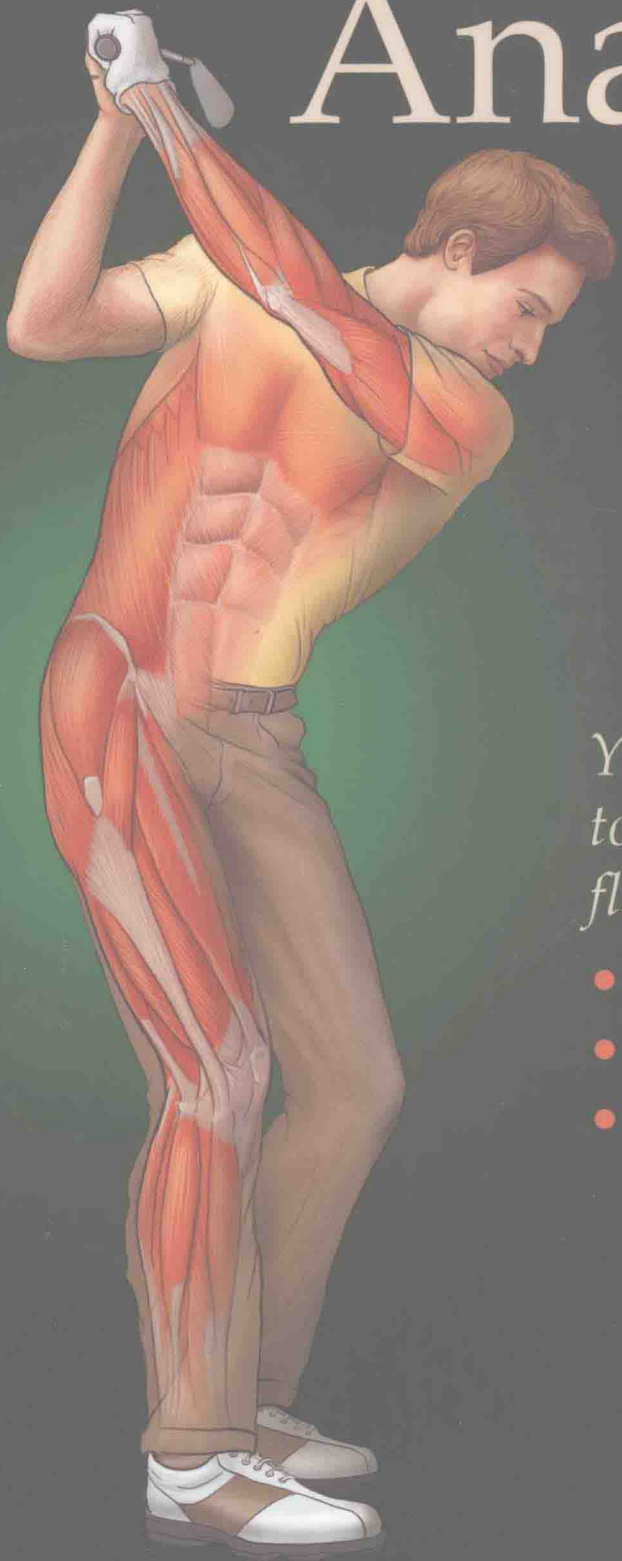
GOLF Anatomy



CRAIG DAVIES
VINCE DISAIA, CSCS

Your illustrated guide to increasing strength, flexibility, and power for:

- *longer drives*
- *more accurate shots*
- *consistent performance*

GOLF ANATOMY

Golf Anatomy	高尔夫解剖学

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Human Kinetics

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FOREWORD

Playing against the world's best golfers on the PGA Tour requires extreme mental and physical conditioning. During the 2009 season, my conditioning allowed me to make the cut in 24 out of 25 tournaments, finish 16th on the PGA Tour's money list, and represent my country on the victorious U.S. President's Cup team. To achieve these results and this level of consistency requires that every aspect of my golf game run on all cylinders.

The most notable change that has occurred in professional golf in the past decade is the necessity for players to maximize their physical skill sets. The fitness trailer that travels with the PGA Tour is busier every year as players attempt to maintain or gain an edge over their peers. Since starting to work with my good friend, Dr. Craig Davies, a few years ago, I have paid more attention to the fitness, nutrition, and physical side of my game. During tournament weeks, I make sure to warm up effectively for about 30 minutes prior to both my tournament rounds and pretournament practice sessions. I also make sure to spend the appropriate amount of time each day when I have finished play on my fitness regime and preventive physical therapy. My weekly program during the season is as much about increasing my performance as preventing injuries. As we all know, golf is a repetitive and stressful sport that can create a great deal of wear and tear on the body if you do not take care of yourself properly. Whether you are talking about professionals or weekend amateurs, it is not uncommon for at least one of the players in a foursome to use pain relievers to help him through a round. If you take care of your body, you should not have to rely on pain relievers.

While it is important to focus on golf fitness during the season, the off-season is when I have the chance to really make major changes to my physical skill sets. I think this is an important concept for both the amateur and professional player, especially those who live in colder climates and are not able to play golf during the winter. The off-season is the perfect time to really focus on your golf fitness and make changes to your body that will help develop your game in both the short and long term.

Golf Anatomy does a great job breaking down the various skill sets (balance, mobility, stability, strength, and power) and injury prevention exercises into simple-to-follow progressions. I have worked with Dr. Craig Davies for a number of years now, and many of the exercises you see within the pages of this book are the very same ones I have used in my own development. I encourage you to pay specific attention to the form you use during the application of these exercises and remind you not to rush through them. These exercises have made the difference in my game, and they can for you, too.

Hunter Mahan

PREFACE

The drastic increase in the popularity of golf over the past couple decades has spawned a revolution in the production of high-tech golf equipment and training devices. Everyone is seeking that magical new club, ball, or training aid that will help him hit the ball farther and score lower. However, in the past 30 years, even with all the improvements in ball and equipment technology, there has been *no* change in the average North American handicap. One major reason for this is that golfers, unlike other athletes, spend minimal time and energy improving their bodies' ability to properly move within the golf swing. Without this key ingredient, a golfer will not only fall short of his potential but will also put himself at high risk of injury.

When attempting to improve their game, golfers spend endless time and money on clubs and lessons without first improving the most efficient tool available to them: *their own bodies*. All golfers are interested in increasing distance, accuracy, and consistency, but they always look to do that with an expensive new club or a new and improved ball. However, faster and more lasting gains in all three of these areas can be achieved by improving physical fitness to allow the body to perform the necessary movements for an effective, powerful golf swing. Once this fitness is achieved, swing lessons become more efficient, new clubs hit farther than ever, and golf ultimately becomes much more fun.

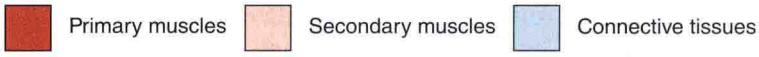
Fortunately, the importance of physical fitness for golf has begun to gain more attention. Tiger Woods' incredible workout regimes and consistency on the course have helped the fitness aspect of the game to begin earning the respect it deserves. However, even with this heightened awareness, most golfers are still ultimately unsure of what muscles are actually used in golf and how these muscles affect each and every swing. This unfortunately leaves golfers with an incomplete knowledge base and does not allow for workouts executed with specific purpose and in direct relation to the golf swing itself.

In *Golf Anatomy*, all of these connections are easily made so that you can have a clear and concise understanding of how your body functions during the golf swing. You will also learn how to train specific areas and understand how each one will directly assist in improving your golf game. Never before has a book so clearly and easily linked the two worlds of fitness and golf. Having the ability to fully understand each step of the process makes the learning and training experience more fulfilling, more motivational, more effective, and much more fun.

This book has ultimately been designed for a few different reasons. First and foremost, every golfer should have a basic understanding of how a proper golf swing functions. This is why the first chapter is dedicated to improving your knowledge of the basic key elements of a good golf swing. These are many

of the same things that golf instructors look for in their students and strive to improve upon to produce a better golfer. The true complexity of the golf swing could never be covered in one chapter, but grasping the main points mentioned in chapter 1 of *Golf Anatomy* will help you appreciate how forces are created in the golf swing and why it is so important to have a body fit for golf. Illustrations let you see what proper swing technique looks like as well as give you an inside view of what the muscles are doing at each point in the swing.

The second main reason for this book is to provide you with a clear and detailed picture of the muscles being used both during the golf swing and within various exercises. After all, the more you know, the better you can prepare. Detailed anatomical illustrations are provided for both the fitness section and golf swing section to show you exactly what is going on within the body during each movement, both on and off the course. The anatomical illustrations that accompany the exercises are color coded to indicate the primary and secondary muscles and connective tissues featured in each exercise and movement.



This intimate look into the body allows you to quickly understand not only which muscles are being worked in each exercise but also how those same muscles are utilized directly in the golf swing itself. This straightforward illustrated connection is unique to *Golf Anatomy*, and it is the easiest way to learn about both the body and the golf swing and how they so closely influence one another.

Third, this book was written to present you with numerous concise exercises that will help improve the mobility, stability, balance, strength, and power of the muscles that directly affect the accuracy, distance, and consistency of your golf swing. These will be presented through step-by-step instructions so that you can easily perform each exercise. Having these instructions combined with detailed anatomical illustrations allows you to train with a purpose and be able to understand how that training translates directly to your swing. Your own body is the most powerful and effective piece of equipment you can use on the golf course. The more knowledge and understanding you have of this tool, the more effectively you can use and improve upon it.

Another major benefit this book provides is information on preventing injuries. The golf swing is one of the most dynamic, explosive, and complex movements in all of sport. The golfer's body produces and absorbs some of the highest forces seen in the athletic world. This is evident in the fact that up to 80 percent of all golfers will experience *at least* one injury during the course of their golfing careers. Considering that more than 35 million people play golf in the United States alone, that amounts to more than 28 million injuries. One reason for the high injury rate is that the forces created in the golf swing produce up to eight times a golfer's body weight in compressive

forces to the spine. To put that into perspective, running—which is considered a high-impact activity that causes stress to the body—produces only three to four times a runner's body weight in compressive forces to the spine. The spine is just one of the many body parts that require both strength and mobility to endure the repeated high-velocity forces of each golf swing. Having to absorb all of these stresses with each swing is reason enough to keep your body as fit, strong, and active as possible. Inability to withstand such forces will lead to dangerous compensations, poor swing technique, and injury. Fitness helps prevent injury and promotes optimal performance on the golf course.

Although improving your physical fitness for better golf performance and reduced risk of injury is an important goal, it is not enough for us to just give you dozens of exercises and have you train at random. For this reason, the outline of *Golf Anatomy* was designed to help you understand the anatomy involved in the golf swing and how it can be used most effectively. Since you are training to improve fitness for a sport, not just to get bigger muscles, it only makes sense to arrange the chapters of *Golf Anatomy* in a *functionally* logical order. This unique approach to training was designed specifically with the golfer in mind and can be found only in this book.

Because of the dynamic nature of the golf swing, many parts of the body need to be stabilized while others are moving at high speeds. Golf definitely necessitates speed, strength, and power, but none of these can be effectively achieved without first having sufficient mobility, balance, and stability. These last three are the building blocks on which the first three depend. For this reason, the early chapters of this book focus on the mobility, stability, and balance of the golfer's body, and we have left strength and power for the later chapters. There is no need to completely master each section before moving to the next, but do not train solely for power if your mobility and stability are greatly lacking. This progression of exercises and chapters is easy to understand and easy to follow, and it is just as easy to achieve results in both your fitness and golf performance.

Achieving a body fit for golf will definitely reduce your risk of injury, but it can never guarantee an injury-free golf career. Since the golf swing is so explosive, injuries are bound to occur. For this specific reason, we have dedicated a chapter to the five body parts most commonly injured in golf. You will learn unique exercises for each body part that will help rehabilitate the area or avoid that specific injury. Knowing and understanding the most common injuries that can occur while you are playing golf can help you avoid putting yourself in a painful and sidelining situation.

With all this useful information, *Golf Anatomy* is truly written for a few different audiences. First and foremost, it is for any golfer who wants to avoid injury; improve fitness; and hit the ball farther, more accurately, and with more consistency. *Golf Anatomy* will help you understand the anatomy behind the swing and the tools to train that anatomy effectively. The second group that will benefit greatly from the information found in this book is teaching professionals. They will gain a much greater understanding of the

body mechanics found within the swing. Instructors often are not aware of or are unable to identify inefficiencies or physical limitations in their students' bodies. This is due to no fault of their own as they are masters of the golf swing, not of the body. However, having a better grasp of the physical anatomy of a golfer's body can help teaching professionals give lessons with greater effectiveness, better understand how to avoid injuries in their golfers, and provide sound advice as to how to improve areas of dysfunction. The third group that can use this book to further their knowledge is strength and conditioning specialists. Although they are experts in fitness training, they might not have enough understanding of golf swing mechanics to apply the correct training protocols. *Golf Anatomy* provides this in-depth detail of the golf swing and will shed light on how training programs can be designed to effectively target the important aspects needed for an efficient and powerful swing.

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My wife and closest friend, Andrea. You have never wavered in your patience and belief in everything I have attempted and consequently achieved, both professionally and personally. My life is better for the major role you play in it.

My mom, sisters, and dad. Each of you has been my crutch at an important crossroad in my life. Your unwavering friendship and love is beyond measure.

Each of the players, at all levels of play, with whom I have worked. You have provided me the opportunity to share in your growth, dreams, and successes. I appreciate the passion, commitment, and belief you all have in yourselves and the trust you have in me. I am honored to be asked to help guide you on your travels.

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And finally, the game of golf and all those who love the long walk outdoors. Thank you for the experiences and opportunities!

Craig Davies

To my parents, who have always supported me and have made me who I am today; to my wife, who inspires me with her love and helps me navigate life's journey; and to my sons, who truly give my life purpose and make each day a blessing.

Vince DiSaia

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CHAPTER 1

THE GOLFER IN MOTION

Picturing the world's best ball strikers conjures up images of effortless power and exceptional grace. Sergio Garcia, Alvaro Quiros, Rory McIlroy, and Geoff Ogilvy all seem to command the ball with power and balance. Picturing the average recreational golfer, perhaps one or all of your usual Saturday morning playing partners, often conjures up an image of a disjointed, uncoordinated movement that is at times complete chaos and futility. When a professional golfer hits balls, it seems like such an easy thing to do. However, the golf swing is one of the most complex movements in all of sport. Almost every joint and muscle in the body is utilized in some capacity during the golf swing. A weakness or deficiency in just one area can greatly reduce your ability to create an efficient swing. Lacking in more than one area can make generating and then transferring maximal force throughout the body extremely difficult if not altogether impossible.

One of the greatest misunderstandings of the average player, and sometimes even high-level players and golf coaches, is that speed and power in the golf swing is predominantly generated from the arms. This misunderstanding arose before high-speed video cameras, force plates, electromyography, and other types of expensive research equipment were used to measure forces and movements within the golf swing. In the prehistoric days of golf (any time before a few years ago), teachers and students could identify only what their eyes were able to see. Since the golf swing is such a quick movement, golfers were able to identify only the arm movement and the planes created by the arm and club. This thinking has drastically changed now that the golf swing has been analyzed and dissected using modern technology. You can't watch a PGA or LPGA event without having the commentators analyze a player's swing with the super-slow-motion bizhub camera. It is now evident that the arm and club actions are often a final thought in the actual development and execution of a golf swing.

A review of the driving distance statistics from the PGA Tour over several years reveals some interesting trends. Let's compare the number 1 player and number 50 player in terms of average driving distance for the years 1980, 1990, 2000, and 2008 (table 1.1). There were 20 players who averaged 299 yards or greater off the tee in 2008. The 50th player in terms of driving distance on tour in 2008 was hitting the ball farther than the 1st player in driving distance in 1996.

Table 1.1 Average Distance for 1st and 50th Players in Driving Distance on PGA Tour

Year	1st in driving distance	50th in driving distance
1980	274.3 yd	261.0 yd
1990	279.6 yd	266.4 yd
2000	301.4 yd	277.5 yd
2008	315.1 yd	293.3 yd

The recent increase in the distance off the tee can be attributed to many factors, the most obvious being improved ball, club-head, and shaft properties. Player fitness and the emergence of true athletes in golf's greatest tour, however, are also major contributors to this phenomenon. In the 1970s and even the 1980s, the number of true athletes on the professional golf tours was rather small when compared to today. The emergence of players such as Tiger Woods in the 1990s and increased purses made it more enticing for athletes to choose to pursue golf as an athletic career. If you look at the men on the PGA Tour these days, the transition of today's players from merely golfers to world-class athletes is obvious.

Although the women's tour has been much slower to adopt this emphasis on fitness, the change is occurring. Annika Sorenstam really pushed fitness in the women's game into the mid-2000s, and she dominated the game like no other member of the women's tour had. The many young stars of today's game, including the long-hitting Vicky Hurst, are incorporating fitness to help them achieve and maintain their success. Today's golfers at the high school, collegiate, and tour levels are bigger, faster, and stronger than they were in the past. The game has been forced to adapt to this new breed of golfer by instilling new rules on balls and clubs and making courses longer and more difficult. To keep up with these changes, golfers must continue to adapt themselves. This means maximizing their bodies to keep up with their peers. The recreational golfer is also affected by these changes. Many of today's new courses are being built longer in response to the turbo-charged play of today's top players. These changes in golf course architecture make it more difficult for the average player to compete. *Golf Anatomy* helps bridge that gap for the amateur by presenting an easy-to-follow manual for improving your golf fitness.

Developing Proper Technique Through Golf Fitness

If there is one thing about golf that we have known for a long time, it is that proper technique is important. Swing coaches have been consulted for many years to help players dial in their swings with improved technique: correct

grip, stance, takeaway, and so on. Coaches use an endless number of drills to help their golfers obtain certain feels and positions within the swing. However, the biggest revelation when it comes to the perfect way to swing a golf club is that there is no perfect way. A club can be swung an infinite number of ways. Many end with the same result—the club face hits the ball squarely at impact. The difference is the efficiency of the swing. If you put Hunter Mahan's swing next to Jim Furyk's swing, you would notice a huge difference. Obviously, both of these players are phenomenal golfers, and they are both considered world-class ball strikers. Although their swing styles look completely different, both have an efficient downswing that transfers a very high percentage of the energy produced during the downswing into the golf ball at impact. Comparing your swing with your favorite player's in an attempt to mimic his every movement often is not a sensible way to improve the technical side of your game. The key is to make your body capable of producing the most efficient swing that *you* can produce. The future of golf no longer relies solely on one standard swing to copy, but rather is a meshing of proper mechanical technique and efficiency of movement. Every player has an unique range of available motion in his joints, level of strength, and balance inconsistencies. Only by maximizing his own profile can a player truly achieve optimal competence.

One of the biggest problems that the common golfer encounters is the inability to achieve and reproduce positions that a swing coach desires. This is frustrating for both coach and student. Until recently, many people never considered that the golfer's body was the obstacle. If your car consistently drifts to the right when you are driving, you immediately suspect the alignment of your car needs a mechanical tune-up. It seems absurd we didn't think that a golfer who constantly moved in an undesirable direction might need a mechanical tune-up as well. In those prehistoric days, it was assumed that the golfer simply was not skilled enough to produce certain movements. So, the swing coach would have to work around those technical limitations.

Millions of dollars are spent each year on golf lessons in the United States alone. Even with this large monetary investment, the average North American handicap has not changed in the past 30 years. We must consider the fact that teaching of the golf swing has concentrated on changing only the aesthetic product (the movement) without developing the quality of the underlying machine, which can either enhance or inhibit the ability to create movement. Each joint in your body has a range of motion that is specific to you. Each of us is different. Some people have great mobility, and some are limited in their range of movement. If you can't rotate your shoulders through a full range of motion when you are at rest, how can they move through a full range of motion during the golf swing? It doesn't make sense to expect them to do so. The problem is, when learning to hit the ball better, many people try to move into positions that aren't physically possible because of limitations in range of motion. Not until the body improves to allow for greater range of motion and strength will a golfer be able to attain these positions during the golf swing.

This is why you need to achieve a certain level of golf fitness before expecting to make the desired swing changes properly and efficiently. The golf swing is, in fact, a very unnatural movement. You cannot expect your body to perform this task in the desired manner without the proper preparation.

So what is golf fitness, and how do you achieve it? Each sport has its own specific demands, and golf is no exception. However, golf fitness is much different from the fitness people go to the gym to achieve. We have all heard that golf is a game of opposites. This is no more evident than when you watch Anthony Kim or Andres Romero drive the ball more than 300 yards. How can someone with such a small frame crush the ball so far? Obviously it takes more than brute strength. Rather, it is the result of a perfect combination of a number of skill sets including, but not limited to, adequate mobility, stability, and balance. *Golf Anatomy* will show you not only which exercises are effective for producing an improved golf swing but also the order in which they should be performed.

The major characteristics that need to be trained for golf fitness are mobility, stability, balance, body awareness (proprioception), strength, and power. The order in which these specific components are trained is just as important as the components themselves. The correct progression of exercises provides the most efficient training and diminishes the risk of injury. Training for power before you have obtained an adequate amount of mobility increases the risk of injury and results in minimal golf-specific translation of fitness to the golf course. A solid foundation of mobility and stability is the essential building block for developing a body that is truly fit for the golf swing.

Generating Power and Speed

At the sport's highest levels, it is increasingly common for players to adapt their swings for improved efficiency in power generation. Our goals in *Golf Anatomy* are to introduce exercises that will help you achieve greater golf fitness and introduce some of the important principles used by today's top teachers and players when developing a technically efficient golf swing.

Generating speed with the arms creates many of the swing faults found on driving ranges throughout North America and the world. For maximal power creation with minimal negative stress on the body, the ground must be the first link in the chain of energy transfer. Newton's third law of motion states that for every force applied by one object onto a second, an equal and opposite force is applied from the second object back onto the first. As such, using the legs to drive forcefully into the ground results in the ground pushing back up into the golfer's body with an equal magnitude of force. The force the ground transmits into the golfer is known as the ground reaction force (GRF). GRF is then transferred up through the legs and into the pelvis. From the pelvis the force is transferred into the golfer's core, shoulder complex, arms, and, finally, the golf club and ball. Transmitting this energy from the ground to the ball with the most efficiency is what allows you to create the most power your body will allow.

This energy moves through what is known as the body's kinetic chain. The different parts of the body act as a system of chain links, whereby the energy or force generated by one part of the body (or link) can be transferred successively to the next link. The optimal coordination (timing) of these body segments and their movements allows for the efficient transfer of energy and power up through the body, moving from one body segment to the next. Each movement in the sequence builds on the previous segment's motion and energy. The result of this transfer and summation is what determines club-head speed.

This kinetic chain is the linkage system that connects adjacent joints and muscles throughout the entire body. A weakness or injury in one area of the body impedes the transfer of energy. The body compensates for this blockage by overusing or misusing other body parts in an attempt to make up for this lost energy. In an efficient golf swing in which the legs generate the majority of the power, large muscles contribute to force generation. When a weakness is present along the body's kinetic chain, the energy produced by the legs is unable to transfer effectively into the core and arms. As a result, the smaller muscles surrounding the area of weakness are placed under great stress. In time, this will lead to overuse injuries within the joints and soft tissues (the muscles, tendons, and ligaments) and make an efficient swing impossible.

We must clarify what we mean by the word *weakness*. When referring to a weakness in the body's kinetic chain, we are not referring strictly to a lack of muscle strength. We also include deficits in joint motion and body awareness. Having proper ranges of motion in each of the body's segments and proper awareness of each of these segments is as important as the strength in each muscle. Therefore, weakness can mean a deficiency in strength, range of motion, or body awareness.

Major Muscles and Joints Used During the Golf Swing

The golf swing involves nearly every muscle and joint in the body. As such, it is very difficult to pick just a few to highlight as the most important. For simplicity, we have attempted to highlight a variety of the major muscles and joints utilized during the various subsections of the full golf swing. This list is not all-encompassing but does provide a solid basis.

Upswing, or Backswing

In general, the upswing phase (figure 1.1), also known as the backswing, is performed with much less tension and physical stress throughout the body than the remainder of the golf swing. In this phase, balance, proprioception, and joint and muscle mobility are often more important than actual muscle strength. Having sufficient external rotation and retraction of the trail-side shoulder complex (the right shoulder in a right-handed golfer) and abduction, internal rotation, and protraction on the target side (the left shoulder in a right-handed golfer) while also possessing sufficient internal rotation of the trail hip,

external rotation of the target hip, and spinal rotation is more important than how strong the big muscle groups are. The problem with many golfers' fitness programs is a lack of time spent on increasing mobility or flexibility. If a golfer is restricted in his ability to move his body into a desirable position while remaining in balance during the upswing, the remainder of the golf swing is negatively affected regardless of the muscular strength or explosiveness of that athlete.

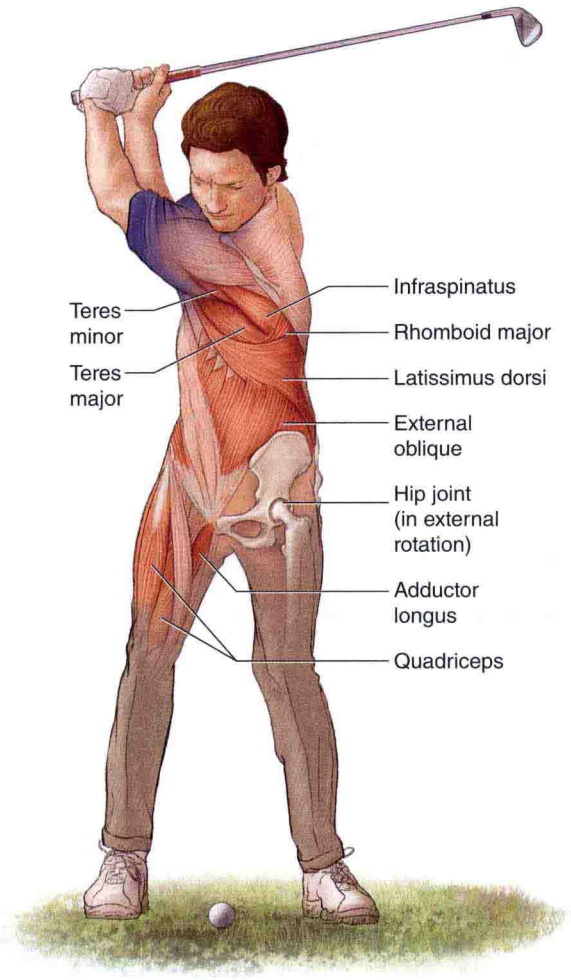

Figure 1.1 Muscles used during the upswing phase.

Although this phase of the swing uses mostly a golfer's mobility, some muscles provide a stable base so others can maximize their movements. During the upswing, the golfer must load the quadriceps, gluteus medius, and gluteus maximus in the trail leg and the obliques as the golfer coils toward the top of this phase of the golf swing. When these muscles work efficiently, the latissimus dorsi, infraspinatus, rhomboids, obliques, and multifidi can elongate properly to achieve the correct, full position of the upswing.

A great deal of time during golf lessons is spent attempting to attain positions in the backswing. Average and even high-level golfers spend very little time on the downswing or follow-through. During fitness training, most golfers do work on developing adequate motion throughout their bodies. However, many golfers may be unable to properly achieve the positions the golf professional wants. When positive changes are not seen, the result is frustration for both players and professionals and may lead to injury and poor performance. When golfers increase their mobility to match the motion the instructor is trying to get them to create during the upswing, more time can be spent learning the downswing, impact, and follow-through phases of the swing.

Downswing

The transition from the upswing to the downswing (figure 1.2) requires great coordination by the athlete and an ability to separate the lower body and pelvis from the upper body. The transition between these two phases of the swing is initiated by the golfer moving the lower body into position to allow for the greatest muscular efficiency. One of the primary objectives is to position the target-side knee over the outside aspect of the target foot. This puts the golfer in proper alignment for the quadriceps muscles to contract and straighten the knee, the gluteus maximus muscle to contract to create hip extension, and the muscles of the hip rotator cuff (piriformis, gluteus medius and minimus, and obturators) to contract to create both lateral stability within the hip and internal rotation of the hip joint, all on the target-side leg. The trail-side leg uses the quadriceps, adductor magnus, hamstrings, gluteus maximus, and gastrocnemius muscles to create knee extension, hip extension, and ankle plantar flexion to help drive the golfer's weight onto the left side. The activation of the muscles in the legs helps drive the golfer into the ground and position the player so that the arms are able to move into position and create the desired angles of attack.

In the core, the obliques and psoas major are highly activated, creating a crunch-like position as the golfer's hips extend and his pelvis tilts in a relatively posterior fashion (the belt buckle starts to point up) while his chest remains over the ball. The target-side latissimus dorsi helps pull the golfer onto his target side while countering the force generated by the pectoralis muscles on both sides of the golfer's body.

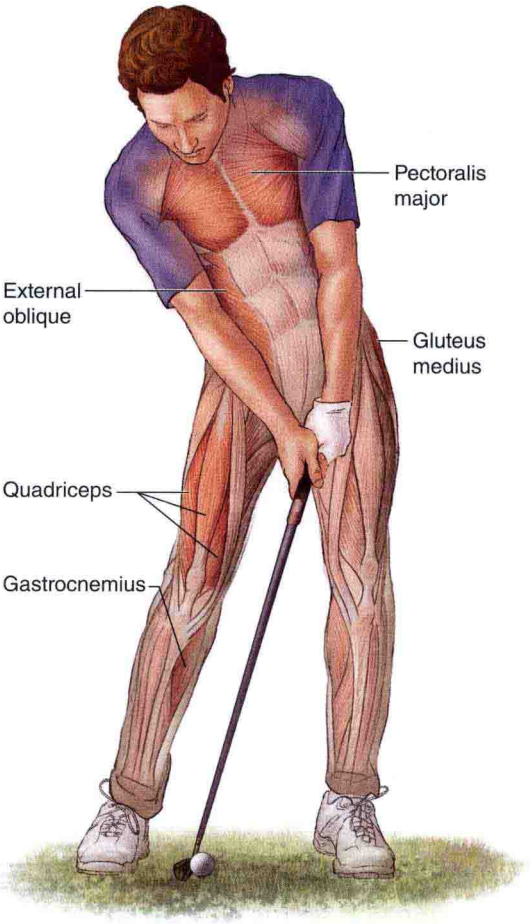

Figure 1.2 Muscles used during the downswing.