



" Human Biomechanics - Kept Simple "



By Gareth Milner BSc (Hons) Ost.

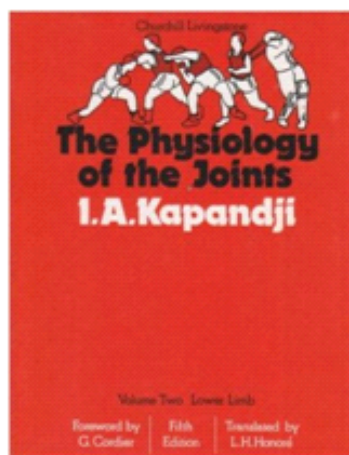
Director of Osteopathic Solutions Ltd

This Blog will help you to understand the movements we can do across our body. It will also give you an understanding on how some of these movements can combine to lead to musculoskeletal disorders whilst manual handling inanimate loads. If you are a Manual Handling Instructor (Trainer) for your business, reading this Blog will help enhance your workforce manual handling training i.e. make you a better Manual Handling Instructor (Trainer).

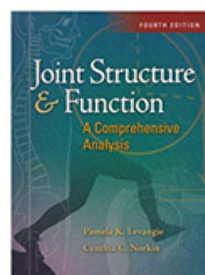
Biomechanics definition:

‘The mechanics of biological and especially muscular activity, as in locomotion or exercise’

I first started to learn Biomechanics in my first year of my Osteopathy degree. The first text I was introduced to was ‘The Physiology of the Joints by Kapandji’ by the Principal of the European School of Osteopathy Renzo Molinari. This was a good book but I did feel it overcomplicated the subject (hence the title of this Blog).



The best Biomechanics text I have ever read is ‘Joint Structure & Function’ by Levangie & Norkin. When reading this book it takes a lot of thinking and progressive understanding (Biomechanics is not a simple subject) but it is excellently written with a strong clinical reference, supporting the Osteopath, Chiropractor and Physiotherapist to provide an optimum standard of physical therapy treatment.



If you are interested in practical biomechanics of best practice manual handling techniques please watch our Manual Handling DVDs on www.osteopathicsolutions-manualhandling.co.uk/bespoke-manual-handling-dvd or on www.youtube.com/channel/UCH_C42lim74URI4NQboifvg

The Human Body is one linked biomechanical system, a tensile structure, but we will be looking at each joint area separately.

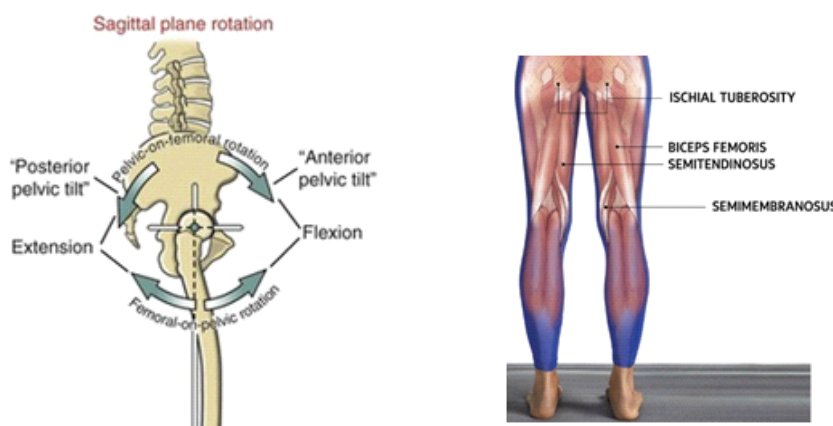
The Vertebral Column/ Spine

We will start with the spine as this is an Osteopath's 'bread and butter'. The spine has the following movements:

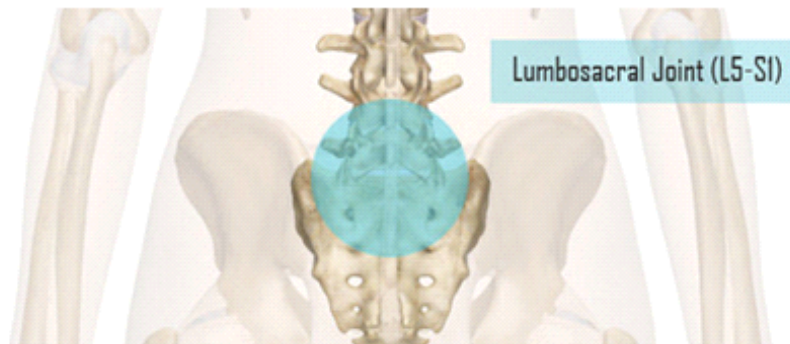


Forward Bending (or Forward Flexion)

Forward Bending. The middle person above is forward bending to the point where she can put her palms flat on the floor. This is essentially hypermobile, and having a hypermobile spine is just as irritating to the spinal joints as having a spine that is hypomobile i.e. stiff. A good flexibility is being able to touch the floor with your fingers when bending forward. The person to the right is bending her knees which slackens the hamstring muscles (right image below), which allows for more anterior pelvic tilt around the hip joint (with reference to the left image below).



The regions of the spine that are most mobile in forward bending are the lower neck (C5-C7) and the mid to lower lumbar spine (L3-L5). This is due to the shape of the joint surfaces in these regions, with the L5/S1 joint being the most mobile joint of the spine in flexion and extension, and not surprisingly the joint we manipulate as Osteopaths the most due to the joint being a major biomechanical pivot of the spine.



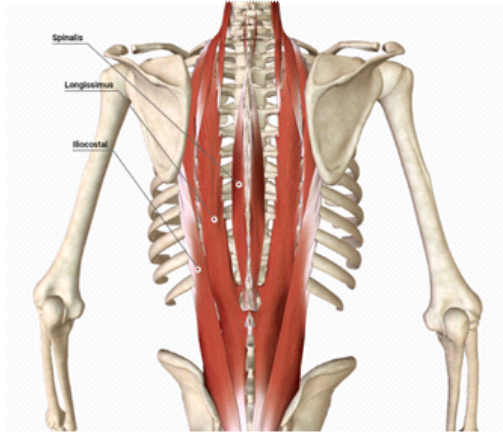
L5/ S1 Facet Joints

Forward bending is initiated by contraction of the abdominal muscles and is 'braked' by contraction of the back muscles (the erector spinae).

Backward bending is commonly viewed as a hazardous movement of the spine. Like any movement, if you push it too far then that is when muscle strains and ligament sprains can happen. The erector spinae muscles (image below) contract to cause a backward bend with the abdominal muscles 'braking' the movement.

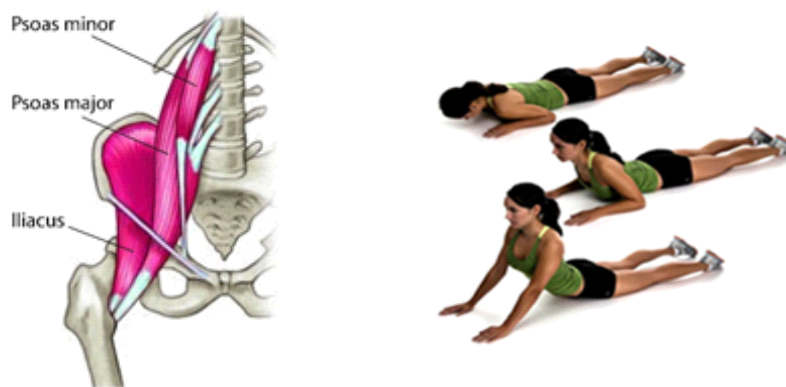


Backward Bending (or Extension)

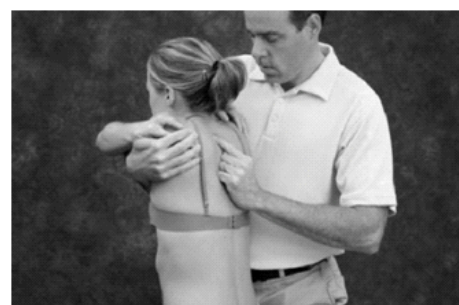


Simplified Image of the Erector Spinae Muscles

Being in the car for long periods is common practice in the UK (as I remember in the first 4 years of running Osteopathic Solutions), and after a long drive I recommend you gently backward bend your spine for 5-10 seconds to stretch the deep abdominal muscle Psoas Major as this muscle will have shortened during the seated driving position. The below stretch is a great way of improving your backward bending mobility and stretching the deep abdominal muscles, especially Psoas Major.

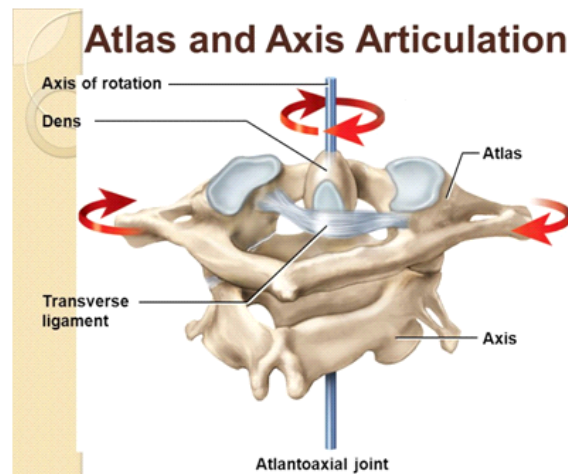


Twisting or in its clinical description, rotation is another spinal movement that is viewed as hazardous. Again, if you twist too far then yes it can strain spinal muscles and sprain spinal ligaments. The erector spinae and oblique abdominal muscles contract to cause spinal rotation. Within manual handling of loads twisting whilst forward bent, lifting or lowering a load increasing your chances of suffering from a lumbar disc injury. Are you unsure what best practice lifting technique is? Then watch our Bespoke Manual Handling DVD for British Pepper & Spice on our YouTube link <https://youtu.be/BEN1ick2fQY>

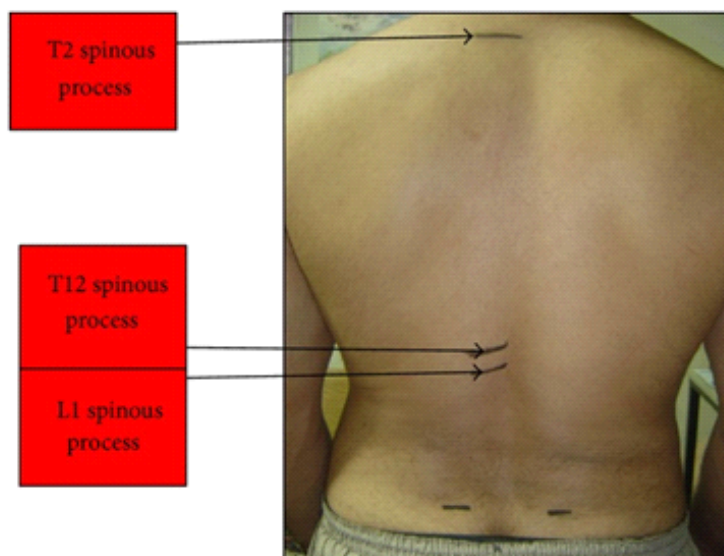


Above is an image of an Osteopath performing passive rotation of the Thoracic Spine

The parts of the spine that rotate most are the C1/C2 joint (upper neck), the Thoracic Spine (mid-back) especially at the Dorso-Lumbar (T12/L1) Junction. There is minimal rotation in the lumbar spine, especially at the L5/S1.



C1 (Atlas)/ C2 (Axis) Rotation

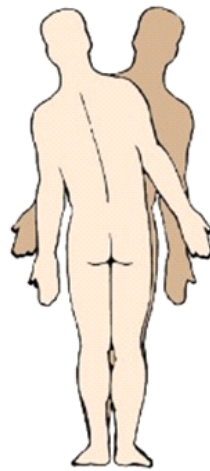


Lower Arrows pointing to T12/ L1 Spinal Segments

The image below is a side lying thoracic spine rotation exercise common to Pilates. I practice this as it is a great way to free up my thoracic spine which gets stiff due to my office seated role (although I do use a rising table) and a history of asthma. Before playing golf (whether on the range or hole 1), I perform a few minutes of spinal rotations. **Check out my Blog 'Biomechanics of a BackSafe Golf Swing' on this Blog page.**



Side Bending (or Lateral Flexion) can be performed to the left and right as shown in the image below. The Thoracic Spine is the area of the spine that is most mobile in side bending, especially from the T1 to the T9 spinal segments.

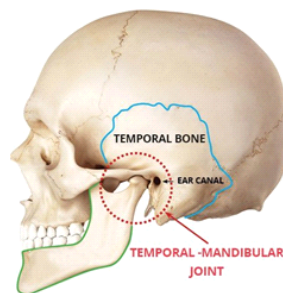


Concerning exercises to improve side bending of your spine at Osteopathic Solutions we do not recommend standing side bending exercises. We would recommend supine, prone and side lying stretching and pilates exercises.

Check out my Blog 'Self Help for your Back Pain' on this Blog page www.osteopathicsolutions-manualhandling.co.uk/osteopathic-solutions-blogs

The Temporomandibular (TMJ) Joint

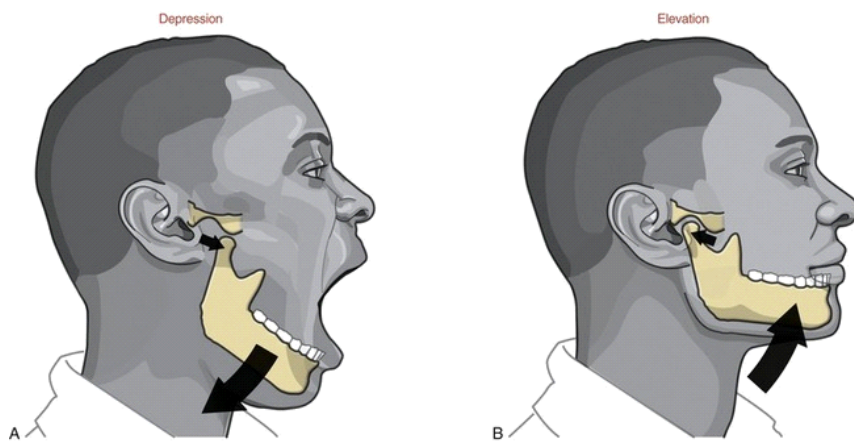
The TMJ joint is the articulation between the mandible bone and the temporal bone as shown below.



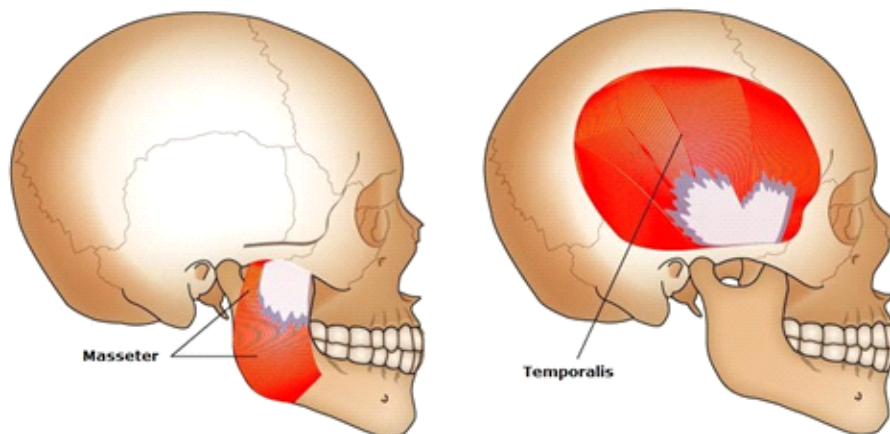
You can feel the movement in your own TMJ joints but placing your fingers in your ears as shown below.



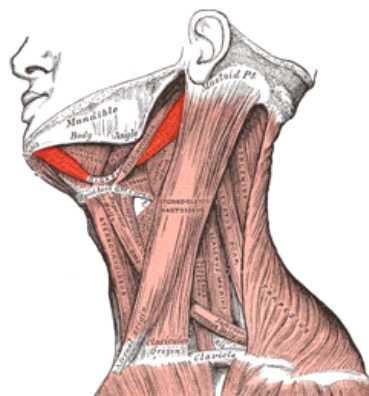
The main movements of the TMJ joints are mandibular (jaw bone) depression i.e. mouth opening, and mandibular elevation i.e. mouth closing.



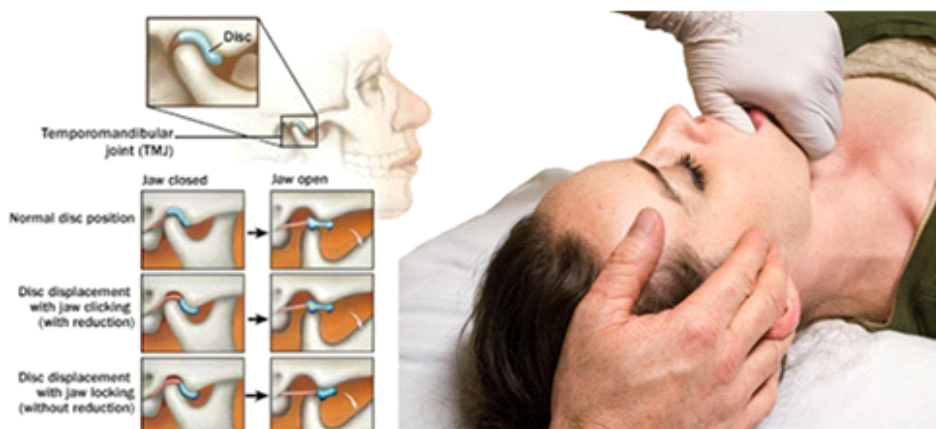
The main muscles that contract to elevate the jaw (B above) are the Masseter and Temporalis muscles.



The main muscle that contracts to depress the jaw (A above) is the Digastric muscle (shown in red on the below image).

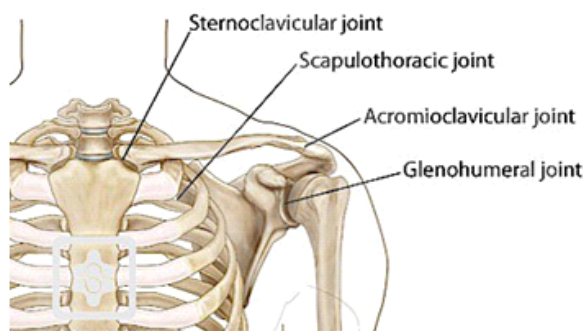


If you are getting chronic headaches and have been to your GP and possibly a Neurologist who have ruled out serious causes e.g. brain tumour, then TMJ dysfunction could be the cause. Possible causes of TMJ dysfunction include blows to the face, tooth issues, stress (causing grinding at night). Osteopathic assessment and manipulative treatment (shown below) could be the cure to these chronic headaches. To find your local Osteopath please view www.osteopathy.org.uk/register-search/



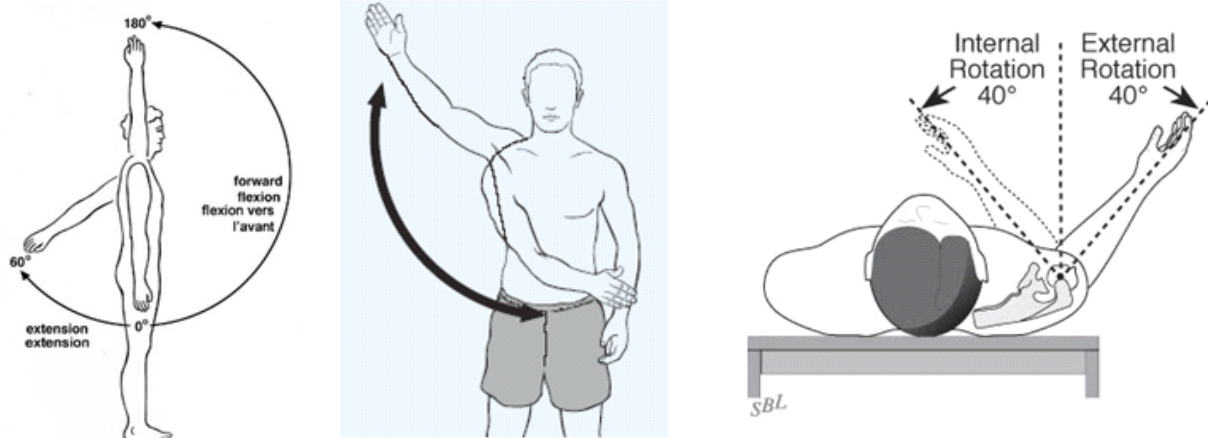
The Shoulder Complex

The shoulder complex is made up of 4 joints moving together, to move the arm.



- Glenohumeral Joint (between the upper arm bone and the shoulder blade)
- Acromioclavicular Joint (between the collar bone and the shoulder blade)
- Sternoclavicular Joint (between the collar bone and the sternum)
- Scapulothoracic Joint (between the shoulder blade and the rib cage)

The Glenohumeral (shoulder) Joint has three rotational degrees of freedom including flexion/extension (shown below left), abduction - raising arm to side)/ adduction - moving the arm across the body or behind your back (shown middle below), and internal/ external rotation (shown below right).

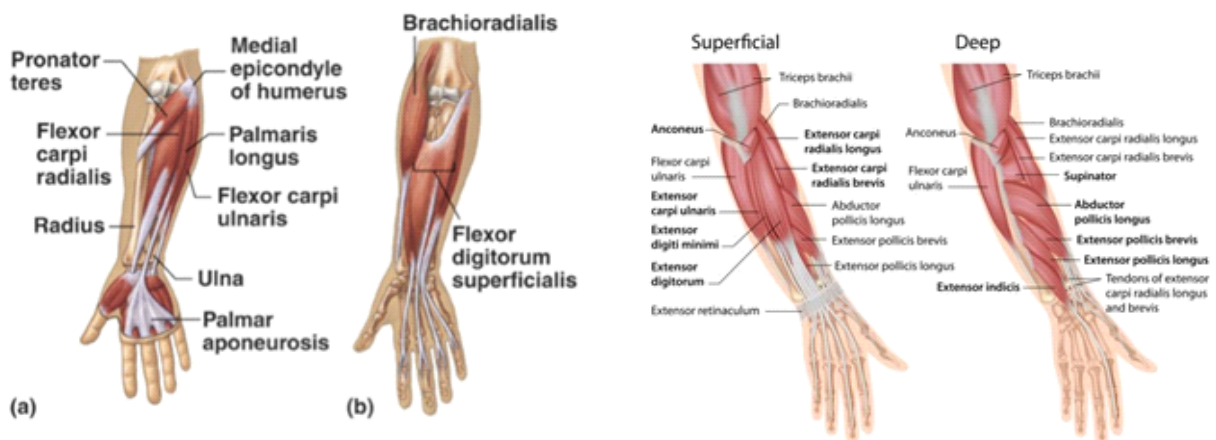


With regard to hazardous manual handling, musculoskeletal injuries can be caused when:

- Lifting and lowering loads with one arm
- Carrying loads with one arm or on the shoulder
- Pushing loads with the arms at 90 degrees to the trunk
- Pulling loads with one arm from a standing start

The Wrist Complex

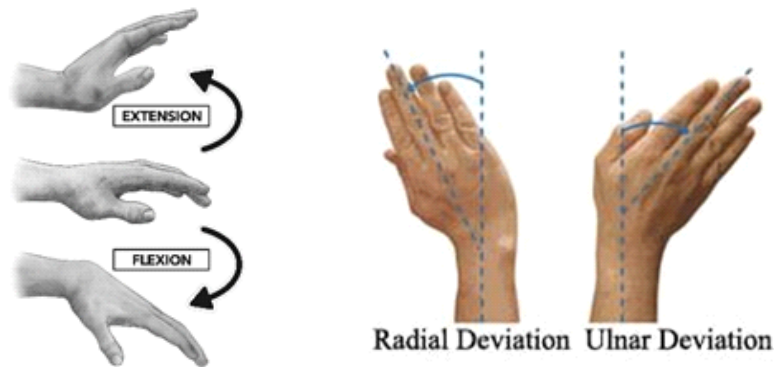
The wrist complex contains 8 small bones and is moved by the muscles in the forearm shown below.



Wrist Flexor Muscles (right arm)

Wrist Extensor Muscles (right arm)

The wrist complex has the motions of extension/ flexion and ulnar/ radial deviation.



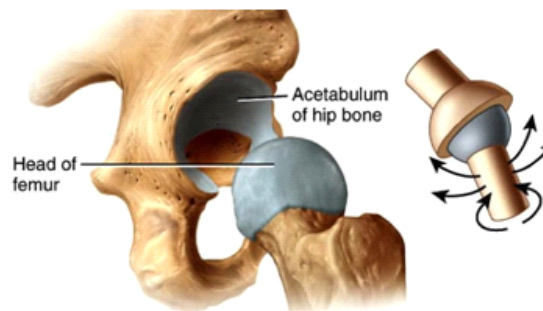
When I was a practising Osteopath, wrist injury presentations were rare. They are mainly caused by trauma like falls onto the wrist, or in sport (hitting a golf ball out of thick rough for example). What was common when I was a clinician was Tennis Elbow, which affects the extensor muscles of the forearm and their tendon insertion onto the upper arm bone. From my personal experience, this is a naggingly painful condition.



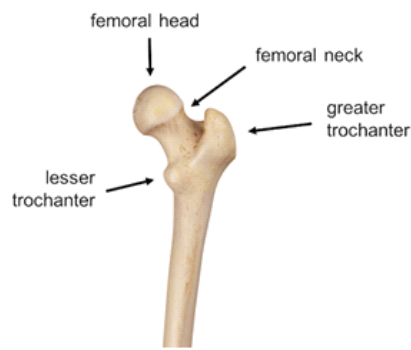
Through normalising the biomechanics of the neck, mid back, shoulder complex, elbow and wrist through manual manipulative techniques, Osteopathy is the go-to therapy for Tennis Elbow, forget the GP, cortisone injections and anti-inflammatory medications, but remember rest (of arm use) is essential also.

The Hip Complex

The hip is the most common operated joint due to osteoarthritis, which is due to the obesity problem more than anything else as this joint is the most stable joint of the body as it is a ball in a socket (shown below).

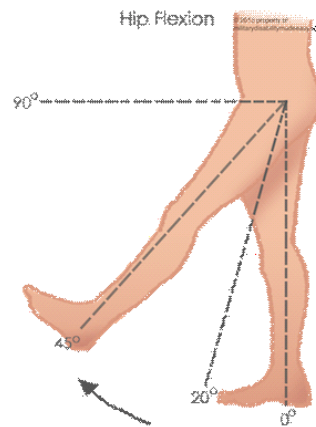


The hip joint consists of the articulation between the head of femur or femoral head (shown above and below) and the acetabulum of the pelvic bone (shown above).

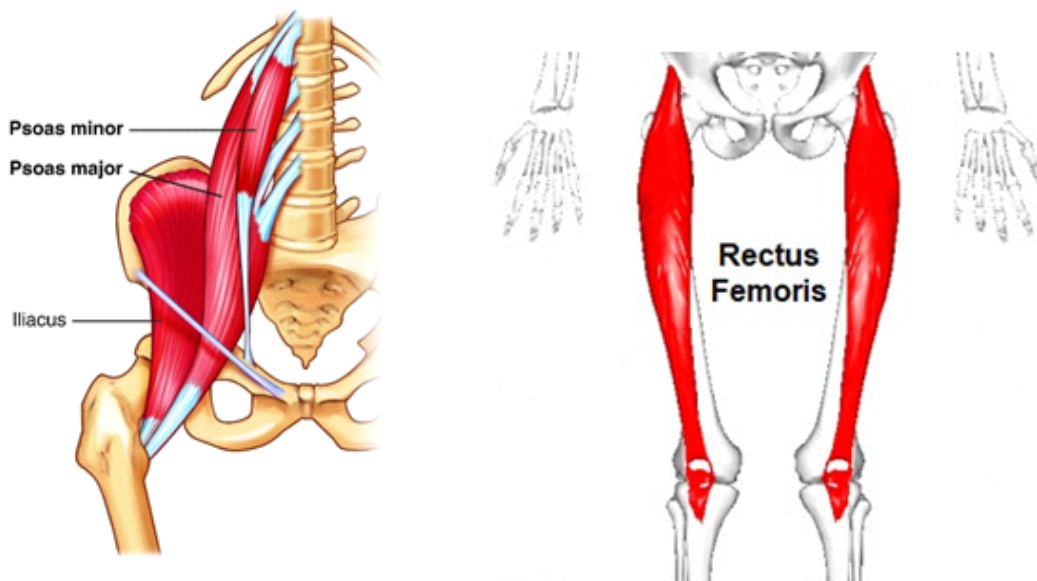


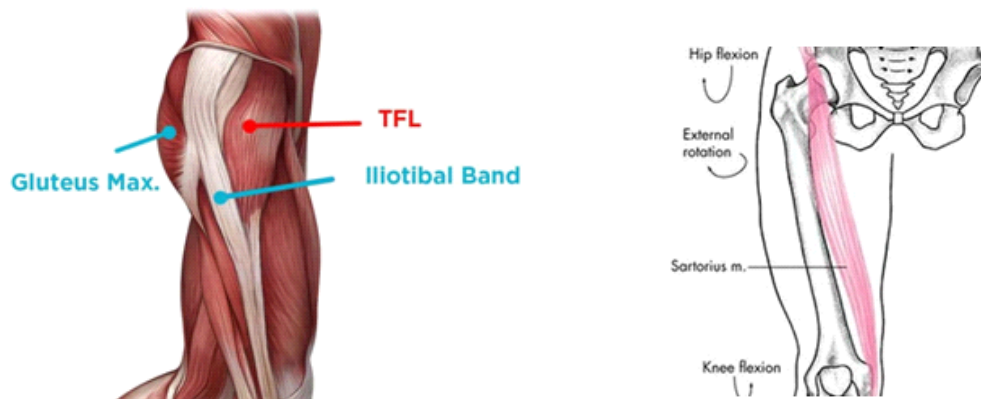
The hip has the following movements:

Flexion

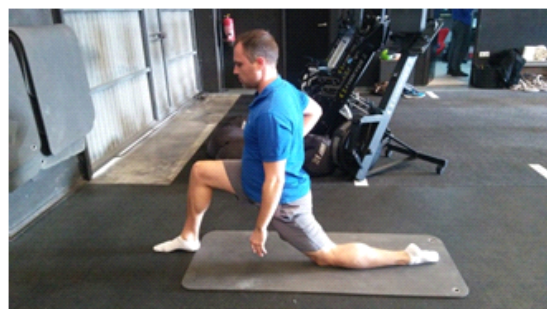


The bringing of the limb forward in the flexion movement is made by muscular contractions of the psoas (major and minor), iliacus, rectus femoris, TFL and sartorius muscles (all shown below).

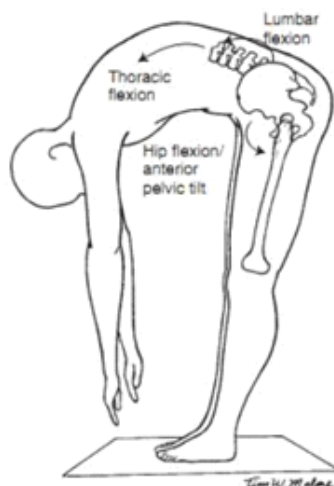




To stretch the hips flexors the below stretch is indicated. It is best practised with a small pillow for the knee cap on the ground, especially if you suffer from knee pain.



When both limbs are weight bearing there is closed -chain hip joint function. As from the title of this blog, we will keep this very simple and give the following example of this closed-chain function.



When you forward bend your spine whilst weight bearing your limbs, the pelvic bone forward tilts which results in a flexion movement of the hip. We will keep it that simple!

Extension

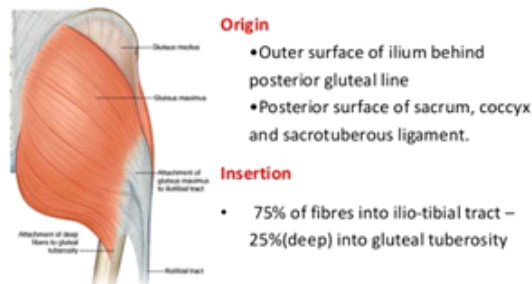
Hip extension (shown below) is generated by contraction of the gluteus maximus and hamstrings muscles. The gluteus maximus muscle is the true squat lifting muscle.



The prone Pilates exercise (shown above) is great for improving hip extension mobility, sacro-iliac joint mobility, and lower back extension mobility. Improved mobility means simply less joint pains.

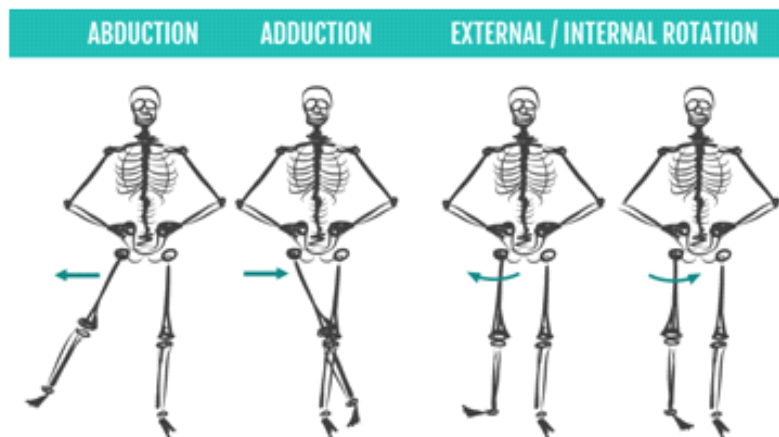
Gluteus maximus

Largest muscle responsible for the prominence of the 'buttocks'



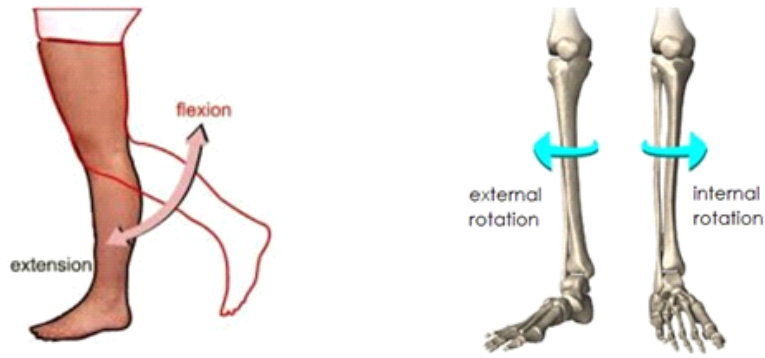
Check out my Blog "**Why Powerful Glutes make Manual Handling Easy**" on our Blog page.

The other movements of the hip are **abduction/ adduction** and **external/ internal rotation**.

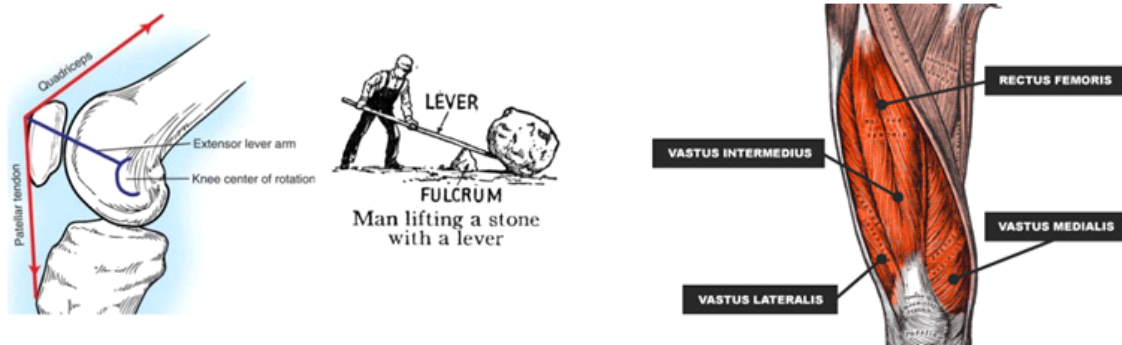


The Knee

As myself a practising Osteopath in the past, this is one of the joints that keeps Osteopaths in business. Due to the knee joints' compromise between having to be mobile but at the same time having to be stable, traumatic injuries and degenerative conditions are so common in us bipedal (walking on 2 feet) Home Sapiens. The principle movements of the knee are flexion, extension, internal rotation and external rotation as shown below.



The knee cap (patella) primarily acts as a mechanical pulley for the 4 quadriceps muscles.



As in all joints, ligaments provide stability to the knee and are numerous. Below is the taping of my right knee during my running training for my September 2019 Rat Race Coast to Coast.

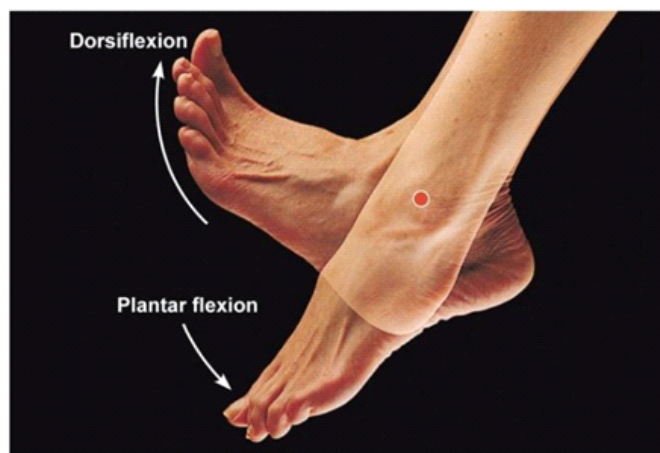


This taping technique promoted improved biomechanics in my right knee, reducing joint aching after long runs.

If you like Scotland and you like exercising then you will like my Blog " My Rat Race 2019 – A Celebration of us Sapiens' Musculoskeletal System ". You can read this on www.osteopathicsolutions-manualhandling.co.uk/osteopathic-solutions-blogs



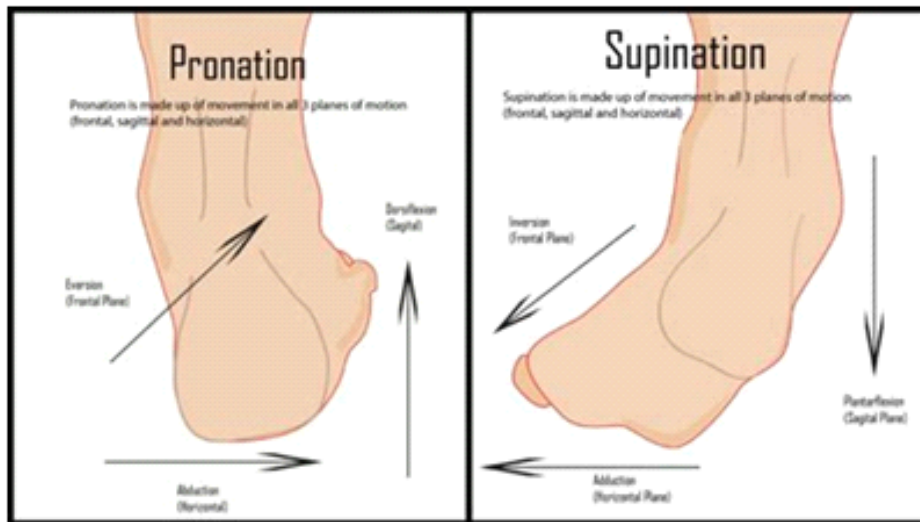
The ankle is an inherently stable joint. Like all joints it is stabilised by muscles (and their tendon attachments) and ligaments which attach the tibia to the talus bone (bones shown above), and ligaments which attach the fibula to the talus bone.



As shown above, the movements of the ankle are Dorsiflexion and Plantar flexion. Commonly dorsiflexion is a restricted movement due to tightness in the calf muscles. Below are 3 exercises that you can practice that improve the range of ankle dorsiflexion and reduce calf muscle tension and pain. Below left, use of a theraband. Middle, standing calf muscle stretch. Below right, use of a foam roller to self massage the calf muscles.

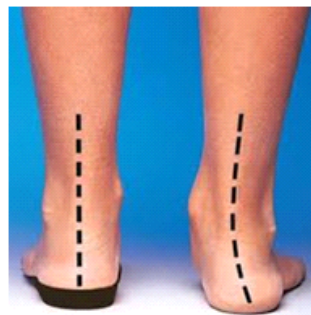


As we are keeping this Blog simple (and the rear foot biomechanics are not), the movements between the joints in the rear foot and the mid foot allow Pronation and Supination movement as shown below.



Clinically when standing, flat feet are common which can lead to foot, ankle, knee, hip and spinal pain and dysfunction. Flat feet are generally inherited and mainly occur due to weakness in ankle ligaments. My simple 3 step plan to help prevent musculoskeletal pain from flat feet is the following:

- Of course, Osteopathic manipulative therapy
- Rehabilitation exercises including calf and plantar muscle strengthening, and lower limb stretches. If you want more information on what exercises to do then email me at garethmilner@osteopathicsolutions.co.uk
- Podiatry with customized orthotics shown on the left foot on the image below right. Simple Plaster of Paris casts work brilliantly as shown below left . A flat foot (pronated) is shown on the right foot on the image below right

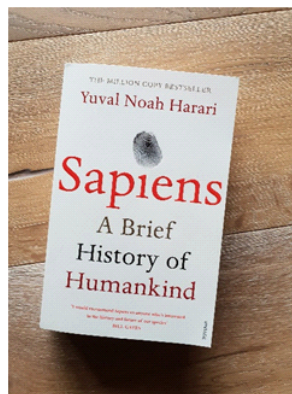


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If you are interested to watch a video of the clinical application of biomechanics within an Osteopathic treatment please view www.osteopathicsolutions-manualhandling.co.uk/osteopathy or on YouTube via <https://youtu.be/E2pvOEYITLI> . This features myself providing an Osteopathic treatment for our Training Coordinator & Social Media Manager Emma Farrell.



Continuing the theme of us Humans, if you are looking for a great read I recommend 'Sapiens', shown below. A book simply about our place on this planet. Past, present and future.



Email me your thoughts about my blog at garethmilner@osteopathicsolutions.co.uk

Thanks for reading.