THE COMPLEXITY OF POWER IN GOLF

Jim McLean

Other Mentions in this Issue

The Power Muscles
Film Technique
The Clubhead Transition

Sources

Excerpts from Dr. James G Garrick MD
Vanity Magazine article (1986), U of Washington, Seattle WA
Peak Condition - Garrick
Decisions in Sports Medicine – Garrick
Donna Gilhen MS Director of Research Center
St Francis Memorial Hospital SF CA
Five Lessons: The Modern Fundamentals of Golf written by Ben Hogan
The X Factor Swing 1996
The X Factor DVD 2004
The Eight Step Swing 2009
Build Your Swing Book 2020

This article delves into how the body produces power using excerpts from a top surgeon and a research director, who together were at the forefront of sports medicine. I read their article in 1986 (Esquire Magazine) and I've kept in my files. Power is at the forefront of golf and this article adds a different perspective.

Many write or speak about how a golfer can gain more speed. Usually it involves biomechanics and the kinematic sequence where they talk about kinetics and the forces that act on club. All of this is good information- all are steps forward in achieving more speed. Let's look deeper.

In this piece I insert "golf" whereas it was not part of the original Garrick and Gilhen article.

Details were removed from the original piece. This includes names, different sports examples, and more detail about the intricacies of human performance. There was more description about the nervous system that I condensed.

How it Happens

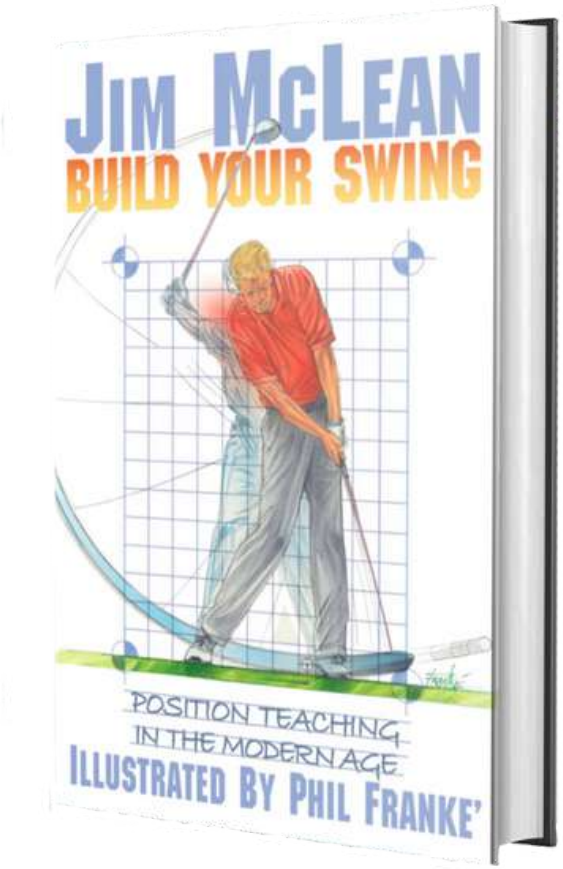
A young man enters a training room and steps up to the heavy bag used by boxers. He punches, one-two, one-two. The bag barely moves. He is punching with his arms. He puts his shoulders into the swing, and he sees the bag move a little- not enough though. An instructor strolls by and says get your hips in there. He hesitates, and then he uses his mid-section. He's awkward, but the bag jumps. He is just beginning to understand that the macho muscles do not provide the pop needed to move the bag, it's not just the arms alone, far from it.

A few more punches and he backs off, cautious of hurting his wrists with the newfound power. He repeats the motion to see where the power is coming from.

Surprise, it starts in the foot when he takes a little step.. the knee goes forward, then the thigh, in a ripple building to the abdomen and as he feels around back with one hand he notices the muscles along the spine engaged. He's forgotten his problems now, tracing the movement. What about when the feet stay planted? The force emanates from the thrust of center, most visibly as a thrust of the hips.

> *The force emanates from the thrust of center, most visibly as a thrust of the hips.*

The young man at the bag was discovering for himself the source of power in the strike, the stroke, and the throw. Much of it is transmitted through the muscles from the mid-thorax to the knees and thighs, and the most powerful of these connect to the pelvis. A few others, such as the loin muscle called the psoas major, originate at the lower spine (lumbar vertebrae) and several back muscles start at thoracic vertebrae slightly higher up. He is working three regions in concert: back, abdomen, and thighs/buttocks (the power muscles).



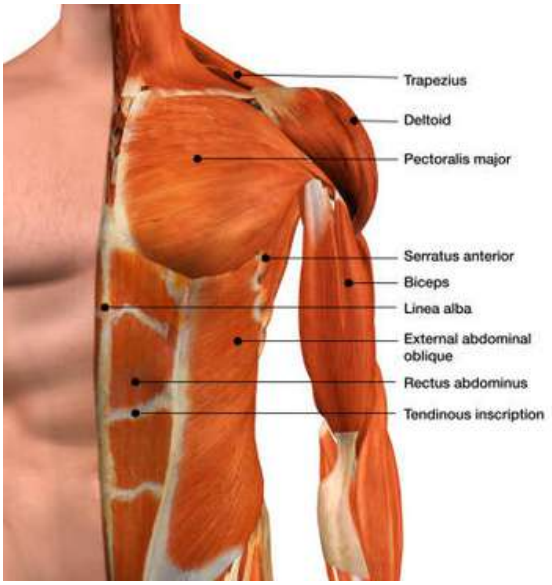
The Power Muscles

The Back

The ridge you feel on both sides of spine, running all the way up from the small of your spine, consists of seven muscles known collectively as the sacrospinalis, or erector spinae. Starting at the bottom, the iliocostalis lumborum originates at the top of the big hipbone (ilium) and inserts at the lower six ribs. If you are sagging forward from the waist, this is the muscle that contracts to pull you erect.

From there on up, the rest of the muscles attach to a succession of vertebrae and ribs, allowing for precise control and considerable flexibility in twisting movements of the trunk. On the inside, the quadratus lumborum also starts at the ilium and inserts at the twelfth rib (a “floating” rib, the lowest one in the back) and the upper four lumbar vertebrae. It flexes the vertebral column from side to side. These muscles keep the spine in the middle of the action with every throw, kick or blow.

> *Now here is the hitch. Physical activities involving our legs – most of them, in other words – strengthen the hip flexors but leave the obliques relatively weak.*



The Abdomen

Here’s where your sit-ups come in. The rectus abdominis, the big, ridged, midline column of muscle that looks so impressive if you’ve worked on it, flexes the vertebral column – that is, it folds you upward. It originates at the pubic bone and runs up to the breastbone, attaching to a couple of ribs along the way. The rectus is an easy one to build up. But the external and the internal obliques, which run from the rib cage to the pelvis, are equally important. Not only do these great sheets of muscle keep your guts in (the anatomy book calls it, politely, compressing the abdomen), but contracting one side or the other bends the vertebral column to that side.

Now here is the hitch. Physical activities involving our legs – most of them, in other words – strengthen the hip flexors but leave the obliques relatively weak. That makes the pelvis and belly tilt forward, arching the small of the back and contributing to the back trouble from with 80 percent of American adults suffer at one time or another. “The abdominal muscles are the guy wires to the back,” says Robert Boston, a trainer of athletes at the New Breed Clinic in Houston. “The stronger they are, the stronger the back.”

The Power Muscles

Back, Abdomen, Thighs and Buttocks

The Thighs and Buttocks

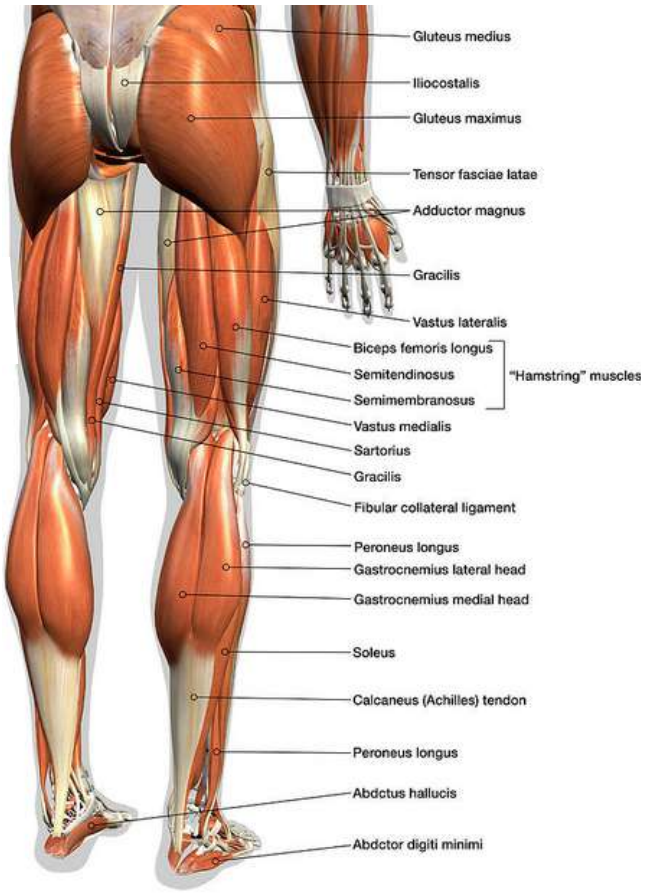
The sheer size of the main propulsion muscles (hamstrings, quadriceps, and gluteus maximus) overshadow other muscles in the same area. Abductors that pull toward the inside of the thigh, and the tensor fasciae latae that pulls to the outside – whose job is to keep you from falling over when you're propelling yourself- both are overpowered by the propulsion muscles .

The arms are not the only parts of the body with biceps muscles: the biceps femoris is a long muscle in the back of the thigh that you use much more than the biceps brachii in the arm. It is one of the three muscles – the others are the semimembranosus – collectively called the hamstrings. Originating at the pelvis, they cross two joints, the hip and the knee. Together, and in opposition to the quadriceps femoris in the front of the thigh, the hamstrings flex the leg and extend the thigh. Quadriceps means "four heads of origin" as biceps means two. The quads consists of three vastus (large) muscles – vastus lateralis, vastus medialis, vastus intermedius – and the rectus femoris. All four attach to the kneecap with a common tendon; but only the rectus femoris originates at the pelvis.

Ben Hogan wrote about the bicep muscles in his seminal book "Ben Hogan's Five Lessons: The Modern Fundamentals of Golf (1957)," "At one and the same time, the muscles of the right hip and the muscles of the right hip and the muscles of the right thigh-both the inside and the powerful outside thigh muscles-start to move the right hip forward. In order for them to do this work, these muscles must be stretched taut with tension that is just waiting for the golfer's signal to be released. This tension is built up on the backswing by retarding the hips but rotating the shoulders fully around. If you permit the hips to turn too much on the backswing, this tension and torsion are lost and then there's nothing to start them forward. Imagine that, at address one end of an elastic strip is fastened to a wall directly behind your left hip and that the other end is fastened to your left hipbone. As the shoulders turn the hips on the backswing, the elastic is stretched with increased tension, when you start turning the hips to the left, the elastic will snap back to the left with tremendous speed. Same thing with the hips. The greater the tension, the faster you can move them. The faster the hips move, the better. They can't go too fast."

You do two-part stretches for the hamstrings and the quads. You can stretch both the upper part the hamstrings and the quads. You can stretch the upper part of the hamstrings just by bending your hips into a semi crouched skiing position. If you want to stretch the top and the bottom, reach down and touch your toes (preferably sitting on the floor, to ease the strain on your lower back). Same idea with the quads. First reach behind you and grasp an ankle with the opposite hand (left ankle in right hand) and pull the heel toward the buttocks. Then extend that leg from the hip. The first move stretches the quads from where they attach at the knee. The second puts an additional stretch on the rectus femoris where it attaches to the outside edge of the big hipbone, the ilium; you're stretching both ends of the muscle.

I point out in the X Factor writing and in my talks worldwide how the hips and shoulders operate in a power golf swing. The low end of the hip turn is 40 degrees and the high end is 65 degrees. Modern biomechanics has proven these original numbers to be correct. You must not turn the hips and shoulders in tandem. This would require a round house, rotation and a very weak coil. If you stay in your forward tilt, you cannot physically turn more than 65 degrees. In my opinion, the hips can't turn too fast in the downswing as long as the sequence is correct and there is enough lateral motion to transfer weight / pressure. But I caution that there is more lateral motion in a short iron swing than a driver.



In action, a two-joint muscle is always stretching one end while relaxing the other. When you bring your leg forward to stride, you stretch the top of your hamstrings and relax the bottom. In golf when you dig in with your feet and then push off the ground, you straighten the knee, which stretches the bottom of the hamstrings – and at that instant you extend the hip, relaxing the top of the hamstrings (ground force). The muscle stays about the same length even while it's doing a lot of work. When things do happen in sequence you get a surge of power with no equal and hit a golf ball further than you could ever imagine. Kinematic sequence in golf is: feet, pelvis, shoulders, arms, hands in that order.

> To lift, throw, shove, pull, squeeze, stroke, and twist freely and effectively, the upper body and the upper arm muscles must work as adjuncts to the foundation and power muscles.
>
> **Decisions in Sports Medicines**
> **Dr. James Garrick MD**

Look at Bubba Watson, Collin Morikawa, Matthew Wolff, Cameron Champ, or Justin Thomas. They propel a golf ball further than almost all golfers, and with phenomenal accuracy. You cannot explain the sinew and bone and muscle alone because none of them look like Mr. Olympia! You ask yourself how they can do it and look so graceful.

The reason is that throwing and striking games are really full body sports, in which you use the upper extremities and the club as you would use the end of a whip. Slow motion video analysis and biomechanics make you truly appreciate how the clubhead lags deep into the downswing. When you see the frames in slow motion the golfer's trail wrist is cocked to the maximum at what I call the delivery position Step 5 "Build Your Swing". The arms are accelerating so fast that the shoulders, as Dr. Garrick points out, "are used as decelerators to keep the arms from flying out with the ball after impact". Top golfers have the sense of "the arms flying off the body" at extension position after impact (Step 7b). This is a common feel that top golf professionals express when describing their swings.

This is why video was a game changer in teaching and so much better than pictures. You see what proceeds, and you see what comes after. Old time teachers used pictures to teach the swing. As a result, many clichés in golf are dead wrong and they remain to this day.

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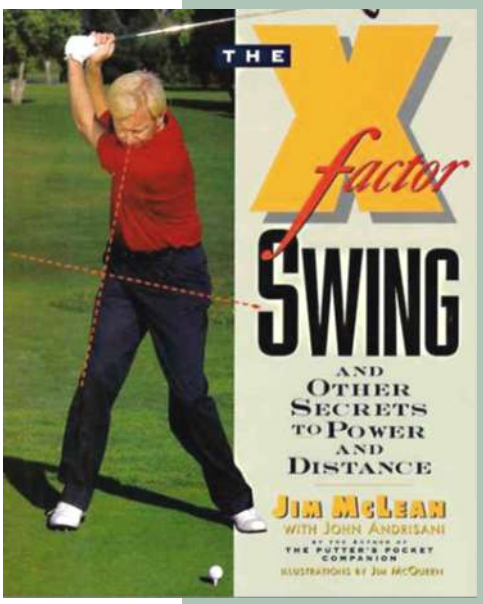


Making it all Work

Camera Angles

It is mandatory that you learn the critical importance of camera angles to do accurate research. Otherwise your research is worthless. Move the camera and it changes everything. Carl Welty taught me the answer was to video every tour player the same way.

Research

Carl Welty was my research partner and he was exact on camera angles. Carl was the first teacher to demand exact camera angles for research. He taught me to be exact. When Carl first began using video, the camera was big and heavy. Back then we held the camera on our shoulder (when we filmed on the course). We filmed with a tripod on the range or when we could set up on a certain hole. Carl was extremely smart on golf research. We put the camera on the tripod at 50” off the ground, or approximately shoulder height. We set the face on camera exactly off a 90-degree angle from the intended target line. To this day almost no teachers do careful research like I was taught from Carl Welty.

Film Technique

You film the simplest way; **down the target line just like Trackman launch monitors that are used on the PGA tour.**

Why this way? Because among other things you can see where the ball launches. You place everything in line: Camera/Ball/Target.

I don't teach on my knees, so why would you put the camera at waist height.

I don't teach behind the golfer. This is bad place to teach from because students cannot relate to this view and can easily make wrong assumptions. Yet some teachers use this method. We filmed from behind for research only, not teaching.

Top golf research is done the way I did it with Carl Welty, the same way on the course or on the range where we know the target. But only Carl and I did it this way for decades. Plus, eventually other teachers who worked for me at Doral and Biltmore. I find other ways faulty, not so good. At any major university their video research would get an F.

At the Grenelefe Golf Resort way before computer software, I showed David Leadbetter how to draw on a TV screen. This was in 1985. But Carl and I had been drawing on the TV for 5 years prior to this with almost nobody knowing about this technique. Once again, Carl Welty was way ahead of the teaching field. I'm well known for writing the X factor book and doing shows on The X Factor with The Golf Channel, but I discovered the First X at Carl's home in Carlsbad, California. I did it by drawing on his TV screen. In some ways drawing on the TV screen was better than software today as the drawing can be better. That X described how the clubshaft shallowed in the swings of tour professionals. Later I would write the X-Factor book describing the differential between hip turn and shoulder turn.

Back to Power

When Justin Thomas finishes his backswing, a relatively passive movement, he begins a “ballistic” action – action that moves a body part through a range of motion assisted wholly or in part by the momentum of that part. A downward push into the ground transfers force into the legs, and then a chain reaction from the trunk, to the shoulders. Timed with the transfer is a burst of contraction in the muscles that pull the arms downward and help rotate the pelvis – primarily with the lats. At this stage the arms and the club, especially the clubhead appear behind the player. That is not because he put the club there. It is because he has initiated the change of direction with the body from the ground up. The body is ahead of clubhead when the clubhead will finally change direction. The feel of the clubhead is light, as if it were hanging out at the end of a long string. This gives Justin “time at the top.” There is no appearance or feeling of rush. I usually get 6-12 clicks on my computer software before the clubhead has begun the forward transition. Biomechanics proves the same.

One of my tenets has been to coil smoothly, and complete the shoulder turn, but do it smoothly and make sure that the body begins the change of direction. The main energy comes in transition as you take the X factor to impact. The X factor is the differential between the hips and shoulders. The shoulders out-turn the hips in the backswing and create a gap (or differential). These rotations are quite passive as compared to the explosion and burst of speed coming into impact. In the downswing phase the shoulders rotate around a single axis, (the spine). The shoulders gain quickly on the hips, because we have 2 points hitting the ground. Starting down the feet initiate the movement and the legs push into the ground. The gap (differential) increases. As an example, the model tour pro turns the shoulders 100 degrees and the hips 60 degrees in the backswing. Starting down the hips get a head start and increase the 40 degree gap. In early transition the gap increases by approximately 10 additional degrees. I’ve termed this the X factor stretch. The gap has now momentarily increased to 50 degrees.

The Clubhead Transition

When the arm swing is used up in the backswing, and the hands can't go back any further, the change of direction will act on the clubhead. The clubhead will fall away from the player. We term this "laying off the shaft," giving us a flatter or shallower swing plane. Once the motion is underway, the lats and the other muscles involved in the downward movement lose their tension. Any tension in the arms will throw the club off plane and slow down swing speed. Relaxed arms provide huge speed. As Justin Thomas (5' 10" 150 lbs.) comes into the impact interval, the clubhead is moving at 125 mph with huge momentum on the end of the string. The elbow flexors and the muscles that pull the arms away from the center of the body – biceps, brachialis, and brachioradialis as flexors and the deltoid, with the help from the supraspinatus above the shoulder blade lengthen to slow and ultimately stop the motion. Justin Thomas looks like the clubhead is flying away from him at the halfway position past impact (extension position, Step 7). He uses pure muscle to keep the arms from coming out of the sockets.

By reading this section, you can understand that the shaft reacts just as it does in other ball and stick sports. In baseball, the bat flattens much more due to the baseball being well off the ground. In golf, the natural athletic movement of the body causes the shaft to shallow. Because the golf ball is on the ground, the tendency for most golfers is to flex the macho muscles. It's very difficult to allow the arms and hands to wait on the power muscles to lead. Whenever the golfer adds pressure at the top of the backswing, as transition occurs, the swing plane will be disrupted.

The Touch Muscles

Whether you are aiming a projectile, playing a lob shot over a bunker to a tight pin location, or playing a piano, “touch” makes the difference between a great performance and a good or average performance. The way you grip the club, the amount of grip pressure, where you feel pressure in each finger, and how you set and release the golf club involves all these muscles. It’s like positioning thrusters on a spacecraft. The big power muscles of the body do the job of first stage booster rockets, the precision muscles act like the tiny jets that adjust the orbit once you are there.

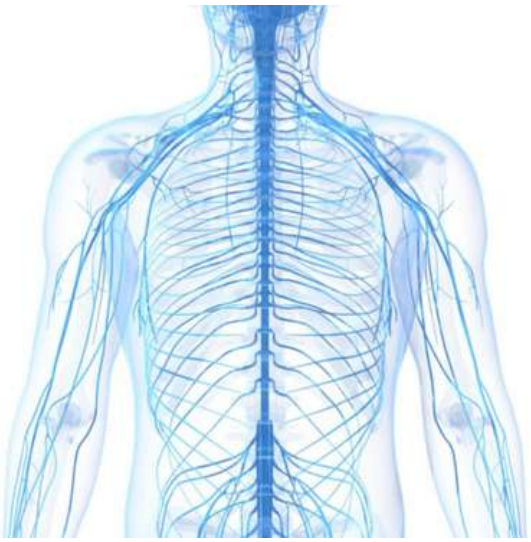
The first touch component might be considered in the wrists, which is, the last power component to be released in the impact interval. Some would say it is all in the wrists, but the muscle interplay that determines the final touch passes through the wrist from above and below.

The hand itself contains some abductor and adductor muscles that move each finger toward and away from the center, respectively; and the pollicis brevis muscles that bunch up at the base of the thumb. It has others, little interosseous muscles to move the finger bones for infinitesimal final adjustments. Their effect, however, depends on movement initiated by muscles that start far up in the forearm, some even at the upper arm. Grasp either forearm with the opposite hand and try moving any finger in any direction- even slightly- without feeling something move in the forearm. You can’t do it. That is as true for guiding a toothbrush as it is for being the number one golfer on the planet.

Considering that the wrist has eight separate carpal bones, none bigger than a pecan, and allows a hand holding a pen to inscribe a full circle, its structure is remarkably stable. A wrist is less liable to injury than an ankle or a knee. A cuff of ligament binds the carpals together, and fifteen flexor and extensor muscles (the tendons of many are prominent) run past them on all sides.

For Tiger Woods to hit a high lofting sand wedge to a tight pin, he cocked his wrist, drawing the back of the hand toward him with extensor muscles running up the back of his forearm. You can clearly feel them working if you touch your forearm as you draw your own wrist back. To move the wrist in opposite direction and launch the ball, Tiger relaxed all those small muscles and ligaments and contracted the flexors on the front of the forearm. From two of them, the flexor digitorum profundus and superficialis, tendons branch out to manage all the fingers: superficialis moves the middle bones of each finger, and profundus does the tips. At the same instant, a supinator (turning palm up) and two pronator (turning palm down) muscles rotated the forearm, like the mast of a satellite dish, for a final fix on the flag stick. Tiger swings and makes perfect contact; the ball stops one foot from the hole. Easy birdie.

Touch muscles, while not especially delicate, are vulnerable to abuse. When injured, fatigued, or overused, any muscle tightens up. The reason may be chemical, or it may be mechanical, such as small hemorrhages in the muscle tissue. In any case, abusing a muscle by overuse can push it from mere tightness to tendinitis, an inflammation in its tendons.



The Nervous System

A convenient way to classify sensory receptors is by their location. Proprioceptors, in muscles, tendons, joints, and the inner ear. They send information to the brain about body position and movement. Proprioception is also called kinesthesia. Equilibrium is a crucial part of an athlete's proprioceptive sense. Exteroceptors sit near the surface of the body. They receive stimuli from outside the body and transmit sensations such as sight (an ingredient of the hand-eye coordination required by the clapping), touch pressure. Here, exteroceptors worked in harmony with proprioceptors.They report sensations arising from within the body that may be interpreted as pain, pressure, fatigue, hunger, thirst, or nausea.

Conclusion

I wanted to conclude with the last paragraph in the Esquire magazine (1986) article:

- You can condition muscles for strength and reaction time.
- You can enhance flexibility and coordination.
- You can condition your mind.

But you cannot, as far as any researcher yet knows, condition the basic equipment of your personal nervous system.

When it comes to:

1. Nerve Impulse Speed
2. Nerve Abundance

What you have is as good as it is going to get.

This means, in context, that some golfers have the gift of speed and quick twitch muscle born into them. Some have, most don't.
If you do not have "in born speed" it doesn't mean you can't get faster. As the great basketball coach John Wooden said about his great teams, I did not have all Ferraris, I had some Fords too. My job was to make them fast Fords.
If you are not born with the gift of phenomenal DNA, the right teacher can make you faster, Maybe a lot faster than you are right now.

When we begin to understand some of the human anatomy involved in striking perfect golf shots it is a miracle some golfers can repeat that motion day in and day out. I know the ability to “let go” is one of the ingredients.

This article presents a solid case for something I wrote in The Eight Step Swing. “The body hits the ball, the arms guide the club, the hands fine tune.”

That means the big muscles, the power muscles generate the most force, not the arms. Power generates in golf as it does in other sports. Great ball strikers have learned how the mass of the body first loads in the backswing, and the mass falls forward. The arms do not gain on the mass in transition. Most weekend golfers do just the opposite by applying the power with their arms and hands.

There is a counter fall as described originally in Gravity Golf (David Lee). Counter fall, in this context, means the lead hip and lead shoulders (the body) moves away from the target line as the arms and club accelerate to impact. This is how the top players swing full out and still stay in balance. It’s also why you see the lead toe turn toward the target., and/or move away from the target line. Players that go up off the lead heel coming into the ball will usually pull that foot away. On force plates we observe weight moving first to the ball of the lead foot, and then quickly to the heel, away from the target line. Force plate traces show that great players and top ball strikers move differently with weight distribution and use ground force. Although there are different ways, there are definitely extreme important similarities in the high handicap amateurs.
You can be a very good hands and arms dominated golfer. I do not deny this. I teach arms and hands swinging to beginners and average golfers to train the swing. Sometimes any level of golfer may need more hands and arms instruction. But the top ball strikers have learned a much more reliable way to hit great shots under pressure. They depend on the power muscles to supply speed and consistency.