Practical Guide to Casting

Author: Matthew Pitt
Senior Orthopaedic Practitioner

General Anatomy

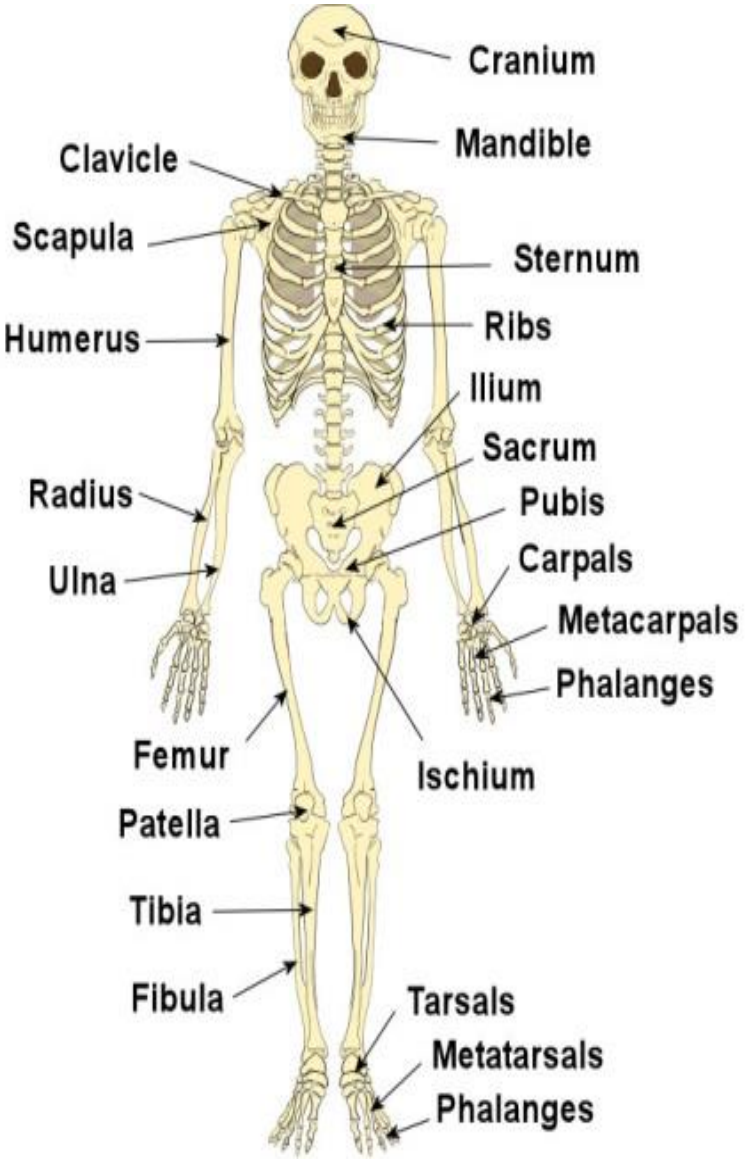
Locomotor System :

The locomotor systems are those which enable a person to move about, change position, hold articles and handle tools.

They are:

- The Skeletal System of bones and Joints
- The Muscular System
- The Nervous System

The Skeletal System



The Skeletal System is formed of the bones of the skeleton, symmetrically arranged. It is divided into:

- **Appendicular skeleton**, comprises the bones of the upper limb and shoulder girdle clavicle and scapula and the lower limb pelvic girdle

- The **Axial skeleton,** comprising bones of the trunk and head.

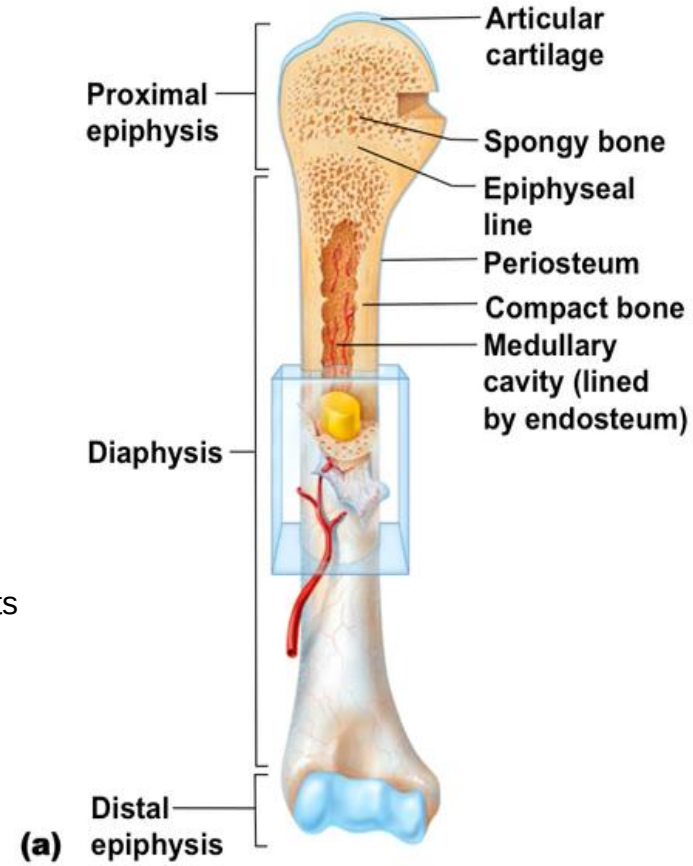
The skeleton has the following functions:

- It forms the framework of the body
- It is arranged to give protection to vulnerable tissues, e.g brain, lungs, heart, spinal cord
- It gives attachment for muscles which bring about movement or maintain posture.
- It takes part in the formation of joints
- It supports and maintains posture of the body
- It is concerned with the use of the calcium in the body and formation of various blood cells

General Anatomy

Structure of Bone

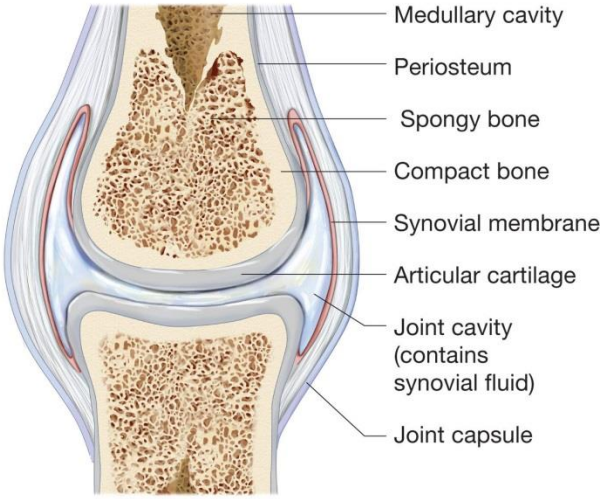
Bone is formed of protein substances, 33% of which is collagen and minerals and salts, primarily calcium phosphate and carbonate, which together make it both strong and resilient. Bone integrity is Maintained by bone cells, osteoblasts or Bone builders and osteoclasts bone consumers. It is a balance between osteoblastic and osteoclastic activity that ensures healthy strong bone. The surface layer, or compact bone, is smooth and rigid and gives the individual bone its strength.



Joints are sites where two or more bones meet. They are classified as fibrous, cartilaginous or Synovial joints according to the substance separating the bones within the joint. Of most interest to the Plaster Room staff will be synovial joints because they are mostly freely-movable and hence disease prone.

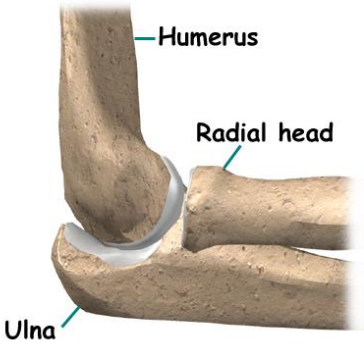
General Anatomy

Synovial Joints



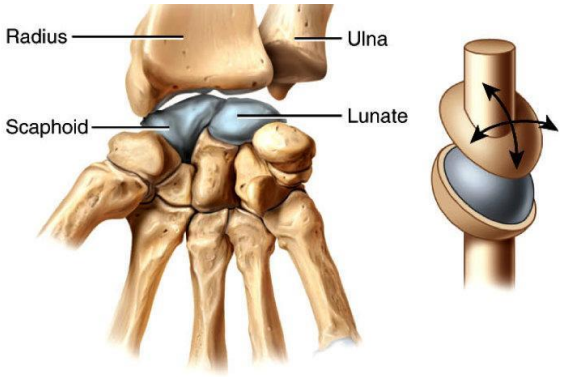
The articulating bone surfaces are smooth and covered with articular cartilage. In healthy joints, the two surfaces of cartilage are in contact with each other and are lubricated by a thin film of synovial fluid. Synovial fluid nourishes and lubricates the intra-articular surfaces. A sleeve of strong fibrous tissue – **the capsule –** holds the two bones together and surrounds the joint

Single Hinge Joint



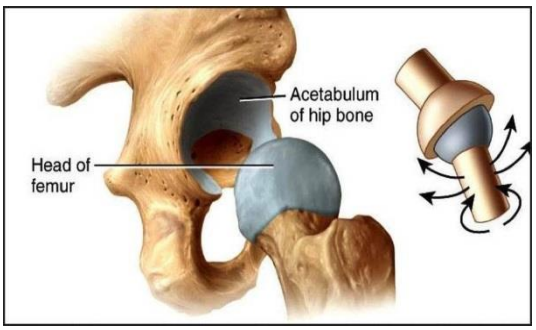
Usually comprises two bones and moves in one plane, e.g. elbow joint or ankle

Composite Hinge or Condyloid Joint



Two bones capable of moving in More then one plane, e.g. wrist

Ball and Socket Joint



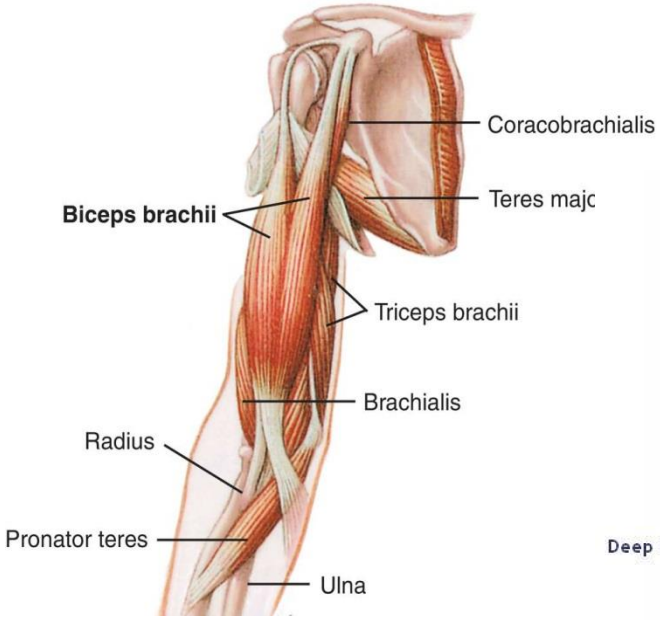
Rounded head on bone fits into a cup shaped cavity on articulating bone, e.g. hip joint or shoulder

General Anatomy

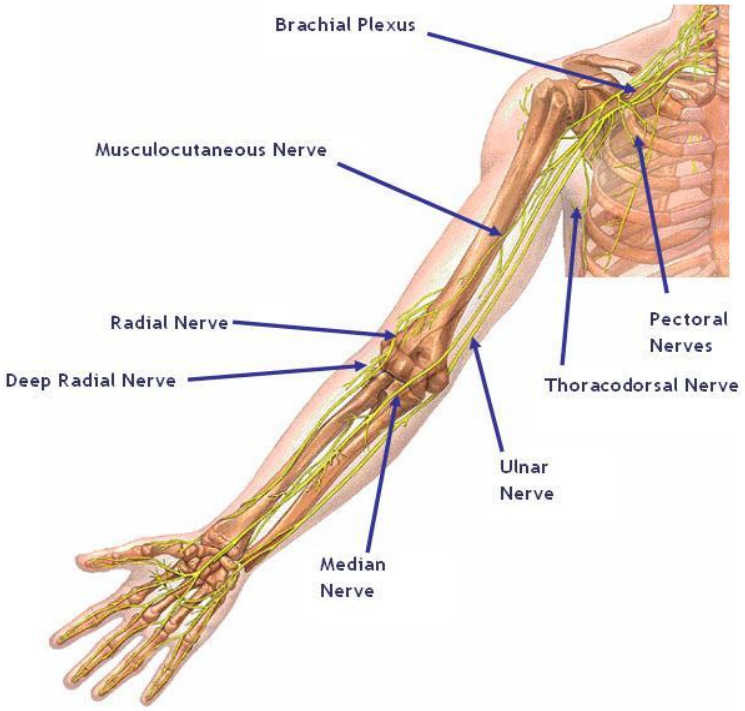
The Muscular System

The principle characteristics of skeletal muscle are contraction (shortening) and extension (lengthening). A muscle consists of the belly or fleshy part of the muscle and usually a tendon for attachment to bone. The muscle must cross a joint in order to bring movement of that particular joint.

Extension of one muscle is usually brought about by contraction of its opposing muscle. This is the simple basis of movement for example, if you flex the elbow joint by contracting biceps brachii and brachialis, the triceps, their antagonist will extend.



Nervous system of the arm



Peripheral nerves which lie close to the surface are vulnerable especially to the application of casts and splints. This can result in temporary or permanent disability, especially the ulnar nerve, radial nerve and median nerve after applying a Below elbow or above elbow casts.

Terminology

- The **Root** of a word can comprise any part of a word, but always has the same meaning
- A **Prefix** is the opening group of letters in a word that direct its meaning
- A **Suffix** is the closing group of letters in a word that direct its meaning

Root	Meaning	Example(s)
Arthro-	Joint	Arthritis
Chondro-	Cartilage	Chondroma
Haem	Blood	Haemarthritis
Osteo	Bone	Osteoarthritis
Patho	Disease	Pathology
Myo	Muscle	Myositis ossificans
Cyst	Sac	Bone cyst
Ped/pes	Foot	Pes planus/talipes

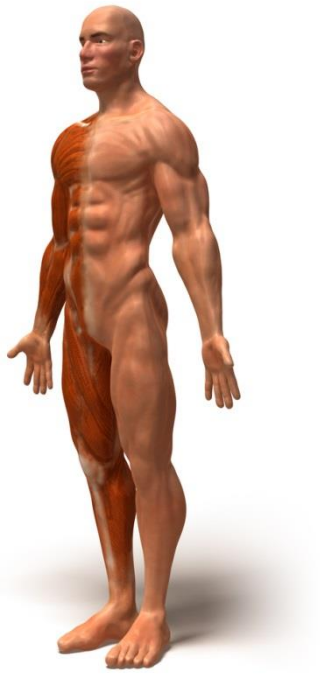
Terminology

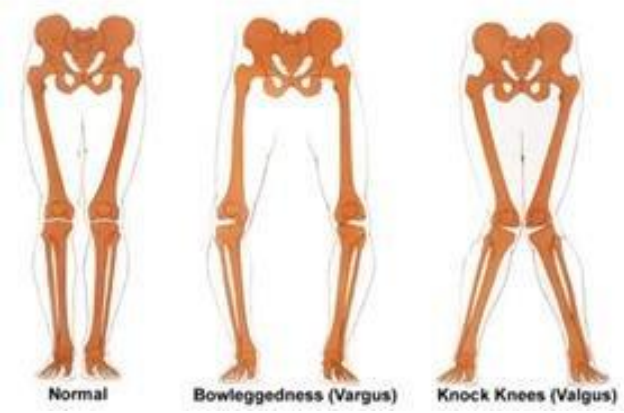
Prefixes	Meaning	Example(s)
Ab	Away from	Abduction
Ad	Towards	Adduction
Bi	Two	Bilateral / Bi-Valve
Epi	On or Upon	Epicondyle
Intra	Within	Intravenous
Infra	Below	Infraspinatus
Pseud	False	Pseudarthritis
Sub	Under	Subperiosteum
Supra	Above	Supracondylar
Suffixes	**Meaning**	**Example(s)**
-algia	Pain	Neuralgia
-osis	Condition/disease	Neurosis
-desis	Surgical Stiffening	Arthrodesis
-ectomy	To remove / excision	Appendectomy
-itis	Inflammation of	Arthritis
-oma	Tumour	Myeloma / Sarcoma
-plasia	Develop/formation	Achondroplasia
-tomy	Cutting into	Osteotomy

Anatomical Position

- The Anatomical position = the subject in the upright position facing the observer with feet flat on the floor, arms by the side, palms facing forward

Anterior	To the front
Posterior (dorsal)	To the back
Proximal	Nearest to the trunk
Distal	Farthest away from the trunk
Superior	Above
Inferior	Below
Medial	Part nearest to the midline
Lateral	Part farthest away from midline
Plantigrade	Planti-grade- position of foot when standing with sole & heel touching the ground
Optimum	Best possible position in the circumstances
Valgus	The distal part of the bone is bent or twisted away from the midline of the body.
Varus	The distal part of the bone is bent or twisted towards the midline of the bodv.



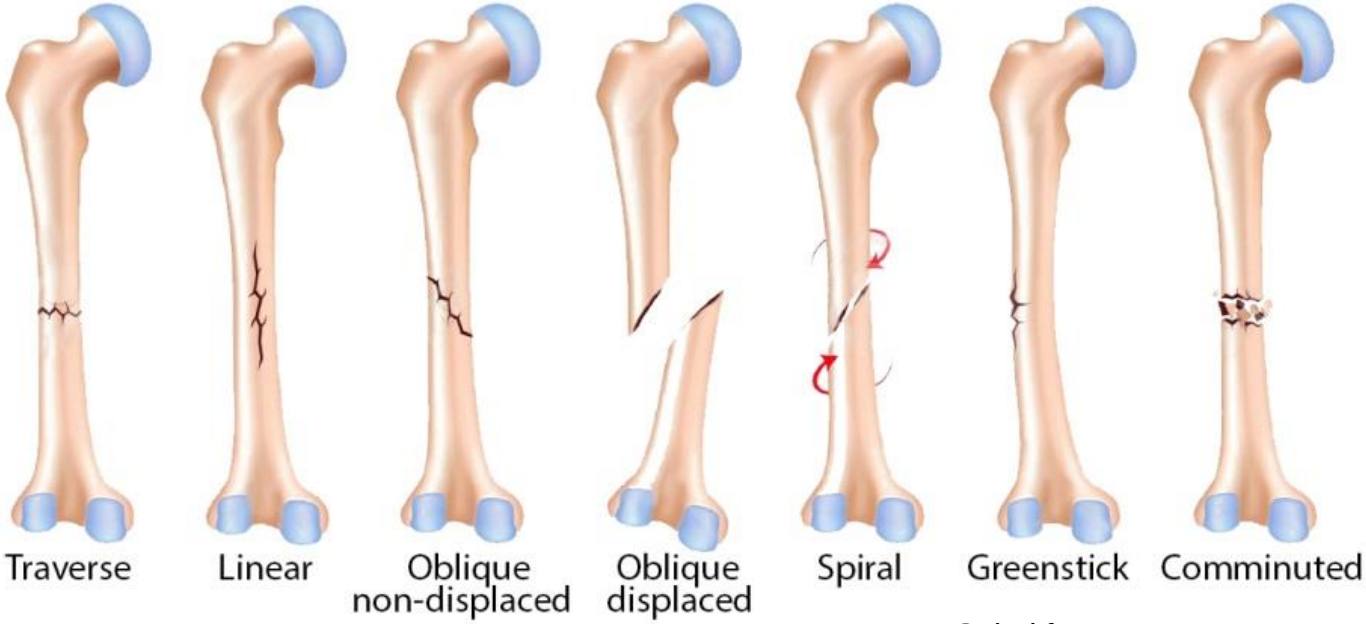


Movements at Synovial Joints

Flexion	Decrease in the angle between the surfaces of articulating bone
Extension	Increase in the angle between the surfaces of articulating bone
Hyperextension	Continuation of extension beyond the anatomical position
Abduction	Movement away from the midline
Adduction	Movement towards the midline
Circumduction	Combination of flexion/extension/abduction/adduction in succession to produce the circular movement of the distal end
Inversion	Movement of the soles of the feet inwards so they face each other
Eversion	Movement of the soles of the feet so that they face away from each other
Dorsiflexion	Movement of the foot/hand upwards in the direction of the dorsum (upper surface)
Plantarflexion	Movement of the foot downwards in the direction of the plantar (sole) surface. Sometimes referred to as Equinus
Palmarflexion	Flexion of the wrist so the palm is towards the forearm
Supination	Movement of the forearm in which the palm is turned anteriorly or upwards (palm to sun)
Pronation	Movement of the forearm in which the palm is turned posteriorly or downwards
Opposition	Opposing i.e. when the thumb is adducted to oppose the fingers

Fractures

A fracture is defined as a **'break in the continuity of a bone**'. In layman's terms a fracture is a break, and break is a fracture. Often the bone is broken completely across, occasionally, the break is only one side of the bone, and we may describe such a fracture to the patient as "greenstick fracture". These incomplete greenstick often occur in children.



Transverse Fracture

Oblique fracture

Spiral fracture

Basic Rules of Casting

Application of casts:
In order to apply an effective cast the practitioner should check the manufacturer's instructions/recommendations for the application of their specific product.

Stockinette:
Is widely used to provide comfortable lining for casts **but it need not be used** if swelling is expected, for example following manipulation, new injuries or if its application would cause undue pain.

Padding:
Natural or synthetic materials should be chosen with the holistic needs of the patient in mind and it should be applied evenly. **One layer** should be sufficient with a 50/50 overlap, **too much padding can cause additional problems e.g. rucking of fabric or a loose cast**. Special attention should be made to bony prominences and orthopaedic felt should be used to off-load pressure.

Crepe Bandage:
The appropriate size crepe bandage should be chosen and **submerged into the water** prior to application of any of the plaster of paris slab. By wetting the bandage you create a stronger bond making the slab stronger and preventing loose bandaging which can come off when clothes are taken on and off.

Plaster of Paris Bandages / Slab:
Should be dipped in water according to the manufacturers recommendations. The water should be cool to tepid. Very cold water will slow the setting process and very hot water can potentially burn the patient. **All casting materials create their own heat (exothermic reaction) as they set/dry.**
Firstly choose the desired width required to adequately immobilise (support) the limb. Roll out your plaster of paris bandage creating a 6 to 8 layer slab. When placing onto the limb gently mould to conform it correctly and smooth it out, do not press or pinch in as this could create a pressure area. Turn back the stockinette if used, catching it in the last layer of bandage. Be careful not to pull the casting bandage back with the stockinette as this will create a crease at the edge. Hold the casted limb in the desired position until set, then rest on a pillow. Any further trimming can now be done to expose joints not requiring immobilisation. The drying time is between 24-48 hours depending on thickness.

Basic Rules

Care of the patient: Check the patients details and written medical prescription/request. Give reassurance, explanations and request permission from the patient to proceed. Children need a trusted adult with them for their comfort and support.

Assess the patient:

What is the pathology?
Why is the cast being applied?
Is there an underlying condition that may affect the way you apply the cast, e.g. diabetes, rheumatoid, neurological impairment or allergies?
Look at the skin. Is there a wound or redness?
Which bony areas will need extra padding?
Where are the blood vessels or nerves that are close to the surface and maybe compromised?
Is swelling expected?

Based on the answer to these questions, decide on the appropriate padding and materials required, having them all laid out on your trolley ready.
Check the medical prescription/request again

General Preparation of the Patient

- Explain the procedure in order to gain the patients co-operation, reduce stress and increase the patients understanding of their injury/condition
- Maintain dignity and privacy and protect clothing, appropriately screen and cover the patient prior to the procedure
- Remove any rings or jewellery and nail polish from the effected part, because of swelling and discolouration after injury or surgery there may be a risk of masking signs or sudden recurrence of swelling. These should not be replaced until the cast is removed
- Position the affected limb in the prescribed position, promoting the best functional position for healing. This must be held and maintained until the cast is dry, by an assistant if necessary

Cast Complications

“PREVENTION IS BETTER THAN CURE!”

A cast being applied too tightly, this may effect:
VEINS – constriction will compress the walls of veins causing swelling, discomfort and pain. The skin feels warm and looks blue and there is blue colour under their nails. Elevation of the limb and exercise of the digits can be tried but the cast needs to be split or bi-valve.

ARTERIES – **are usually involved due to the injury and not the cast.** In arterial compression the limb will become pale and there will be paraesthesia. The limb will be cold and pulses may be difficult to palpate. When pressure is applied to the finger nail, the colour does not return. Immediate medical help must be obtained. Splitting the cast or bi-valving is urgent.

NERVE COMPRESSION – gives pins and needles sensation then limitation of movement and pain, elevation and exercise may relieve this however if it persists after 20 mins of observed exercise, medical advice should be sought.

INSUFFICIENT or inappropriate padding – insufficient padding may not protect the skin. Too much padding will rub up and crease inside the cast causing uneven pressure and discomfort.

UNEXPECTED excessive swelling – will cause the same signs and symptoms as those caused by a cast being applied to tight.

BANDAGES being applied with twisting or tension – this will cause uneven pressure and ridges in the cast which in turn may cause plaster sores

Pressure on superficial nerves and blood vessels – As well as nerve compression, pressure over superficial nerves may have serious consequences, for example: insufficient padding over the head of the fibula may damage the lateral popliteal/ common peroneal nerve causing foot drop

Plaster Sores – Occur when skin presses directly onto bone. Foreign bodies inside the cast will cause plaster sores, with children inserting small toys or coins into the cast

Cast Complications

Compartment Syndrome

A compartment consists of muscle, blood vessels, nerves and tendons. All these are covered within a inelastic fascial tissue.

Compartment Syndrome is where there is raised pressure within a muscle (an Osteo-fascial) compartment.

CAUSES:-

1.From direct arterial injury, fractures or soft tissue damage. Compartment pressure increases due to bleeding and or oedema and swelling within the facia

2.From burns, frostbite, limb compression or constrictive cast and or dressings. Compartment volume decreases, due to constriction, raising pressure within the compartment.

3.Combination of 1 and 2

Pressure within the compartments compromise the blood supply leading to ischemia of the affected muscles.

SITES:

There are many muscle compartments within the body, most being in the extremities.

The most commonly effected sites are the lower limb and forearm.

SIGNS AND SYMPTOMS:

Symptoms can occur within 2 hours to 6 days following incidence. The first 12 to 24 hours following injury is the most common. Symptoms lasting longer than 6 to 8 hours can result in permanent damage.

PAIN:

Severe and inappropriate to the injury and not controlled by normal levels of analgesia

Increased on passive ‘stretch of he affected muscle’

PALLOR: Pale skin tone

PULSE:

May be present, gradually weakening or absent

PARATHESIA:

Pins and needles, sensation altered and blunted progressing to:-

PARALYSIS:

Loss of movement indicates permanent damage

MANAGEMENT:

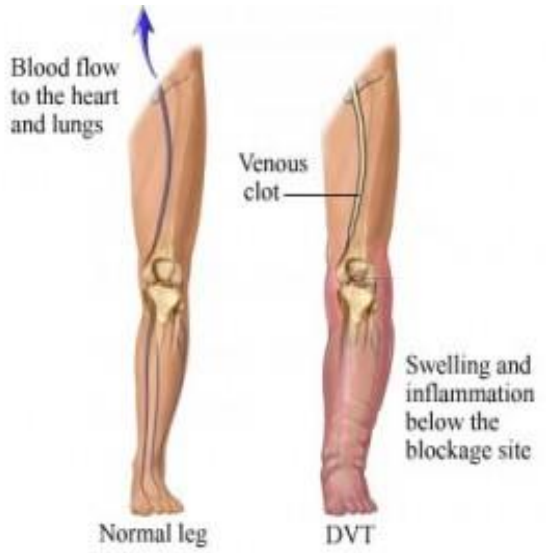
Elevate the limb – with caution – only to heart height

Contact medical team

Split cast and dressings to skin

Complication in cast

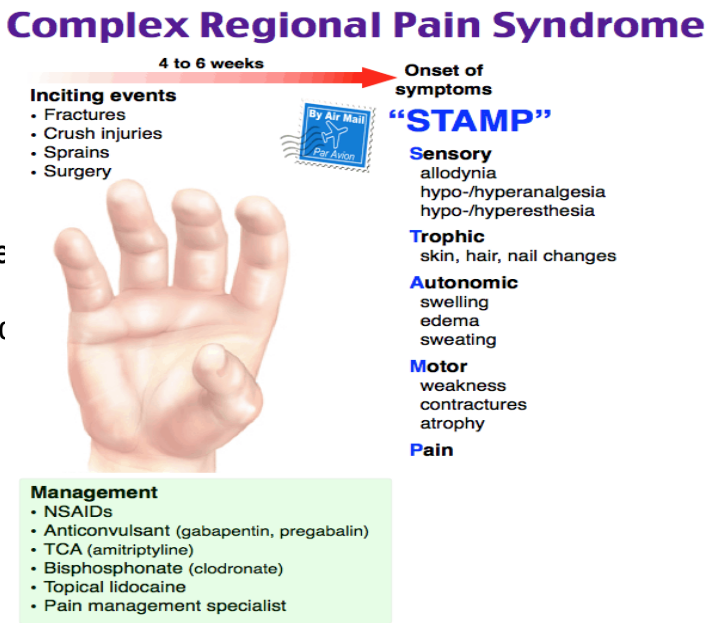
Venous Thromboembolism (VTE)
Patients having a lower limb cast applied should be assessed for VTE risk



Deep Vein Thrombosis (DVT)
Signs and Symptoms:
Pain in calf
Oedema
Sometimes redness
Pain on palpitation
Pain in the calf on dorsiflexion of the foot

Pulmonary Embolism (PE) – blood clots in the lungs
Signs and Symptoms: Chest pain on breathing in, Heamoptysis (coughing up blood)

Complex Regional Pain Syndrome
Pain and stiffness
Hand or foot is puffy, discoloured and moist



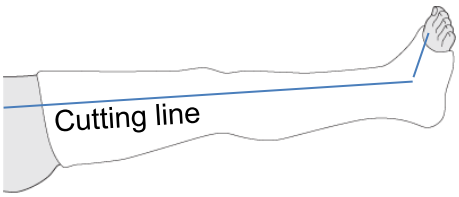
Problems of Union:
Mal union may cause deformity or shortening of the limb
Delayed or slow union
Non-union

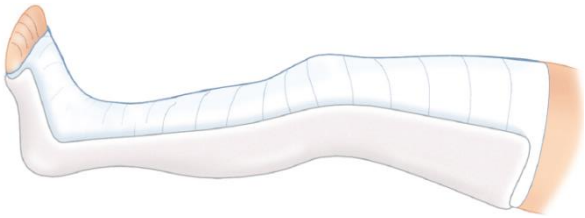
Removal or Splitting of Casts

Explain and Reassure Patient:
Show the saw on the palm of your own hand and demonstrate oscillation

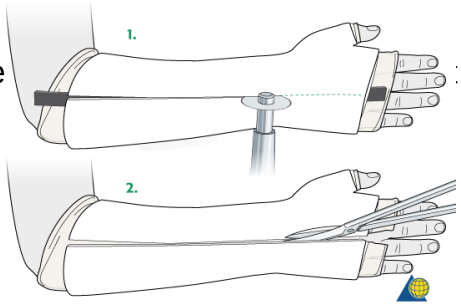
Splitting of the cast to relieve pressure/swelling:
- Do one single cut along the length of the cast
- **Do not just cut partway along its length or cut out a 'V' shape. Fluid will spread through the area with no relief of swelling or tightness**

Draw cutting lines on the cast:
- Avoid bony areas
- Avoid blood stained areas if possible
- Bivalve (follow your lines each side of the cast to leave the posterior half for use as a resting splint)





Saw Technique:
Cut with the saw using an in and out motion holding the
Beware the blade gets hot enough to burn the skin:
- If you drag the blade along the cast
- through prolonged use
- If the cast is thick
- On large cast (Above knee, Hinge cast brace)
- If the blade is blunt (rotate regularly)
- Recently applied (still drying)



If the patient moves or complains:

ALWAYS BELIEVE THE PATIENT

Use spreaders to carefully separate the cast and scissors to cut the padding
SKIN CARE:
Check the limb for signs of pressure

Indications and Treatment

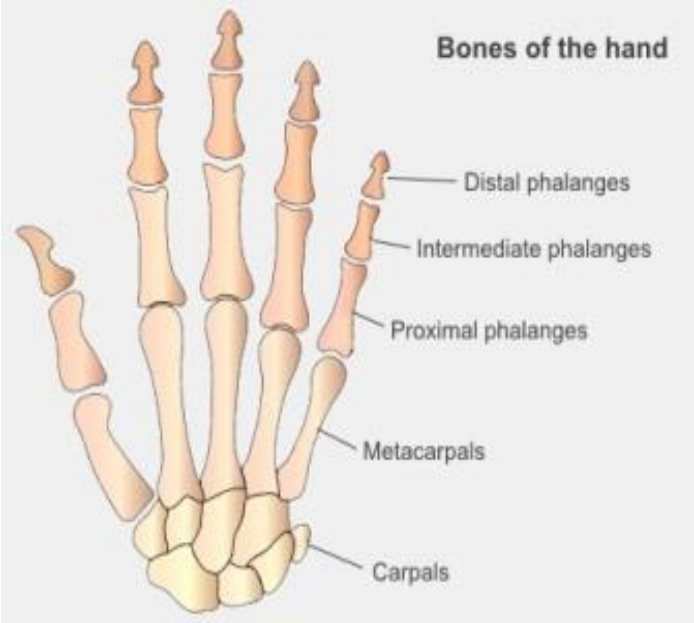
Fracture Site	Treatment
Humeral Shaft	Collar & Cuff/ Humeral Brace
Supracondylar	Above Elbow Back Slab
Olecranon	Above Elbow Back Slab
Dislocated Elbow	Above elbow Back Slab
Radius and Ulna Distal 3rd and up	Above Elbow Back Slab/Sugar Tong
Distal Radius & Ulnar	Below Elbow Back Slab Neutral
Distal Radius & Ulnar 'Colles' type	Below Elbow Back Slab palmar flexion/ulnar deviation
Distal Radius & Ulnar 'Smiths' type	Volar slab wrist hyperextended
Scaphoid	Scaphoid Back Slab/Below Elbow
Achilles Tendon Rupture	Dorsal Slab in equinus
Calcaneus	Below Knee Back slab
Medial/Lateral malleoli (mortice and above)	Below Knee Back Slab
Tri-malleolar	Below Knee Back Slab
Tibia and Fibula Mid Shaft	Above Knee Back Slab / Above Knee Full Cast Split
Talus	Below Knee Back Slab
Metatarsals	Below Knee Back slab
Patella/Tibial Plateau/ Distal femur	Above Knee Back slab

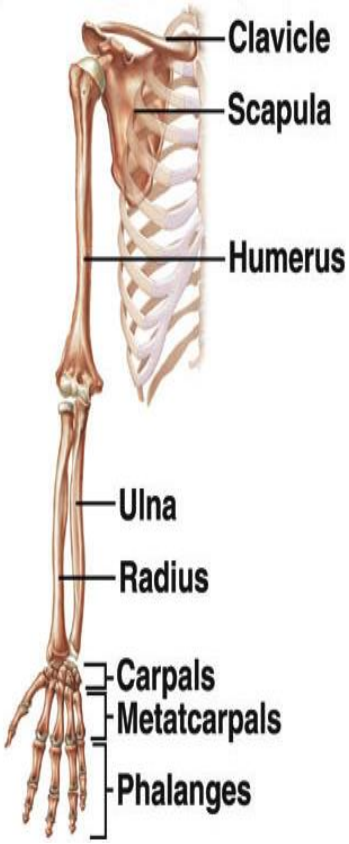
Anatomy of the Upper Limb

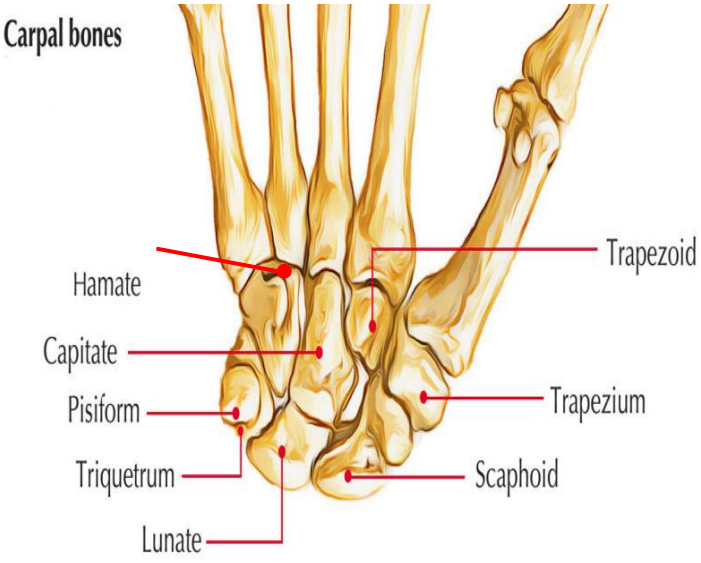
It is made up of bones, muscles and joints:

- **Thumb, Fingers and Hands** – Phalanges and Metacarpals
- **Wrist** – Carpals
- **Forearm** – Ulna and Radius
- **Arm** – Humerus
- **Joints** – Interphalangeal, Metacarpal – Phalangeal, Carpo-metacarpal, Wrist, Radio-ulnar, Elbow and Shoulder

Bones of the fingers, thumb and hand







Bones of the Wrist

Fractures of the hand

Fractures to the 4th & 5th metacarpals

Fractures of the 3rd & 4th metacarpal

Our Vision
To provide every patient with the care we want for those we love the most

Norfolk and Norwich University Hospitals NHS
NHS Foundation Trust

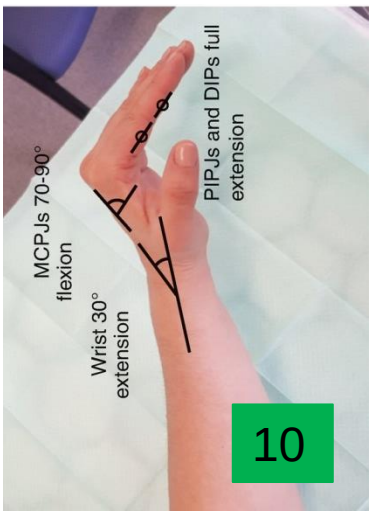
Fractures of Metacarpals

Volar Slab

Application Guide

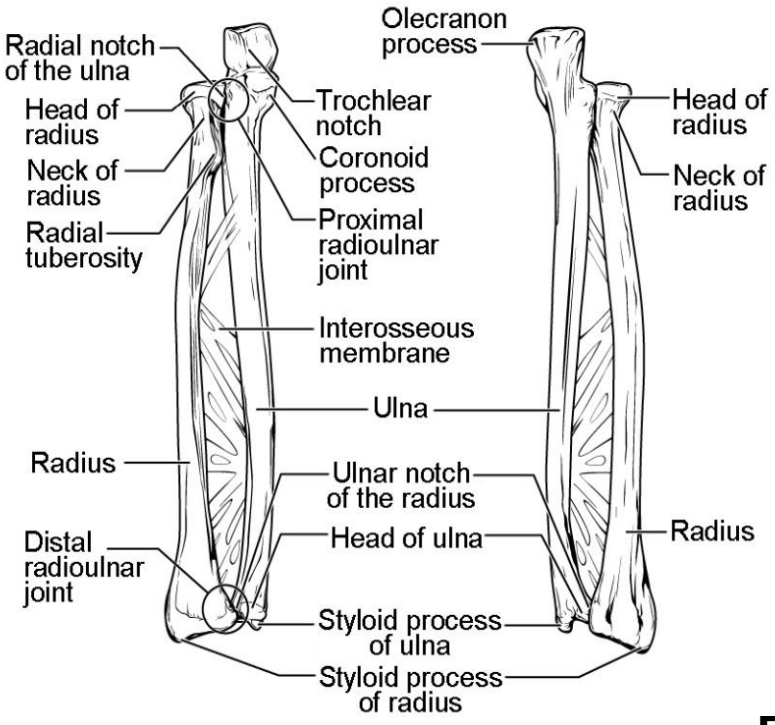
Materials Required:
1 x Length 5cm Stockinette
1 x Roll 7.5cm Sofban
1 x Roll 15cm Plaster of Paris
1 x Roll 7.5cm crepe bandage
Tape to secure

Casts of the Hand

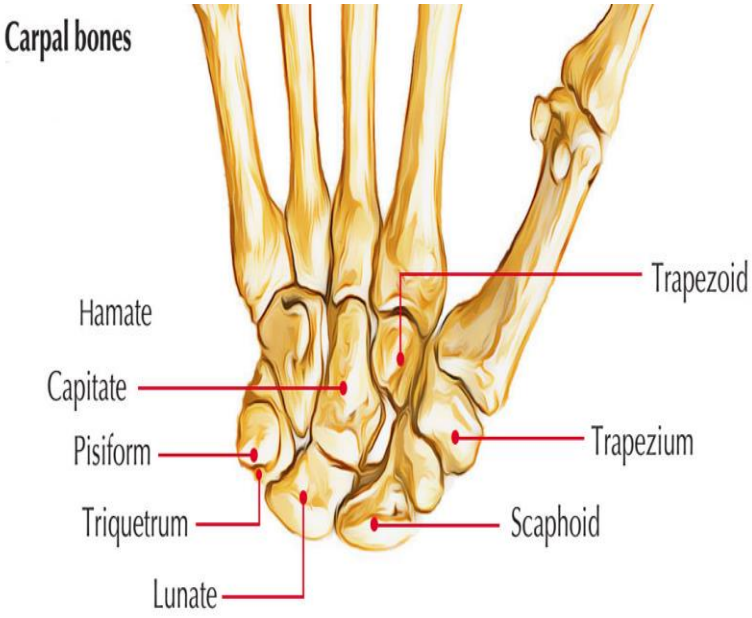


Anatomy of the Wrist and Forearm

Bones of the forearm



Bones of the Wrist



Fractures of the Wrist and Forearm

Distal Radius comminuted ‘Colles’ type

Distal Radius ‘Smiths’ type #

Scaphoid Fracture

Distal radius ‘Greenstick’, Torus #

Mid Shaft Ulna fracture
‘Night stick’

Olecranon fracture

Our Vision
To provide every patient with the care we want for those we love the most

Norfolk and Norwich University Hospitals NHS
NHS Foundation Trust

Casts of the Wrist

Below Elbow Back-slab

Application Guide

Materials Required :

1 x length of 5cm stockinette
1 x Roll of 7.5cm sofban
1 x Roll of 7.5cm Crepe bandage
1 x Roll of 15cm Plaster of Paris

Indications:
Distal Radius fractures
Ulna styloid
Distal Radius 'Colles' type
Distal Radius Greenstick/Torus
Scaphoid

- Apply the Sofban using a 50/50 overlap
- Measure the Slab from the base of the knuckles to two fingers from elbow crease
- Use 6 to 8 layers
- Cut a half circle for the thumb area
- Secure slab using wet crepe bandage under slight tension

Our Vision
To provide every patient with the care we want for those we love the most

Norfolk and Norwich University Hospitals NHS
NHS Foundation Trust

Casts of the Wrist and Forearm

Above Elbow Back Slab

Application Guide

Materials Required:

1 x Length of 7.5cm Stockinette
2 x Rolls 7.5cm Sofban
2 x Rolls 7.5cm crepe bandage
1 x Roll 15cm plaster of Paris POP
1 x Roll 7.5cm plaster of Paris POP
More of the 15cm might be required for larger arms

Indications:
Distal Humeral fractures
Supracondylar
Olecranon
Dislocated Elbow
Radius and Ulna distal 3rd up
Ulna Nightstick Fractures
Radial Head

- Unless otherwise stated make sure the elbow is held at 90° degree angle
- Sofban should be applied with a 50/50 overlap
- Be aware of bony prominences
- Medial and Lateral supporting slabs need to be 6 to 8 layers thick
- Back Slab needs to 6 to 8 Layers thick

Casts of the Wrist and Forearm

Above Elbow Back Slab

Application Guide

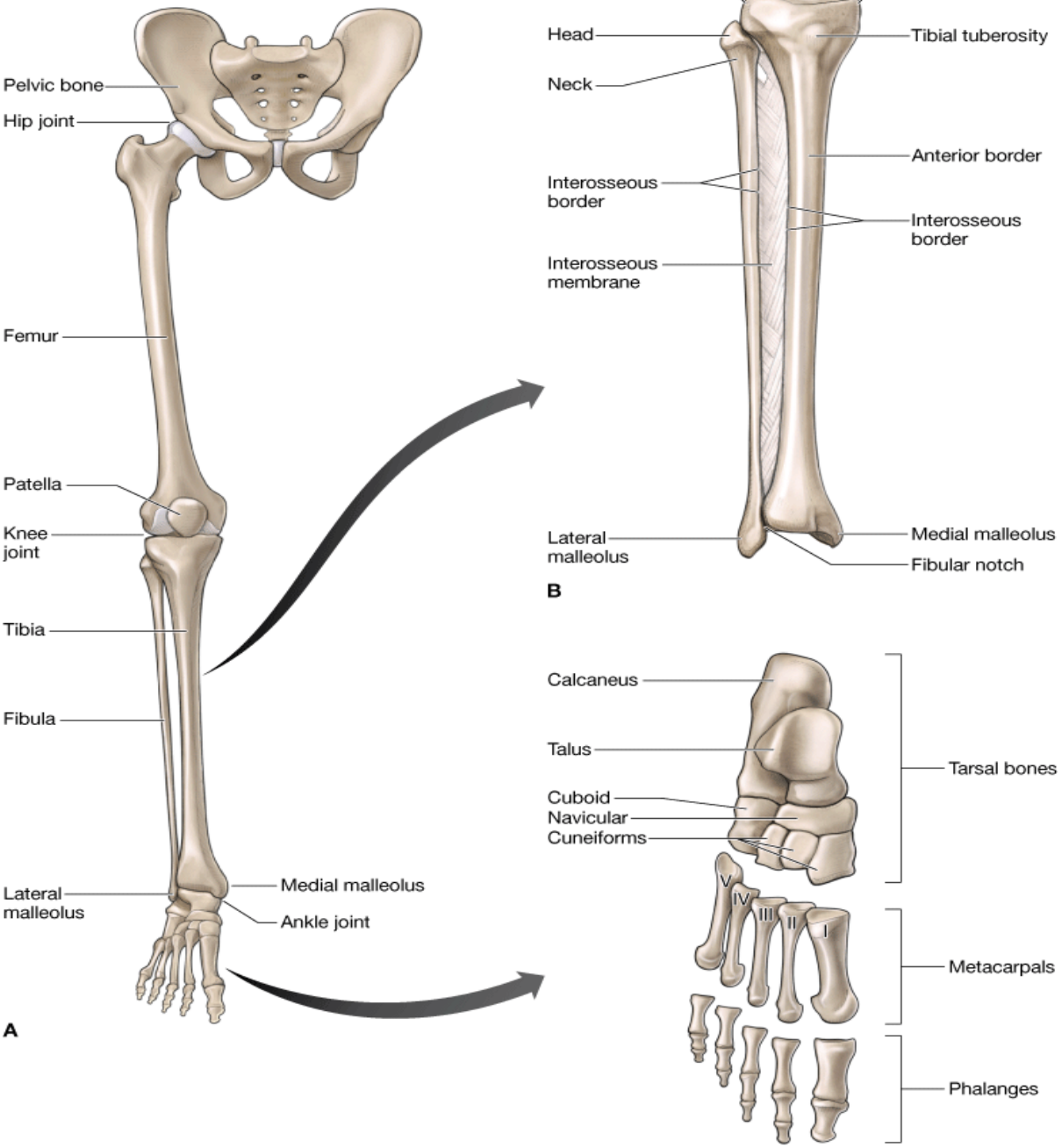
- Submerge slab into tepid water and squeeze excess water away
- Mould into position your two supporting slabs medially and laterally
- Mould back slab into position finishing three fingers away from the arm pit and to the base of the 5th Metacarpal
- Apply your wet crepe bandage using 50/50 overlap using light tension and secure with tape

Anatomy of the Lower Limb

Bones of the lower Limb, Feet and Toes

The lower limb is constructed to carry the body weight and to move the body from place to place

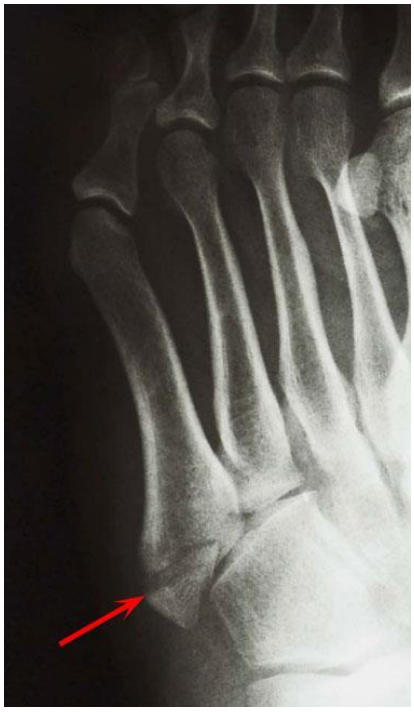
The lower limb comprises the thigh, lower leg, ankle, feet and toes



Fractures of the lower limb

Spiral Tibia fracture including Fibula

Comminuted Tibia plateau fracture including fibula head



Avulsion fracture base of 5th

Calcaneus fracture

Medial Malleolus and distal fibula

Our Vision
To provide every patient with the care we want for those we love the most

Norfolk and Norwich University Hospitals NHS
NHS Foundation Trust

Below Knee Back slab

Below Knee Back Slab Application Guide
Materials Required:

1 x Length of 7.5cm stockinette
2 x Rolls 15cm sofban
2 x Rolls 15cm Plaster of Paris P.O.P
2 x Rolls 10cm Plaster of Paris P.O.P
2 x Rolls 15cm crepe bandage
POP width dependent on leg size

Indications:
Ankle fractures, navicular, talus, malleoli
Metatarsal fractures
Calcaneus fractures
Soft Tissue injuries

Below Knee Back slab

- Apply the stirrup moulding and smoothing into the leg
- Make sure the ankle/foot is still at 90 degrees
- Apply the back slab leaving the knee crease free moulding and smoothing the two slab together
- Turn back your stockinette
- Apply your crepe bandage using a 50/50 overlap. Secure in place with tape or additional POP. Make sure you have not joined edges together preventing swelling.

Below Knee (Equinus) Anterior slab

Achilles Tendon Dorsal Below Knee Slab

Materials Required:
1 x length 7.5cm stockinette
1 x Roll 15cm Sofban
2 x Rolls 15cm Plaster of Paris or 1 x 20cm
2 x Rolls 15cm crepe bandage or 1 x 20cm

Casting Standards
British Orthopaedic Association

Casting, the application, adaption and removal of patients casts, is a **SKILL** requiring knowledge and judgement, not forgetting sensitivity, in order to safely care for the patient.

Casting is not solely carried out by orthopaedic practitioners, but nurses and other members of the multi-professional team.

Whilst most casting takes place in the Plaster Room many patients are cared for with Emergency Department, Minor Injury Units and other clinical areas. It is hope that practitioners working within these areas will be able to use the guidelines to help develop local standards which specify the resources they require, the methods that they will use and the outcomes that they should expect.

The care described in the standards is based on the patient's rights to be valued as a unique person and to retain control of their own self (DOH 2010, Mental Capacity Act 2005, NHS Wales 2010)

A patients needs can include deficits in their knowledge about why they need a cast and care of themselves in a cast, biological crises, difficulties in the environment or restrictions imposed by treatment regimens, such as the inability to mobilise themselves in the usual way.

The standards within this document are not new. Instead they represent practice that the British Orthopaedic Association Casting Committee (BOACC) believes should be integral part of care. The standards have an audit protocol, which identifies a method by which actual care can be compared with the recommended standards.