of stress anteriorly as in football kicking – posteriorly there may be alterations in the articular line (4) representing #s

D  generalized exostoses (5) & osteophytes (6) present around the joint indicate arthritic changes – along with narrowing and fuzziness of the joint line (7)
The Ankle – Inspection

Anterior

A  Scars & deformities – These may be due to previous operations – i.e. sinus drainage (1) or past fractures (2)

B  Posture deformities – plantar flexion – These may indicate shortened or ruptured tendons, partic the Achilles tendon or bone deformities generally congenital – Talipes deformity

C  Bruising & Swelling – Note if the swelling – oedema is uni or bilateral (indication of systemic disease), local or generalized

D  lateral egg-shaped lateral swelling – If this appears quickly – and is hard lateral and local – it indicates lateral lig tear
The Ankle – Inspection

Posterior

It is not possible to see a lot of the bony features from behind in the ankle because of the Archilles tendon tends to cover most of them. This is the longest (16cm) & strongest tendon in the body, essential to the functioning of the joint.

The best method to examine posterior ankle joint is to lay the patient prone on the bench & have the feet extended over the edge, comparing the normal side contour with the abnormal side.

A upper limb NAD / lower limb shows localized swelling (1) & an exostosis (2) of the Calcaneus – (Hagland’s deformity) often associated with tendinitis of the Achilles tendon.

B in Achilles tendon rupture the tendon contour is obviously disturbed (3)
The Foot
The Big Toe – Toes Inspection

Toes show a number of deformities generally more exaggerated on the big toe but most occur in any 1 or more toes –

**Hallux Rigidus** = OA of the 1st MTP of the big toe will show up with thickening of the jt (1) or a fixed flexion deformity (2) with a bunion due to poor foot posture on the sole (7). This is a common site for gout and other articulate arthropathies.

**Claw toes** if generalized indicate a primary neuromuscular problem or local intrinsic muscle problem – extended forefoot (8) with a fixed flexion of the IP jts (9)

**Corns** hard on the external surfaces (10) or soft (11) when b/n toes can occur anywhere distinguished from bunions in that they do not occur at pressure sites

**Hammer toes** – have fixed flexed PIP jts (12)

**Mallet toes** – have fixed flexed DIP jts (13)

**Curly toes** – are due to a form of fixed flexion in the IP & MTP jts (14)

  grade 1 – mild (14i)

  grade 2 – showing some over or under-riding (14ii)

  grade 3 – severe – concealing all of the nail from the dorsum (14iii)
Toe nails may be painful for several reasons associated with inflammation, malformation and trauma.

- deformed toenail = onychogryphosis (15)
- ingrown toenail (16)
- texture roughened (17)
- elevated – due to subungual exostoses (18)