Osteopathic Solutions

´´Biomechanics of a BackSafe Golf Swing´´

Me at Cabopino Golf Course, Marbella

By Gareth Milner

Director of Osteopathic Solutions Ltd

Firstly, I am no PGA or European Tour golfer. I have played for nearly 30 years and on a good day play off 18, on a bad day, well let´s not mention that. But what I do have is an expert knowledge in Human Biomechanics (from my degree in Osteopathy) and with that I can give you golfers expert knowledge on how to hit a golf ball in a way that won´t strain your musculoskeletal system (too much).

In this Blog I have looked at the current top 5 golfers in the world and their swing biomechanics, as well as looking at what coaches refer to as the perfect golf swing.

Firstly let´s look at the current **World Number 1 Golfer Brooks Koepka.** Before we look at his swing, this guy is of the Tiger Woods mold in that physical training outside of golf is of the upmost importance. He weight trains (like most of the top golfers do) building a muscular, but athletic physique. With this, he will clearly be able to generate more power in the swing, and not surprisingly he is one of the longest hitters of the golf ball.

Posture and body position. His hip joints are in line with the ankle joint. Toes in line with the posterior aspect of his right arm. Spine is straight but no longer upright (just what we teach when squat lifting an inanimate load), with some forward bending (flexion) of his upper back and lower neck. His feet are parallel and spread wider than his shoulder width (again what we teach when squat lifting), a position of great stability. In the take away there is little hand movement.

At the top of the swing his left arm is very hig h and straight at the elbow (nearer vertical) with his right arm abducted and flexed at the shoulder joint, and flexed at the elbow. There is flexion of his left wrist. The pelvis is fixed with rotation through both hips, but little flexion of the left knee. What we can´t see in Brook´s swing is his abdomen more facing us which is why his knee doesn´t flex much.

On the downswing, he really drives his hips forward early getting the pelvis facing the target, allowing him to bring the clubface back to square at impact. The pelvis moves laterally towards the

target with his spine side bending to the right, with weight shift onto his left leg (you can see the shape of his left quadriceps being more pronounced as he weight bears more through the left leg).

He is without doubt setting the professional golf standards at present, but this is a swing that needs peak physical shape and flexibility and one that is not achievable for us mere mortals.

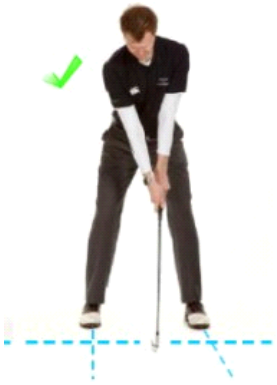
The Biomechanics of the Golf Swing

The introduction of diagnostic tools in the past decade such as 3 Dimensional Motion Analysis, Force Plate testing, and Movement assessments strategies have allowed for a very precise analysis of the modern day golf swing. In this day and age subjective reviews of the golf swing and what transpires in the execution of the golf swing are no longer prevalent. Science has certainly advanced the game in every aspect. These advances include the biomechanical and physicals components of the game.

Before we look at biomechanics of the swing, let's look at the **Set-Up** broken down into the **stance** and **posture** that will allow for a swing that is low impact on your musculoskeletal system.

Stance

A golf stance is made up of several elements – the right width of stance, the right amount of knee flex, the angle of the feet and overall posture. A stance that is too narrow will prevent you from generating a lot of power in your golf swing. It will also make it difficult to keep your balance and could cause you to forward bend. To ensure the correct width of your stance, measure the width of your shoulders using a club. Then make sure the insides of your feet are at least this wide apart for all shots. Avoid pointing your toes out at too much of an angle. Your rear foot should be at right angles to the target line. Your front foot can be angled outwards but only slight. Knees should be slightly bent but not flexed. Your body weight should be spread 50/50 between your toes and heels as well as 50/50 between your left and right foot for most shots.



Posture

Great golf posture is crucial for consistent, accurate and powerful ball striking. You don't have to be an athlete to achieve great posture. Tilt towards the ball from your hip joints, not waist. The difference is subtle, but bending from the waist causes the back to get rounded. For better posture, try this:

- Stand tall in front of a mirror, tuck your fingertips into the joints at the front of your hips
- Tip your upper body forward as you push your hips and backside out behind you
- Keep your shoulder blades flat, and add a little flex to your knees
- You should feel athletic and relaxed

Try to re-create this hip-hinged position when you play. You'll look like a pro, and hit more like one.

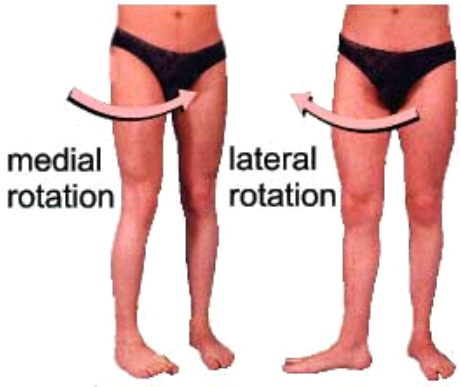
The Swing

The golf swing can be broken down into the following series of biomechanical movements:

Set-up (discussed briefly above)
Backswing
Transition
Downswing
Impact
Follow-through

Backswing

As the club moves backwards shear force is applied to the anterior (front) portion of the right foot while at the same time a posterior shear force is applied to the left foot. This is the beginning of torque development in the body that will be transitioned into the clubhead at impact. Rotation of the hips (for a right handed golfer, internal rotation of the right hip and external rotation of the left hip) as the pelvis moves, spine, and shoulders continues during the backswing.



By the way this is not me in my pants!

The order of this rotation is the knees, hips, and torso occurring around an approximate vertical axis through the center of the body. This creates additional torque to be translated into the clubhead in later stages of the swing. The important point to remember in the backswing is that the entire rotation of these body parts occurs around an imaginary axis of the body. The body during this portion of the swing is creating/ storing energy to be released during the downswing phase of the golf swing.

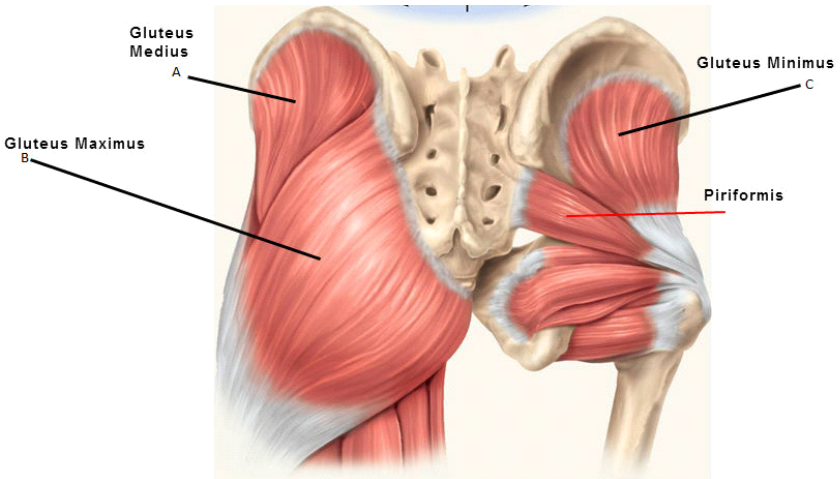
The creation of torque and the development of torque by the body requires r otation. Rotation in the lower body, torso, and shoulders is contingent upon a number of physical parameters such as joint range of motion, muscular extensibility, stretch reflex, and segmental strength in the lower body, hips, core, and upper back. If any of these physical entities are lacking, the ability to execute the backswing and develop torque will be diminished.

Transition

The transition point of the swing is where the body completes its backward movement and begins the forward movement. The best reference point to when the transition stage of the swing begins is when weight shift onto the inside of the right foot is completed (right-handed golfers) and movement back towards the left foot begins. The transition phase of the golf swing as with every other phase of the golf swing requires specified levels of joint mobility and segmental stability. Limitations in thoracic spine or hip mobility will typically result in compensations or inefficient movement patterns to occur at this stage of the golf swing. In addition, an inability to stabilize the lumbo/ pelvic/ hip complex will negate the ability to maintain the correct postural position required in the initiation of the downswing phase. For myself after having lessons, keeping my pelvis still on the backswing and transition has improved my golf a lot and has also reduced the strain on my neck (history of disc herniation at C5/C6).

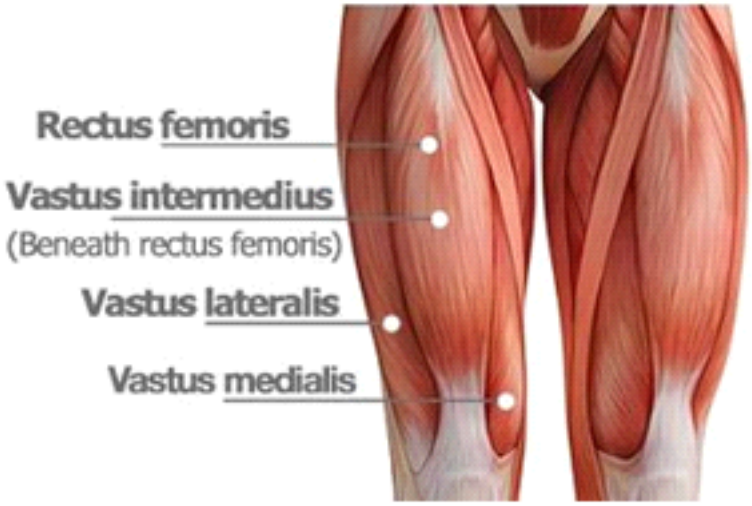
Downswing

The generation of torque is created in the lower body and then is transitioned up through the body into the club. The majority of torque in this phase of the swing is generated by the glutes, hamstrings, quadriceps and core musculature of the body (deep spinal muscles and abdominal muscles).

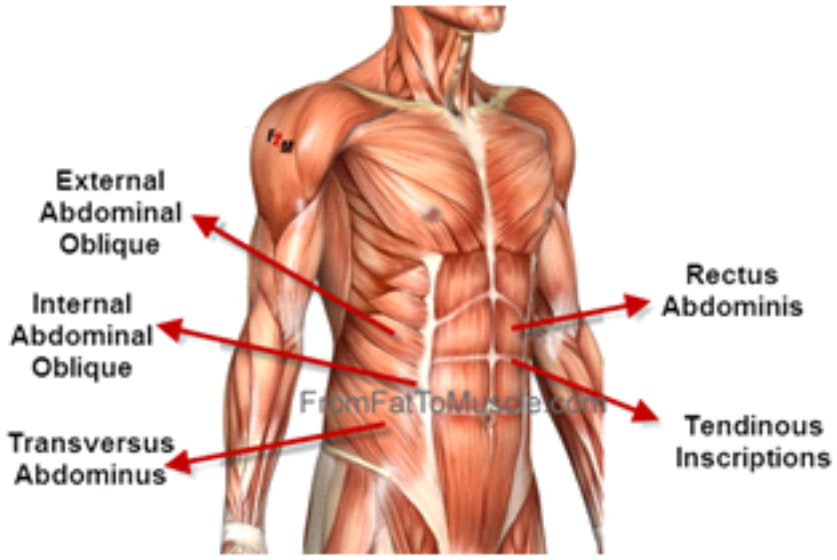


Glutes

Hamstrings

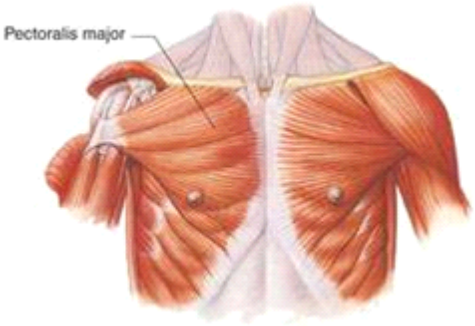


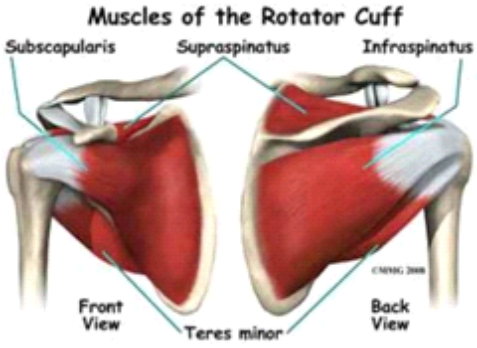
Quadriceps



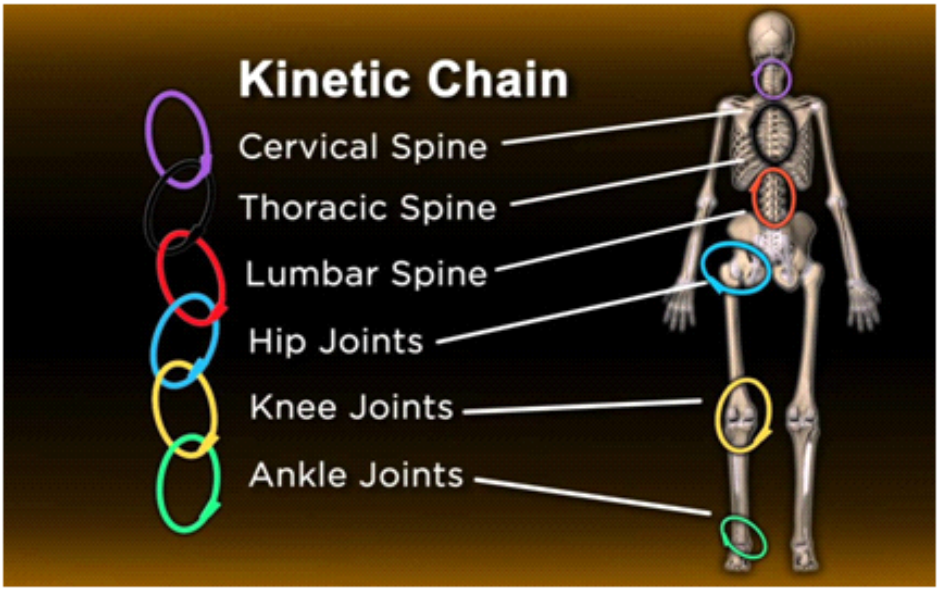
Abdominal Muscles

The torque created in the lower body creates acceleration in the upper body as energy is transferred onto the clubhead. Studies indicate there is moderate muscular activity in the pectoralis major (shown below left), latissimus dorsi (shown below middle), and rotator cuff muscles (shown below right), during the downswing. The downswing is complete at the point in which impact occurs with the golf ball.

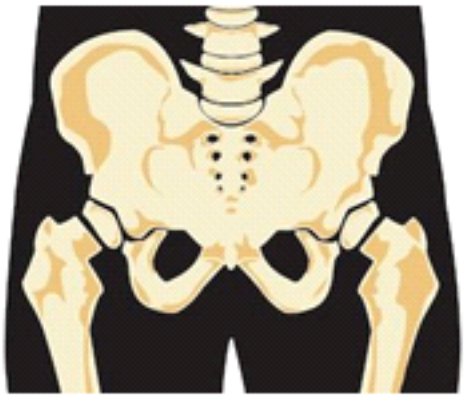




After completion of the transition stage and commencement of the downswing, the golfer will continue the weight shift onto the left foot through movement of the pelvis toward the intended target line. During this movement of the kinetic chain force is applied onto the anterior portion of the right foot (shown below in Dustin Johnson) and posterior side of the left foot, which in turn generates a counterclockwise torque (right handed golfer).

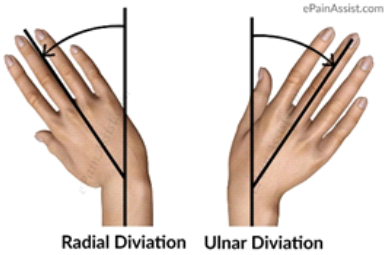


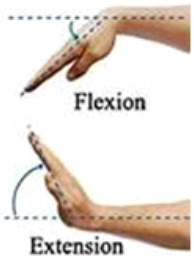
The torque generated by the lower body is transferred to the torso with an additional amount of energy supplied by the musculature of the lumbo/ pelvic/ hip complex.



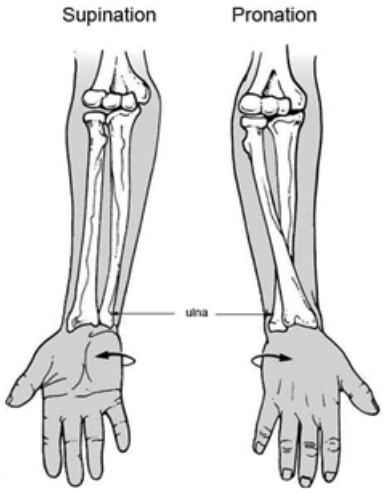
Lumbo/ Pelvic/ Hip complex

The muscles of the right and left shoulder contribute to speed generation. In addition, a negative torque by the wrists remaining radially deviated (shown below left) and maximum dorsiflexion of the right wrist (right handed golfer – shown as flexion below right) occurs when the club is approximately horizontal to the ground.





Once the club has reached a parallel position to the ground, at this position ulnar deviation of the wrists occur sequentially allowing the left forearm to supinate and right forearm to pronate (supination and pronation of elbow shown below), commonly referred to as a "knuckles down" move.



Impact

Impact is the point at which the potential energy/ speed generated by the body during the backswing, transition, and downswing is transferred into the golf ball. The purpose of impact is to hit the ball in the correct direction with the chosen amount of force. At impact, weight transfer is complete and shear forces from both feet are towards the intended target. The clubhead and ball at impact are in contact for approximately half a millisecond (0.0005 seconds) – I personally find this amazing. Any error in timing, positioning of the kinetic chain, sequencing of the swing, or positioning of the clubface will directly affect the impact position, ball flight, speed and direction.

Biomechanically at the impact position the counterclockwise rotation of the feet is complete. Research indicates at impact the left foot (right-handed golfer) is supporting 80% to 95% of the golfer's weight). In addition to the percentage of weight shift, research has found the lower handicap golfer had their weight supported toward the heel of the left foot, whereas the higher handicapper supported the weight in the middle of the foot. The hypothesis behind this differentiation at impact between the lower and higher handicapper was the skilled golfer obtains more counterclockwise rotation during the swing.

Maximum clubhead speed is intended to occur at the impact position. Higher handicap players due to biomechanical inefficiencies and or physical dysfunctions loose speed prior to impact resulting in a loss of distance and potential ball flight direction.

Execution of the impact position requires the release of the hands with correct timing for the transfer of speed to the club head. In order to perform the wrist release, weight shift correctly, sequence the transfer of energy through the body, and release speed into the golf ball, all phases of the golf swing leading up to this point must be executed correctly. Errors in the kinematic sequence or phases of the golf swing caused by physical limitations, poor mechanics, or improper equipment will affect impact. Physical dysfunctions in terms of mobility, flexibility, stability, strength and/or power development will "show up" at impact relative to ball flight, distance, and direction.

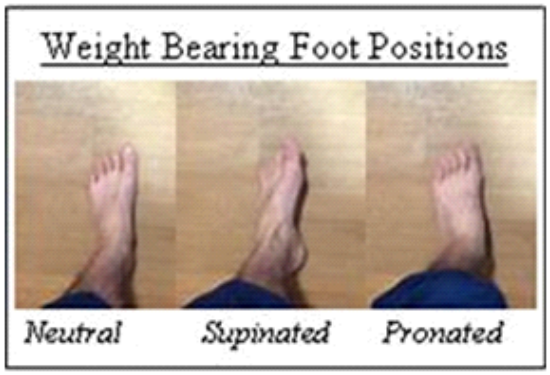
Follow-Through

After contact, the impact stage of the swing is complete and the follow through stage begins. The follow through is essentially the deceleration of the body after contact with the ball has been made. This is completed with the body rotating to a completion point where the clubhead is behind the golfer. The follow through is where the kinematic sequence of the swing ends, energy not transferred into the golf ball is dissipated, and the body slows itself back down. It is the deceleration phase of the golf swing.

Biomechanically after impact with the golf ball is complete the left forearm continues to supinate, the right forearm continues to pronate, pelvis and thoracic spine rotations concludes.

Sidelying Exercise to improve Thoracic Spine Rotation

Deceleration of the kinetic chain requires activation of the subscapularis, latissimus dorsi, and pectoralis major. In addition, both legs rotate as the right knee flexes and left ankle supinates (middle image below).



The right heel will lift off the ground during the follow through positioning the majority of the vertical load on the left foot (right handed golfer) . Deceleration of the kinetic chain during the follow through phase of the golf swing requires a high level of eccentric and stabilization strength of the muscular system. This allows for dissipation of energy not translated into the club head and a slowing down of the body. Poor conditioning of the neuromuscular system or limited joint ranges of motion may limit the ability of the golfer to execute this phase of the golf swing efficiently.

As you are armed with a little more understanding of the biomechanics of the swing let's look at the rest of the current top 5 golfers in the world.

World Number 2 Golfer, Rory McIlroy

For me the most fluid, natural and powerful swinger of a golf club within world professional golf (he just needs to dial in his pitching wedge yardages and hole more putts consistently – coming from me who plays off 18 on a good day!!). At the start of the backswing there is a very slight lateral movement of his pelvis away from the target which immediately stops with a large amount of rotation through his hips, then his thoracic spine (the part of the spine which biomechanically can rotate a lot – but not in all of us non athletes), whilst keeping his eye on the ball which requires excellent neck (cervical spine) mobility in forward bending (flexion) and left rotation.

Unlike Brooks Koepka, there is a more traditional front knee flex at the top of the backswing and less reliance on his torque generation from the waist upwards. Because of this massive rotation through the hips and thoracic spine Rory doesn´t need to fully swing the club (to parallel with the ground) in order to generate maximum power and club head speed. On the downswing there is a big loading through the left quadriceps as he weight transfers onto the left leg. The only biomechanical worry for me with his swing is the follow through where his lumbar spine does backward bend (extend) significantly. He will get away with it at 30 years old but wear and tear will start to happen towards his late 30s with his follow through biomechanics.

World Number 3 Golfer, Dustin Johnson

A unique swing that is again super athletic. On the take away of the club there an immediate extension of the right wrist. Something very different to Rory McIlroy is that Dustin has the club very high at the top of his backswing which will take a lot of abduction through his right shoulder. Very similar to Rory with the knee flex, hip and thoracic spine rotation on the backswing. At the top of the backswing the left wrist is flexed (shown below left).

On the downswing Dustin transfers most of his weigh t onto the left leg with hardly any weight bearing on his right leg on ball impact (shown above right). Dustin Johnson sure is a great golfer (and one of my personal favourites), but my worry for him is that he will suffer from right shoulder, left knee and wrist injuries over the next decade. But what a golf swing!

World Number 4 Golfer, Justin Rose

My daughter Abigail´s favourite golfer. Below is her meeting him at the British Masters at Walton Health in 2018.

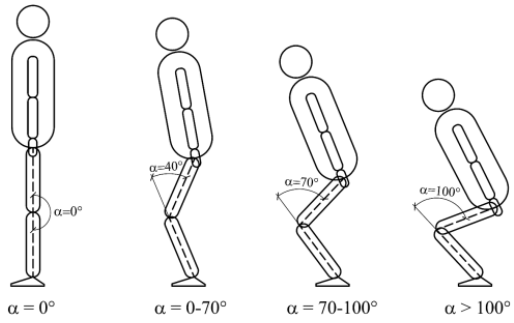
When I watch Justin Rose he is always thinking about technique (as shown on his pre shot routine on this YouTube clip https://youtu.be/I9gkRs7ywjQ), rather like my past favourite Nick Faldo. Even with such a great swing, Justin has suffered from a lumbar disc herniation in the past which now at 38 years old will start to affect his amount of playing and ability to put hours on the range.

Nothing much to say about Justin Rose´s swing (in the sense that he has no individual idiosyncrasies) other than this is textbook stuff in how to swing a golf club. He keeps his head and pelvis ultra still on the backswing, swinging within himself i.e. not swinging the club to horizontal with the ground. His swing is one of balance, rhythm, fluidity and power. I do feel the extension (backward bending) through the lumbar spine (lower back) is something he needs to be mindful of (however working in the gym and regular Manual Therapy should keep injury at bay). A great golfer with a great swing – just more Major Championships please Justin! Can I give him more praise than that Abigail?

World Number 5 Golfer, Justin Thomas

I recently followed Justin Thomas at the Scottish Open and he is not a big guy, in fact he is skinny. But boy does he hit a golf ball far and true. Let´s look at his biomechanics.

His swing has similarities to Dustin Johnson´s. The high hands at the top of the backswing and the huge weight transfer onto this left leg early on the downswing. It looks like he consciously flexes the left knee (knee flexion diagram below) on the backswing so he can get maximum rotation in the pelvis, winding up the power.

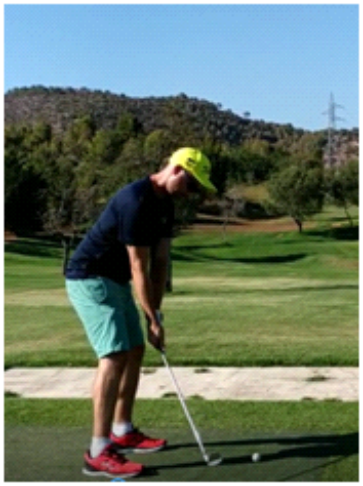


For me his swing though will cause him problems later in life. The extreme transfer of bodyweight onto his left leg compromises his lumbar spine and (I hope I am wrong) I expect he will suffer from a lumbar disc herniation before he reaches 35. He is currently 26 years old and he is at that point of age where his body can hold on to the repetitive strain but give it a decade more of swinging like this and it will take it toll. Nonetheless what a golfer who I am sure will reach World Number 1 again in the next 3-4 years.

The great thing for me about world golf now is the breadth of competition. The top 5 have all experienced what it is like to be called ´World Number 1´.

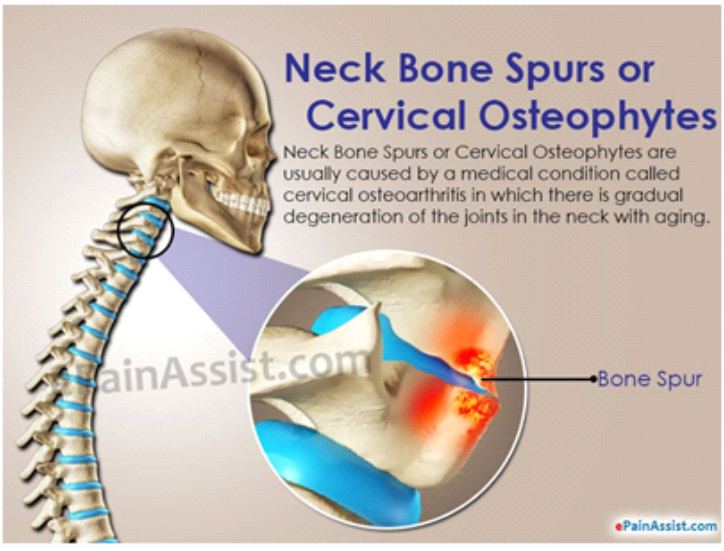
My Swing

Over the last 6 years I have worked hard to maintain a static pelvis on my backswing. I used to laterally move my pelvis on the backswing away from the target which used to put such strain on my neck at impact. As well, via watching Sky Sports Golf and especially Justin Rose (my favourite too Abigail!), I have learnt to throw my pelvis to face the target on the downswing. Although I play off 15-20, I am happy I am hitting the ball the best I ever have (smashed 4 drives pure straight and long yesterday, so very chuffed).





Following my work on this blog, I will aim to use my left knee flex more and see what that does to my power and accuracy. I will also work with my Osteopath and in the gym to get my right arm higher to get the club away from my body more at the top of the backswing, aiming for Dustin Johnson and Justin Thomas´s positions. I have worked on my tempo also, slowing it down keeping a good rhythm like Justin Rose does. All in all, my golf is going in the right direction and with these changes my neck (previous C5/C6 herniation now left with half the disc height and an osteophyte at the right C5C6 foramina) hardly suffers from the loading.



My Simple Top Tips for BackSafe Golf

I may not be a PGA Tour Professional but I have nearly 30 years of experience of playing this game and these are my 4 simple tips for a BackSafe golf swing:

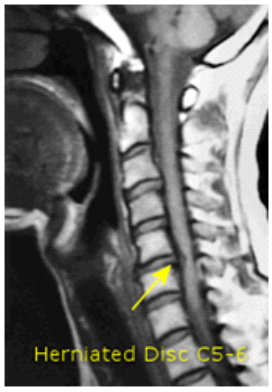
- Go to a professional golf shop and get **fitted with the right clubs** for your height and swing biomechanics
- Get your **Set-Up bang on** (discussed above) – just like when lifting, pushing and pulling an inanimate load
- **Keep your pelvis still on the backswing – rotate through your hips.** Don´t let it laterally move (away from the target) on the back swing
- **Keep a nice, rhythmic swing tempo**. From the back swing to the follow through. Leave the smashing the ball as hard and as quick as you can to those ´bombers´
- **Avoid overswinging**. It may have worked for John Daly but it won´t work for you – could be the reason he has crippling knee arthritis now

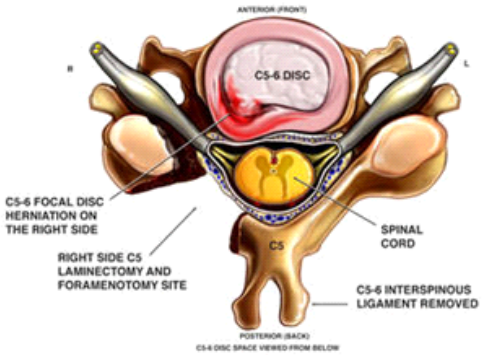
John Daly, Open Champion 1995

Musculoskeletal Injuries caused by flawed Golf Swing Biomechanics

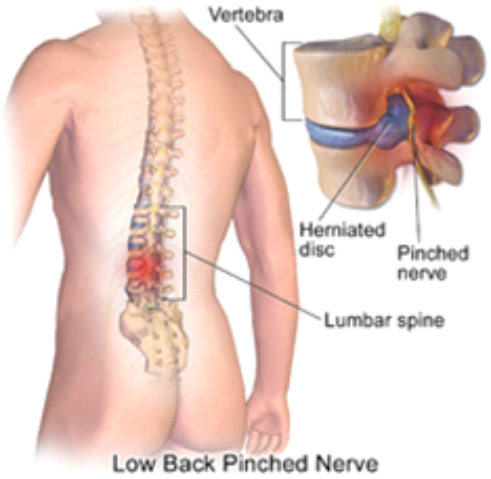
Going back to Brooks Koepka´s swing, I hope I am wrong, but I cannot see anything other than herniated lumbar discs (especially at L5/S1) for him when he approaches 40 years old. The amount of practice they do and with the stress he puts on his body with his swing mechanics, I cannot see anything other. If you look at the top 25 golfers, Justin Rose, Tiger Woods (famously) and Jason Day have all suffered from lower lumbar disc injury. The only reason there isn´t more in the top 25 is that most of the guys are in their 20s.

Spinal disc herniations (from my own experience) are very painful, either in the lower neck (especially C5/C6) and/ or in the lower back (especially at L5/S1). If you have one you won´t be playing much golf until it heals (if it does).





C5/C6 Disc Hernation

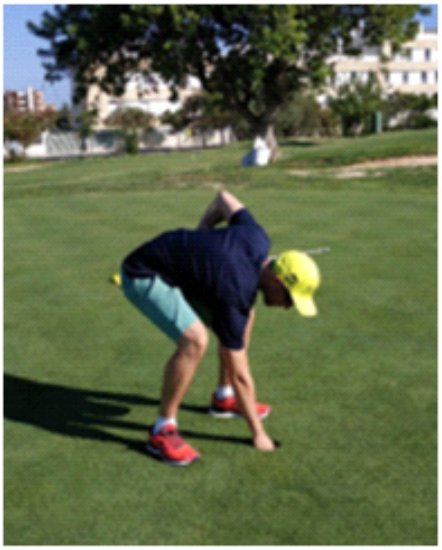


L5/S1 Disc Hernation

If you have a spinal disc injury, email me at garethmilner@osteopathicsolutions.co.uk for my **10 step plan** to get rid of that injury and get back on the golf course.

Even if you have a swing that is efficiently biomechanically, playing too much golf will commonly cause these spinal injuries between 35-45 years old. Yes, spinal surgery can help but ask Tiger Woods how many surgeries he has had to get him back to playing, and really playing not that much.

Even if you have a swing that is efficiently biomechanically, golf´s environment can damage your spine. Gradients for example like the ball way below your feet will add strain; hitting out of long grass is physically tough and forces will be absorbed in your lower neck and back. If you are not a professional you will every now and again hit a shot ´fat´, taking too much of a divot which again will go into your neck and lower back. Also, the manual handling element, lifting, carrying and lowering of your golf bag or pushing your bag on a trolley as well as picking your ball out of the hole. Check out my Blog **" Improve Your Manual Handling Handicap - Safer Manual Handling For Golfers "** on our Blogs page www.osteopathicsolutions-manualhandling.co.uk/osteopathic-solutions-blogs



BackSafe picking up of your golf ball

If you like this Blog you will like my next Blog **'' Human Biomechanics – Kept Simple ''** available to read on our Blogs page in late September 2019.

If you want to keep your back fit for golf read my Blog **'' Self help for your Back Pain ''** which is also available to read on our Blogs page www.osteopathicsolutions-manualhandling.co.uk/osteopathic-solutions-blogs

I really enjoyed researching for this blog and like me, I am sure it will make you understand the golf swing a lot more. Thanks for reading and **always** enjoy your golf!

Hitting my 1st shot at Son Quint Pitch & Putt, August 2019