Does a balanced posture affect putting success?

How should I stand when putting?

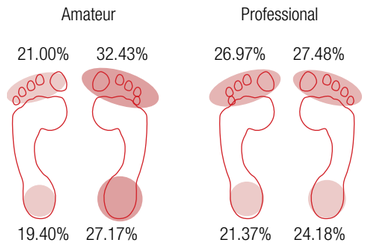
Despite the relatively small body movements involved during the putting stroke, how a player stands and moves during those few brief seconds may reveal how posture at address and through the stroke could play a more important role than first thought in determining putting success. Top players look to create a stable, balanced, and solid base, along with a fixed pivot point to execute the stroke consistently.[1,2] Without these, the putting stroke may not stand up under pressure.

Using the latest scanning technology, a study published in the *Annual Review of Golf Coaching*[1] measured the pressure under the feet of both right-handed amateur and professional golfers while addressing the ball and making a strike. Recordings of the weight distribution between the right and left foot and the toes and heels revealed that amateurs place on average 20 percent more weight on the right side than left, with more pressure through their toes than heels. Professional players have a more even distribution, spreading pressure more consistently. When measuring the movement of pressure throughout the putt, the study also identified that amateur players created more sway during the putt while the professionals remained relatively still.

With uneven weight distribution at address, the researchers suggested that the amateur player is already placing their body in an "unbalanced" posture before they attempt the putt, meaning that any subsequent movements will simply be compensating. It has been found that many right-handed amateurs place a greater percentage of pressure on the right foot than the left, and more toward the right toe (vice versa for left-handed players) when standing still. When in the putting address posture the same pattern is observed; golfers with handicaps greater than 10 performed significantly worse than those with handicaps less than zero when both were asked to balance on one foot.[2] Given the importance of postural stability before and during the putting stroke, using activities that improve balance can lead to a more repeatable and mechanically sound ball strike.

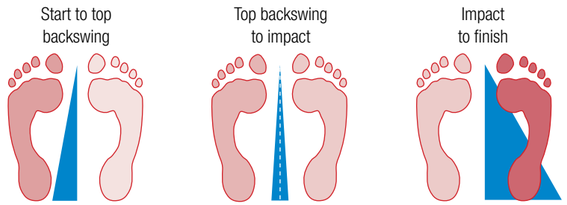
▶ ***Footwork*** *A good putting technique creates a stable posture and pivot point to allow the putter to be returned consistently from address to impact without adjustment. Research suggests that variations in balance at address, and in the extent of pressure movement during the swing, may account for differences in putting success between amateurs and professionals.*

The right balance

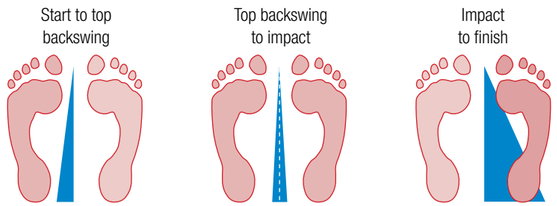


Mean area pressure values for different right-handed players

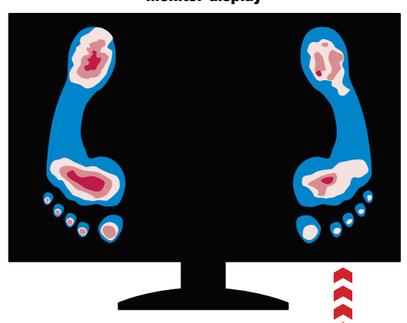
Pressure shift for amateur players

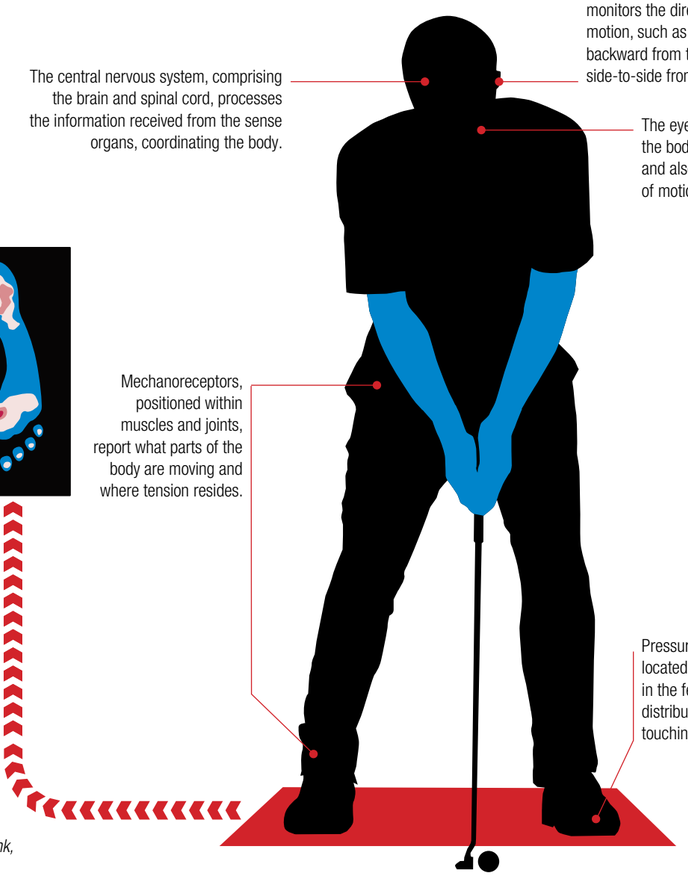


Pressure shift for professional players



Pressure putting





Putting stance on pressure-sensing mat

▲ ***Analyzing balance*** *This illustrates a typical pressure image of a right-handed amateur golfer at the address position for a putt. The pale pink, dark pink, and red colors show the depth of pressure. For this amateur, as for many, the distribution of pressure is greater on the right foot and on the toes. Research[1] indicates that on average 60 percent is on the right foot and 40 percent on the left. Professional tournament players have a much more even distribution of pressure across left and right and heel and toe for putting (50 percent split).[1] Having an unequal balance before starting the stroke will certainly impact on the balance throughout the swing, and it is likely that this will begin unwanted movements to keep the club on line through impact.*

▲ ***Putting posture*** *An important component of the complete golf swing, good posture at the start and throughout the movement reflects good balance, stability, and mobility. Research shows that golfers with poor postural balance at address may lose rhythm or tempo, which affects their mechanical efficiency.[1]*

What are the main mechanical stresses on the body during golf?

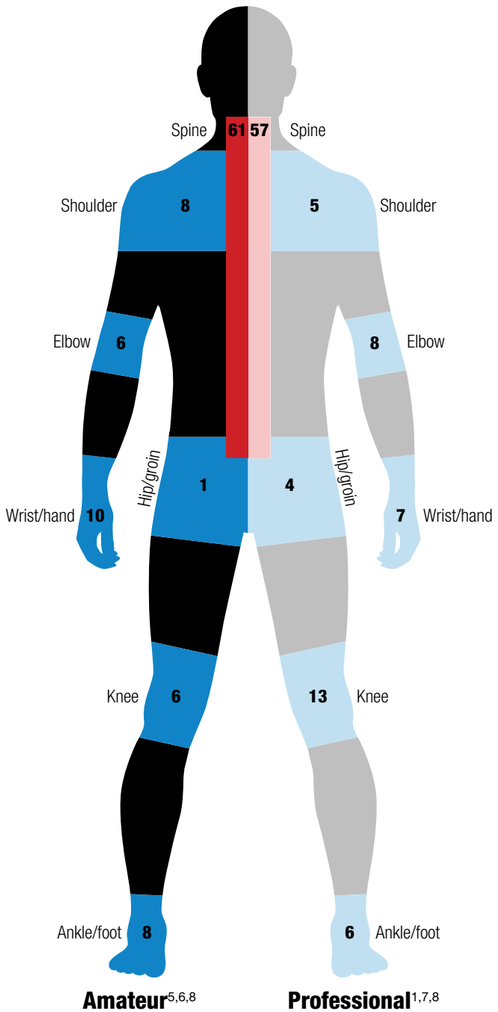
Will I get a bad back from playing golf?

The golf swing may appear to be relatively low-impact, given that the golfer remains in contact with the ground at all times, isn't hit by anything, and doesn't hit anything large. However, the explosive twisting, pulling, pushing, compressing, and bending motion during the swing causes considerable stress, particularly on the spine, which must withstand rotational loads caused when the upper body twists around the lower body. This is known as thorax–pelvis separation or the "X-factor stretch" (see pages 44–45), which occurs at the top of the backswing and the start of the downswing. The average recreational player, who is likely to play twice a week, swings the club nearly 20,000 times per year—can the body handle the mechanical loads placed on it when repeating this dynamic and explosive movement?

With the swing lasting little more than a second, and generating a clubhead speed of nearly 100 mph (160 km/h), the back has been calculated to produce compression loads in excess of 7000 newtons;[2] this means that for a 175 lb (80 kg) golfer there is the equivalent of around 10 times their own bodyweight acting on their spine. The back has evolved anatomically to provide reinforcement during compression, lateral bending, and torsion of the spinal disks to withstand these stresses during movement. However, amateur golfers can generate around 80 percent greater torque and shear loads than professional golfers because of an inefficient swing, thus leaving the weekend golfer prone to back problems.[2–4]

These problems may include muscle strains, slipped disk, or stress fractures of the vertebral body.[2] Most injuries of the back are cumulative—known as "cumulative trauma disorders" (CTDs).[8] A player who is out of shape, has poor address posture, or lacks mobility in the hips, mid-back, and shoulders, may eventually injure their back. The best way to improve your swing efficiency is to seek expert advice from a professional coach, who will also be able to advise on exercises to improve your mobility, flexibility, stability, and strength.

Percentage of muscle injuries

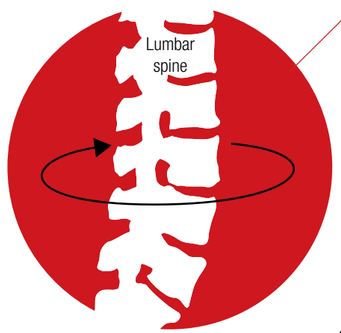


Twist and swing

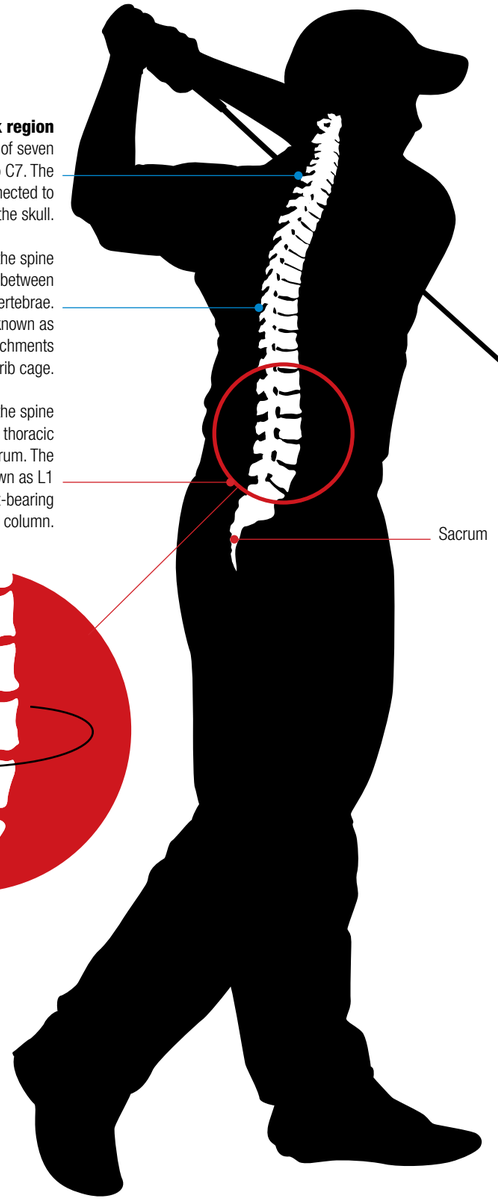
The cervical or neck region of the spine consists of seven vertebrae, known as C1 to C7. The top cervical vertebra is connected to the base of the skull.

The thoracic region of the spine is located at the chest level, between the cervical and lumbar vertebrae. The 12 thoracic vertebrae, known as T1 to T12, also serve as attachments for the rib cage.

The lumbar region of the spine is located between the thoracic vertebrae and the sacrum. The five lumbar vertebrae, known as L1 to L5, are the main weight-bearing section of the spinal column.



▲ ***Torque talk*** *The twisting force that occurs in the lumbar region during the swing may cause injury over time, if the golfer has not prepared and exercised adequately.*



▲ ***Lumbar loading*** *The lumbar's key role during the rotational movement of the swing is stabilization. Only marginal rotation—between 2 and 3 degrees of intersegmental twist—may be enough to cause the onset of micro-trauma. Torsional loading of the lumbar spine during the swing, often caused by poor hip or mid-back mobility, can lead to acute local soft-tissue damage, such as muscle strain or internal disk disruption.[2–4]*

◀ ***Spine-crunching*** *It is agreed by many experts that changes in the golf swing over time—to emphasize swing speed and ball distance—have led to an exaggerated lateral bending or "spinal crunching" within the lower regions of players' backs (the backward "C" shape of the spine). As the "X-factor stretch" has increased to generate greater rotational forces, greater loads are placed on the lower spinal column and supporting muscular structures.*

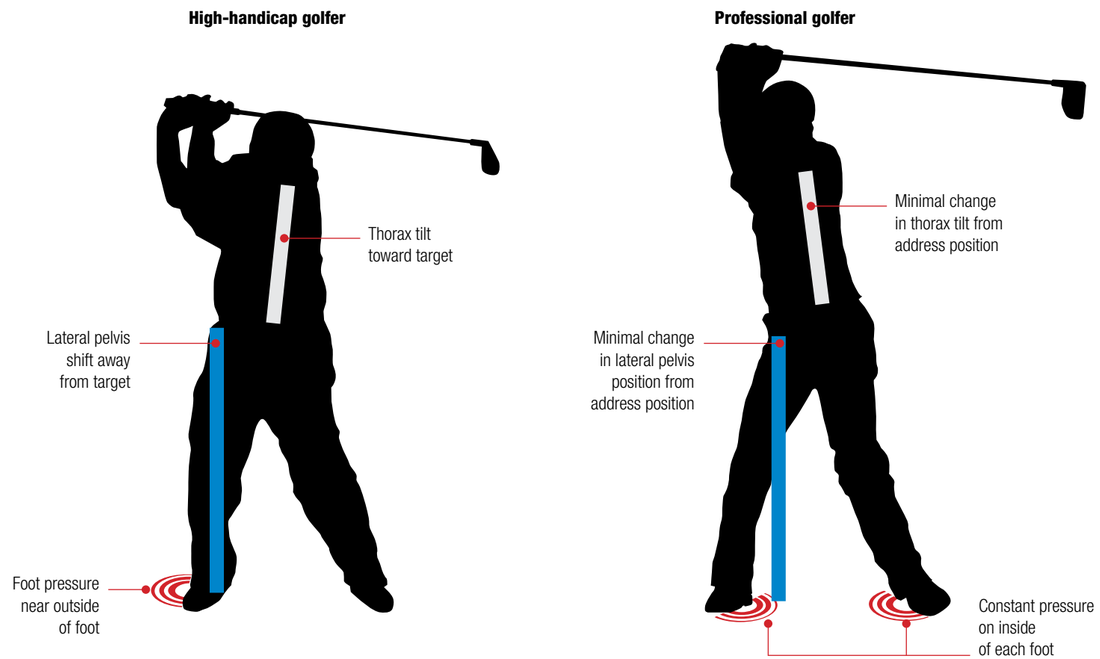
What are the core movements that set Tour pros apart?

What movements help Tour pros to hit the ball better?

From watching the Tour pro on television, most people can easily recognize their swings as powerful and efficient. Not surprisingly, the bulk of biomechanical studies[1] have confirmed that professional golfers achieve faster body rotation and a better-timed sequence of the rotating segments—both of which lead to faster clubhead speed compared with high-handicappers. These differences between professionals and less-skilled golfers seem fairly obvious, but what exactly are the characteristics of the swing which lead to faster body rotation and, ultimately, faster clubhead speeds?

▼ ***Tilt-shift*** *The image of the professional golfer (right) demonstrates two key characteristic core movement patterns at the top of the backswing. First, the thorax is tilted away slightly from the target (white line), keeping close to the address position, and second, the pelvis has maintained its lateral position during the backswing (blue line). These core movements are possible because of a balanced interaction with the ground. The professional golfer also shows reduced lateral shear forces and a constant pressure on the medial aspect of each foot (red lines). In contrast, the high-handicap golfer (left) has shifted the pelvis laterally (blue line), tilted the thorax toward the target (white line), and allowed foot pressure to move to the lateral aspect of the rear foot (red lines).*

Top of backswing

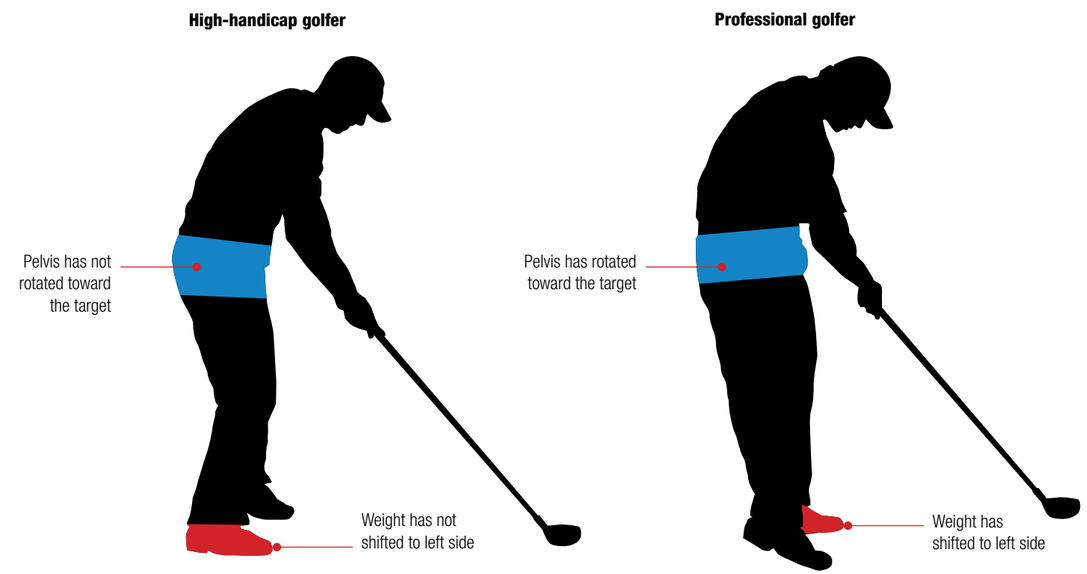


There are many finely tuned and highly coordinated movements of the arms, hands, and club that contribute to faster clubhead speed, but limb movements represent the end of the kinematic chain and these must be preceded by proper movements in the core—the pelvis and thorax. In terms of core movement, there are several key moves the professional golfers make that distinguish them from the average golfer. In particular, professional golfers maintain lateral stability and posture during the backswing to a greater extent. Core stability can be seen by looking for lateral tilting of the thorax and lateral shifting of the pelvis—professionals show minimal change in both of these key indicators during the backswing.[2,3] In the downswing, the professionals rotate their pelvis toward the target earlier than the average golfer—this is commonly referred to as "clearing the hips." In fact, professional golfers begin the downswing with pelvis rotation, whereas the average golfer tends to begin the downswing with thorax and shoulder rotation. Finally, at impact, the professional's pelvis and thorax are both opened toward the target.[3]

▼ ***Read the hips*** *A side-on view at impact: the professional golfer (right) has rotated the pelvis toward the target. The high-handicap golfer on the left has kept the pelvis square to the target at impact, limiting clubhead speed. In addition to rotating the pelvis toward the target, the professional has also shifted the pelvis toward the target during the downswing, evidenced by the right heel being slightly raised off the ground at impact.*

These core movements are achieved as a consequence of the golfer's interaction with the ground. Professional golfers impart greater anterior–posterior shear forces and reduced lateral shear forces on the ground compared with less-skilled golfers. The skilled golfer's foot pressure is to the inside (medial) and toward the heel (posterior) of each foot.[4] This interaction with the ground promotes stability at the transition of the backswing. This then sets up a quick, powerful rotation during the downswing, which is initiated by the anterior–posterior shear forces. The average golfer struggling with low clubhead speed could learn a great deal from studying the core movements of professional golfers.

Impact



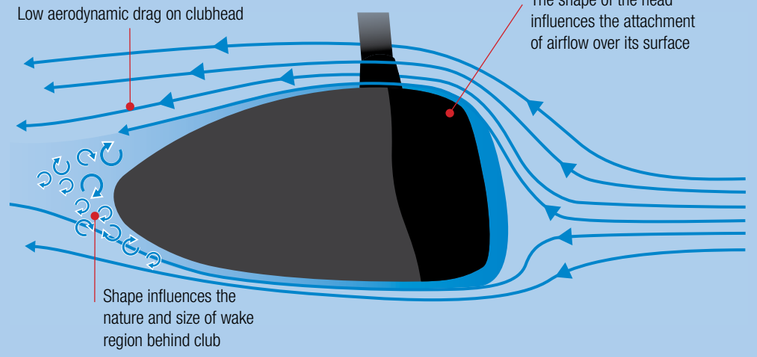
equipment: the driver

One of the most remarkable achievements in club design is the evolution of the driver. In golf, progress usually takes decades, but in the case of the driver, this can be measured in mere years. Club designers have continually pushed the boundaries of innovation, developing the size, shape, and construction of the clubhead to maximize driver performance. The most influential changes in driver design appeared in the mid-1990s with the use of titanium, well known for its higher strength and lighter weight than steel. Designers began creating much larger clubheads, while still meeting the weight specifications of a normal driver.

This in turn had the effect of creating a higher moment of inertia and subsequently making it easier to hit the ball straight even for off-center strikes. In a short space of time, clubhead volumes developed from 190 cc to 300 cc. The year 2000 saw the first 350 cc driver, followed in 2001 with a 400 cc driver and a 500 cc driver in 2002. At this point, the rulemakers began to propose limits on drivers as they were potentially seeing technology threaten to diminish skill level. So in October 2003, the ruling authorities imposed a 460 cc limit on clubhead size from start of the 2004 season.

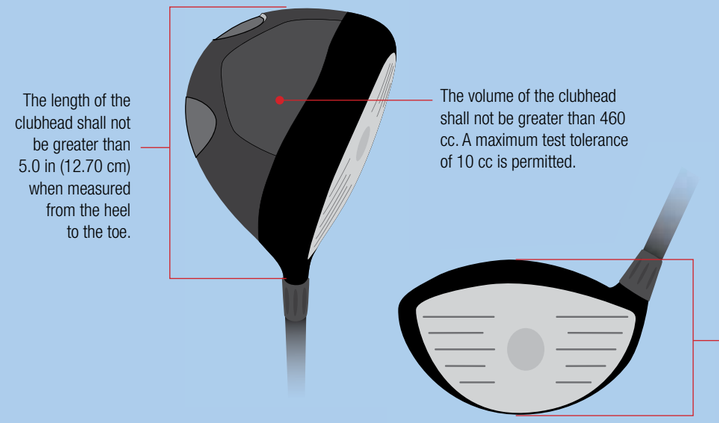
With restrictions of head volume introduced, club designers shifted their focus to explore shape, weighting, and material properties. Recently, attention has turned to predicting clubhead drag forces and identifying specific geometric features contributing to the total drag (pressure and friction drag) on drivers. With clubhead speeds exceeding 100 mph (161 km/h) prior to contact with the golf ball, the driver is a bulky, intrusive object which can generate significant drag force during the swing motion. The shape of the club has a definite influence on this force, and golf club designers must account for this while trying to optimize the club shape. Manufacturers' research has shown that the reduction in clubhead speed measured during player tests correlates strongly with the resulting increase in aerodynamic drag for extreme dimension clubheads (i.e. 460 cc). The use of computational fluid dynamics (CFD) has enabled engineers to make small modifications to both the face area and the transition area from the face to the body of the club to help keep airflow attached to the head surface and reduce aerodynamic drag.

Driving design



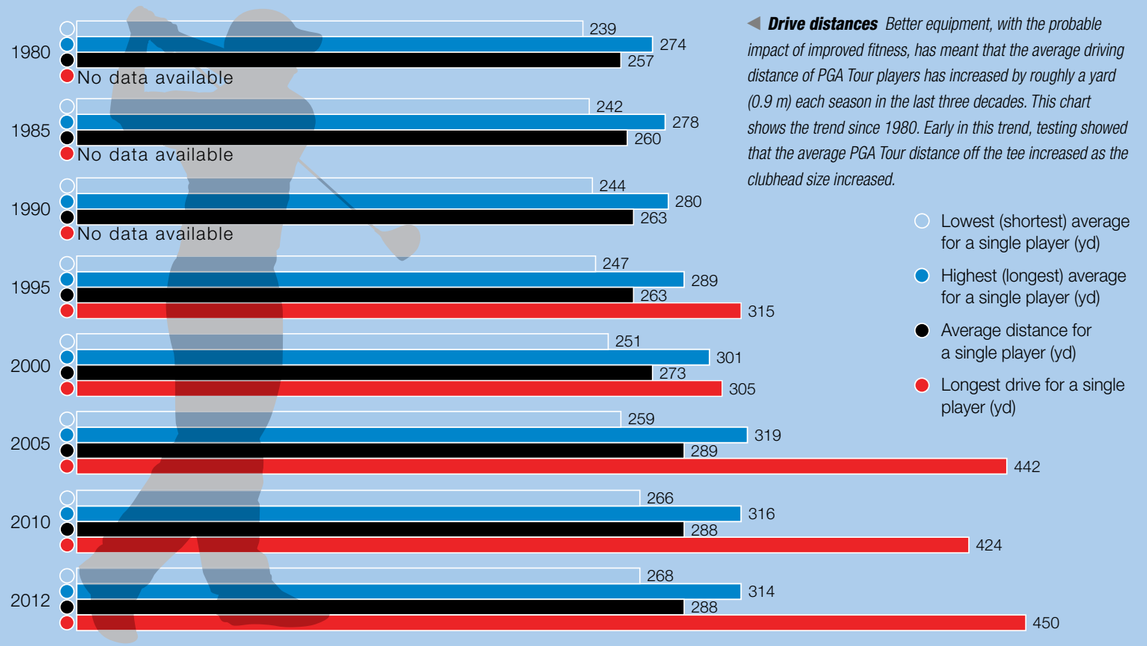
▶ ***Modeling airflow*** *Engineers are able to model clubhead designs by applying computational fluid dynamic (CFD) technology. These techniques, often used in the aviation and automotive industries, provide cutting-edge modeling to replicate airflow dynamics around the head. The aim is to ensure the airflow does not separate during the early stages of the swing, resulting in lower drag in all orientations, and thereby improving the overall design and clubhead speed. Drivers now have increased dimensions and high inertia with low aerodynamic drag forces, enabling increased clubhead speeds and greater drive distance for golfers.*

By the rule



◀ ***Clubhead dimensions*** *Rules governing clubhead dimensions were introduced in 2004 because of the trend toward increased driver head sizes. The Equipment Standards Committee of the Royal and Ancient determined that driver heads larger than those already permitted were not traditional and customary. Many clubheads have markings on the head to indicate approximate volume.*

Driving farther



◀ ***Drive distances*** *Better equipment, with the probable impact of improved fitness, has meant that the average driving distance of PGA Tour players has increased by roughly a yard (0.9 m) each season in the last three decades. This chart shows the trend since 1980. Early in this trend, testing showed that the average PGA Tour distance off the tee increased as the clubhead size increased.*

How effective is the Driving Accuracy statistic?

How do I measure my driving?

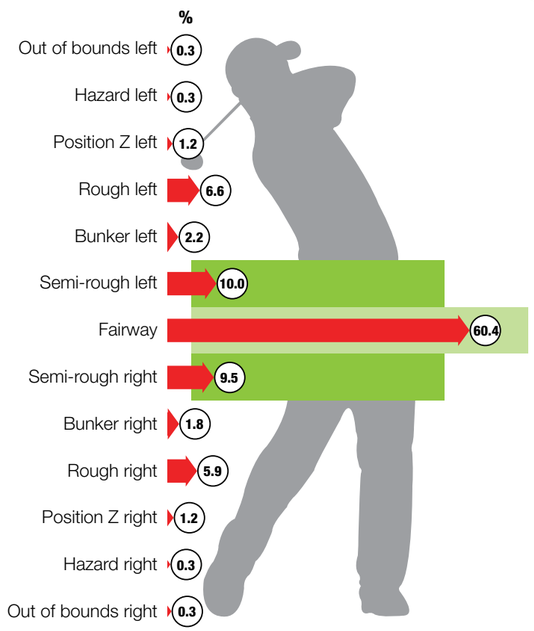
The drive is one of the seven distinct shot types in golf. Per round, to the nearest whole number, there are 14 drives on average. Driving statistics for the European and US Tours cumulatively track the number of fairways hit with the drive in each round. This measure of fairways hit or missed is termed the "driving accuracy" and this is used as the principal indicator of driving effectiveness. A drive is classified as being the first shot at all par 4s and 5s irrespective of the club used.

Drive results can be one of seven possibilities: fairway, semi-rough (or first cut), bunkers, rough, position Z (e.g. the middle of trees or gorse), hazards, or out of bounds. Data collected from the European Tour to elite amateur level show that the proportion of drive results which find the semi-rough, left or right of the fairway, can be as high as 35 percent, particularly where more links courses are played, and the average percentage is around 20 percent.

As the purpose of the shot type known as the drive is to find a position on the hole from where a successful approach may be attempted and the green in regulation found, finding the fairway itself is a secondary objective. With such a significant proportion of drive results missing the fairways and yet still providing positions from which a successful approach can be made, the traditional driving accuracy statistic is not a particularly useful guide to overall driving effectiveness.

However, the incidence of drive results that find a position from which a successful approach can not be made is between 10 and 20 percent for the most effective drivers. The least accurate drivers will find the rough, bunkers, or worse with over 20 percent of their drives, sometimes more than 25 percent and occasionally more than 30 percent. This range of 10–30 percent of inaccurate drives resulting in "undesirable" positions provides a far more accurate illustration of overall driving effectiveness than the traditional measure of fairways hit or missed.

Driving accuracy percentage



Reaching the green

◀ ▶ ***Margin for error*** *On this drive, the golfer with good course-management skills will be targeting the right half/right edge of the fairway to avoid the hazard on the left, knowing that if the ball goes slightly left of the intended target line, they will still be playing the approach from the fairway, and if slightly right, they will be playing from the right semi, the first cut on the right from where they know that they can still find the green with an approach shot. On particularly tight fairways with a hazard threatening on one side, the golfer may even be targeting the semi-rough on the opposite side, ignoring the fairway altogether.*

◀ ***Fair play*** *In 2011, 60.4 percent of the drives by Scotland's best amateurs (+2 handicap and better) found the fairways. Almost half of the remaining 40 percent (19.5 percent) found the left or right semi-rough. The green may still be reached from most of these non-fairway positions, including from the rough, and often from sandtraps.*