

The USTA Newsletter for Tennis Coaches

High-Performance Coaching

Are Tennis Players Eccentric?

by E. Paul Roetert, Ph.D. and Todd S. Ellenbecker, PT

No, this is not a sport psychology article. Although some tennis players *may* be a little different, this article will focus more on the physical aspects of the sport. Specifically, we'll take a look at how different muscle groups function during various tennis strokes.

In tennis, muscles need to perform in a variety of ways. Muscular endurance is important because of the repetitive nature of the sport. However, muscular *power* also is important because of the strength and speed needed for explosive movements in getting to the ball and hitting each shot. In addition, there are two types of muscle actions that occur when hitting tennis strokes: "concentric" and "eccentric" (there's that "eccentric" term you saw in the title). In a concentric action, the muscle fibers contract and shorten; in an eccentric action, the muscle fibers lengthen. Understanding how and when different muscles are used during tennis strokes can help us become better tennis coaches.

Let's take a look at Samantha. Samantha is a fine player. She's actually achieved a national

ranking in her age group. She has steadily improved each year she's been playing and enjoys competing. However, she'd like to put a little more pace on the ball or as her coach says, "hit a heavier ball." When asked what he meant by hitting a heavier ball, he explained that he wanted Samantha to hit the ball with more pace and depth on a consistent basis. If you were Samantha's coach, how could you help her in achieving that goal?

Well, from a coaching perspective you can certainly improve her technique. The article and sequence pictures on pages 5 through 8 describe some key principles in producing more forceful strokes. In addition, you can improve Samantha's strength and power by training the appropriate muscle groups. The exercises on page 10 are excellent for players wanting to hit more explosive shots.

But before we work on technique or start performing strength and power exercises, we should understand some basic anatomy and movement patterns that occur during tennis strokes. The human body is made up of some 600 muscles, and the beauty of the sport of tennis is that many of these muscles are used when playing. That's why tennis gives us such a great workout. The key is to utilize these muscles as effectively and efficiently as possible to produce the most coordinated movement patterns.

Lower Body

Because players are hitting the ball harder than they ever have before, speed has become tremendously important in the game. Players may have to cover several miles during a match, and most of that is made up of short sprints

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with a variety of direction changes. Research shows us that although tennis may be largely one-sided in terms of building the upper body, the strength and power demands for the lower body are quite similar for both left and right sides. One important consideration for tennis players is the balance of strength between the quadriceps and hamstrings. This is termed the "quadriceps/hamstring ratio." Players should be sure to strengthen both the quadriceps and hamstring muscles since performing resistance training with only one group may lead to imbalances.

An example of how the quadriceps muscle works can be demonstrated in the split step. When players land in the split step, the quadriceps muscle works eccentrically to decelerate

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USA Tennis High Performance Coaching Program Update

Our continued goal of the *High-Performance Coaching Newsletter* is to provide articles and information that are relevant, practical and on the cutting edge of tennis for all coaches throughout the United States.

In this issue, we stay true to this goal by providing the latest on the modern game and the link between world-class technique, core body strength and physical conditioning. You will notice this theme in the feature article by Paul Roetert, Ph.D., the sequence feature by Nick Saviano and the sport science article by Noel Gressner.

We hope you enjoy this unique theme approach to the newsletter, and we look forward to your comments, which can be sent to us at Coaching@usta.com.

Sincerely,

Nick Saviano
Director, USA Tennis Coaching Education

Paul Lubbers, Ph.D.
Administrator, USA Tennis Coaching Education

USA Tennis High Performance Coaching Program Update

The USA Tennis Coaching Education Department continues to accept applications for the USA Tennis High Performance Coaching Program for 2002 and 2003. The program is intended specifically for the high-performance coach who is working with players who are striving for excellence in competitive tennis (i.e., sectional junior players to collegiate and young professionals). See page 12 for dates, locations and application deadlines.

Applications for the 2002 and 2003 program dates are available by contacting 305-365-USTA or e-mailing us at Coaching@USTA.com. We encourage all interested coaches to apply as soon as possible.

USA Tennis High Performance Coaching Program Attendance

The following list of coaches attended the January 2-8, 2002, USA Tennis High Performance Coaching Program in Key Biscayne, Florida, and successfully completed all three phases of the program. Congratulations coaches!!

Jorge Andrew
Columbia, SC

Ashley Hobson
Stone Mountain, GA

Darren Richer
Upland, CA

Dave Brown
Pembroke Pines, FL

Tom Kelly
Ormond Beach, FL

Roberto Saad
Miami, FL

Michael Burge
Bonita Springs, FL

Kathy Kolankiewicz
Albuquerque, NM

Robby Salum
Sarasota, FL

Michael Center
Austin, TX

Brett Kurtz
Coconut Creek, FL

Daniel Spatz
Miami, FL

Bill Clark
Cooper City, FL

Jo Ann Kurz
Boise, ID

Keith Swindoll
Tuscaloosa, AL

Gregory Contro
Lake Bluff, Ill

Holger Nickel
Idaho Falls, ID

Christine Tharp
Cherryville, NC

Doug Eng
Medford, MA

Ken Obermeier
Orlando, FL

Scott Tharp
Cherryville, NC

Gabriel Ferrer
Sarasota, FL

Claire Pollard
Evanston, IL

Joni Van Ryck De Groot
Miami, FL

USTA Professional Circuits: Progression to the Pro Level

by Paul Annacone

The pathway to the top of the world's tennis stage has long been a topic for debate. We have a particular challenge in the United States to find a way to serve our players' needs to help them get their foot in the door. Our professional circuit programs address that issue. The concept is to open the door to the professional tour, and from there, the players have to work their way to the next level, which would be the main ATP and WTA Tour events. This has been a work in progress, and the staff has done a terrific job in raising the number of opportunities and awareness of these level events. From January to June, an American player won every men's challenger event in the U.S. This is a wonderful testimony to the impact these events are having.

Although there are a few different ways to reach the elite levels of professional tennis, by setting in place a structure with a multitude of opportunities for our aspiring players to earn ATP and WTA points, we have created a smoother transition. Instead of our young players flying all over the globe to compete for precious ranking points, we now have 100 events at the initial professional levels that allow American players an opportunity to open that door to the top.

The other pathways to the top of the game are:

1. Jump from ITF junior status directly into the elite professional level (this is done through wild cards and management company help).
2. Progress through Federation help, which is a part of the circuit impact, satellites, wild cards and training opportunities.
3. The BIG BANG theory. The unique player that has a huge breakthrough at a major professional event.

Recently, I was asked, "How many events is the correct total number to have for our players?" My response was, "I can't tell you."

Our goal is to help set up a system to offer the opportunity for our players to progress through the initial stages of professional development in an economical and efficient way. That is being done. Are there currently too many events? Not enough? I still cannot answer this. I feel we need to take a hard look at where the events fall in the calendar and if they are meeting our goals. The total number is not as important as where they are located in the calendar.

We have a specific challenge with regard to the women's game. Due to the age eligibility restrictions, our young women have to decide where and when they play their 8, 9 or 10 events. This is a shame. We finally have been able to set up a system here in the U.S. that can take the pressure off our young women players (a main concern, along with physical burn-out) and give them numerous opportunities to break into the professional ranks. But now they are not allowed to pursue this in an unrestricted way. In essence, we have added pressure to them by saying you only have "x" amount of opportunities per year to break



Ashley Harkelroad (left), the 2002 Junior French Open finalist, possesses an ITF junior ranking of No. 16 in the world and a WTA ranking of No. 227. Brian Vahaly, the 2001 NCAA runner-up, has improved his ATP singles ranking from No. 403 to No. 118 in 2002.

through. This is a direct contradiction to one of the intents of the rule. Now our young girls are trying other means to increase the number of competitive opportunities and reach the next level. This is done primarily by ITF junior events (due to the fact that we have a limited national schedule and the global competition is an asset to help players acclimate to professional life). Unfortunately, we do not have a plethora of those events in North America.

This forces our young players to travel more and adds to the stress of the transition. Whereas if the age eligibility rule was modified, they could stay here in the U.S. and pursue their breakthrough in our circuit events unencumbered. Circuit events also do not provide the same amount of stress as WTA Tour events.

The stress of professional tennis will always be there. I feel that if we, as parents, coaches and mentors, can do a better job dealing with the extraneous events that occur in the act of pursuing a pro tennis career, our players will deal with the successes and failures in a much more healthy manner. This is an incredibly competitive field, and it is our responsibility to educate ourselves and our players as much as possible to help deal with the emotional roller-coaster ride of professional tennis life.

One thought I like to keep in mind when discussing this with young players who pursue excellence in anything is that this activity is not who you are, it is what you do. I feel with this motto it will help alleviate some of the pressure.

Thanks to the USTA Professional Circuit staff and volunteers who continue to pursue ways to enhance the opportunity for our players to reach their potential.

Are Tennis Players Eccentric?

the body as the knees bend. This is a critically important factor in the split step, and the use of exercises like the lunge and partial squat are examples of exercises that strengthen the quadriceps for tennis players. The quadriceps muscle also is used concentrically during the serve as the body is propelled vertically up towards the ball prior to ball contact.

The hamstrings are the long muscles behind the thigh that provide power to the legs to extend the hip and bend the knee during the propulsion phase of running. Sprinters have large, well-developed hamstrings since they must propel themselves forward at fast, maximal speeds to excel in their sport. The hamstring curl exercise is one of the best ways to strengthen the hamstring in an isolated fashion.

In the lower leg, the gastrocnemius and soleus muscles (better known collectively as your calf muscles) provide explosive power to the leg during the push-off phase of walking and running. The calf muscles are much larger than the muscles in the front of the lower leg. The primary muscle in the front of the leg is the anterior tibialis muscle. This relatively small muscle works eccentrically when your heel touches down to prevent your foot from “slapping” the ground during running. Coaches often use their ears to determine whether an athlete has weak anterior tibialis muscles since these athletes will make very loud slapping noises during running, due to an inability to control the foot upon impact with ground.

Mid-Section

Part of the reason that tennis has changed so much over the past 25 years is that racquet technology has changed. Racquets are bigger, stiffer, wider, stronger and longer than they used to be. Because of the improvements in technology, players are able to hit the ball harder than ever. Players have adjusted and are frequently hitting the ball with open stances. These open stances produce a tremendous amount

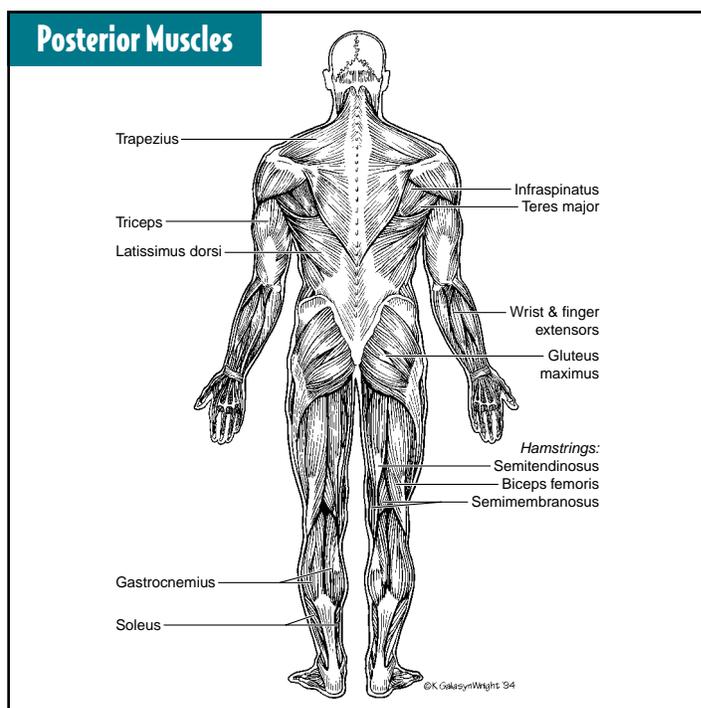
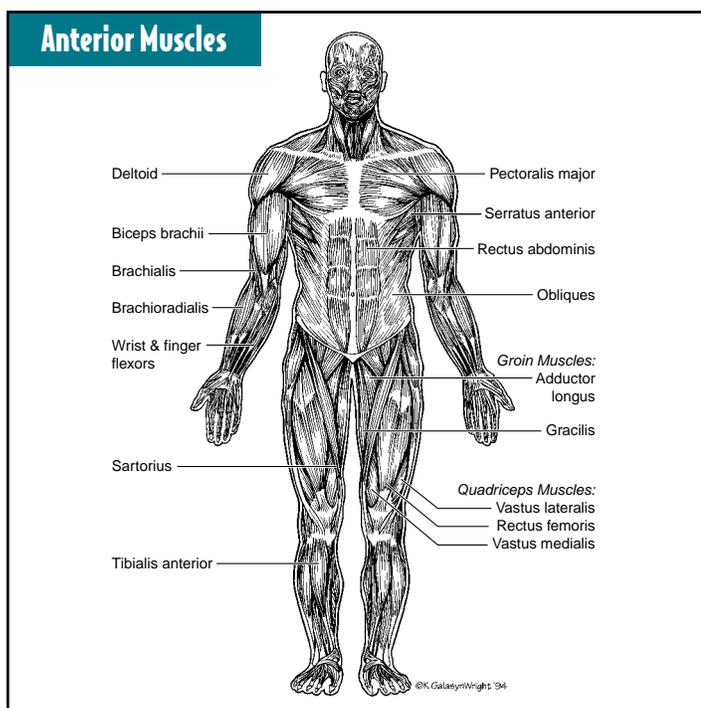
of body rotation, therefore putting a lot of stress on the abdominals as well as the low back musculature. Research shows us that in tennis players the abdominals are stronger than the lower back muscles. This is in contrast to the general population. During tennis-specific movements, the abdominal and lower back muscles must work both concentrically and eccentrically to provide stability to the body especially during trunk rotation. Because of the research showing that abdominals are stronger in elite tennis players, sports medicine professionals and sports scientists have begun recommending exercises to strengthen the obliques (muscles that rotate the trunk) and erector spinae or lower back muscles (muscles that extend the spine) in addition to the traditional sit-up exercises. Sit-ups that include some form of rotation will help strengthen the obliques.

An example of an exercise that strengthens the erector spinae would be the “superman” (in Samantha’s case “superwoman”) exercise. This exercise is performed by having the player lay on his or her back and raise the arms and legs off the ground, just slightly arching the back. This serves not only to strengthen the lower back muscles, but also helps to promote muscle balance in the trunk.

Upper Body

As we pointed out, the ball is now being struck much harder than before. You can imagine the stress this can put on the dominant shoulder. Power is at a premium nowadays in the modern game. In addition, throughout a three-set tennis match you may hit more than 1000 balls. Therefore, muscular endurance is critical as well. We also want to prevent injury, so we cannot neglect the non-dominant side of the body either. Research shows us that the internal rotators of the shoulder (muscles in

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Angular Momentum and Core Strength Keys to Success In the Modern Game

by Nick Saviano

This sequence article is an obvious departure from previous articles. We are going to illustrate key points in technique and strength and conditioning issues by using sequence pictures from three different strokes.

The first is the resurrected Vince Spadea (after dropping from 20 to the 200s in the world ranking, he is now back in the Top 100) who possesses one of the best two-handed backhands on the tour. The second is Andy Roddick hitting one of his huge serves. The third is Jennifer Capriati hitting a powerful forehand return.

Over the past 20 years, professional tennis has changed significantly. Athletes are bigger, stronger and better physically trained and conditioned. There has been changes in equipment, specifically larger racquet head size, increased strength and length without an increase in the weight. These changes have created a minor metamorphosis in technique with the players generating increasing racquet head speed that results in more power and spin on their shots. Simultaneously, these players must deal with increasing power and spin from their opponents while having significantly less time to respond. All of this has profoundly affected strategy and tactics in the game.

The intent of this article is to address two key points: the specific biomechanical principle and the physical strength needed by the athletes in order to maximize their potential in this new generation of tennis.

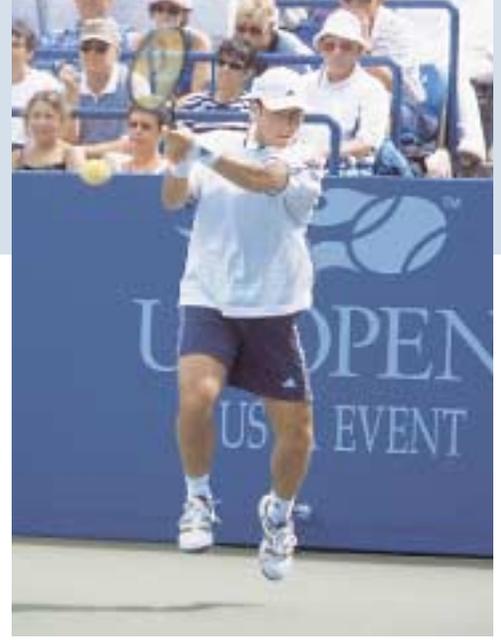
First, let's examine the biomechanical issue. There has been a significant increase in the use of angular momentum (rotational force) on returns of serve, ground strokes and serves. Angular momentum is a major reason for the increase in power of the game today.

There are two types of momentum: angular and linear. Linear momentum is the momentum in a straight line, such as the momentum created by the forward step in a squared stance forehand. Angular momentum is created by rotations of the various body segments, such as with the open-stance forehand. Both linear and angular momentum are used in virtually all strokes.

The second point is the critical need for athletes to have good "core strength" to be able to execute these shots. By "core strength," we are referring to the abdominal (stomach), obliques (side), multifidus (low back) and the deep musculature of the hips, gluteus maximus and spinal erectors.

We have selected sequence pictures that clearly show how angular momentum and "core strength" are incorporated into and affect serves, returns and ground strokes. We feel this has major implications for teaching technique and physical conditioning. The bottom line is this: *every successful world-class player in the game today possesses excellent "core strength" and uses significant angular momentum in their ground strokes, returns and serves.*







Lance Jeffrey



5

6

7

PREPARATION PHASE



In the first two photos, all three players are in the preparation phase of the stroke as they “store energy” in the large muscle groups. Notice the tremendous rotation of the upper body. The shoulders rotate the most, followed by slightly less rotation of the torso and a little less from the hips, creating a corkscrew effect. These mechanics will create a lot of angular momentum and a great deal of strain on the abdominals, obliques and multifidus (lower back). This is accompanied by flex in the knees and ankles, which allows for generating maximum power from the legs. This puts extreme demands on the quadriceps and gluteus maximus (note that the use of the open stance by Spadea and Capriati facilitate this storing of energy). Remember that most of the energy for the stroke is initiated and generated from the ground up.

HITTING PHASE



In the next three pictures, you can clearly see how all three players are unleashing the stored energy in the muscle groups in a sequential order from the ground up. The energy is first released from the leg drive (quadriceps and gluteus maximus), then moves up the body via trunk rotation (abdominal, obliques and multifidus) to the upper arm, forearm and hand flexion. The second point to note about this sequential order is that it goes from large muscles to the smaller fine motor skills muscles—forearm, wrist and hand—which control the racquet through the swing path. The third point is the incredible angular momentum or rotational force being generated. On all of these strokes it is clear how the “core strength” muscles add to the explosiveness and ultimately the successful execution of the shot.

FOLLOW-THROUGH/RECOVERY PHASE



In the remaining two photos, you can see the result of the angular momentum on the stroke as the players’ bodies complete their tremendous rotation. In this phase the players are decelerating on the follow-through after the players have finished accelerating through the hitting zone. This requires good strength in the muscles from the upper back (posterior deltoid, scapular muscles and rotator cuff muscles) to slow the racquet down and avoid injury. The players also are using their “core strength” to stabilize their body after contact to counter any unwanted inertia (movement in a given direction) and start the recovery for the next shot.

Top to bottom: Vince Spadea, Andy Roddick and Jennifer Capriati.

the front of the shoulder and chest) are generally stronger than the external rotators (muscles in the back of the shoulder and upper back). The relatively small rotator cuff muscles (group of four muscles that virtually hold the ball in the socket) work both concentrically and eccentrically during all tennis strokes. An example of how the rotator cuff works eccentrically is best demonstrated in the serving motion.

After ball impact, the shoulder is rotating forward at a very quick pace. The rotator cuff muscles behind the shoulder work eccentrically to slow down the arm during follow-through. This controlling function of the rotator cuff requires strength and muscular endurance and is why specific exercises should be performed by tennis players as a regular part of their training program.

Another very important muscle in the upper body is the serratus anterior. This important muscle stabilizes the shoulder blade or scapula against the thoracic wall. Virtually every time you hit a tennis ball this little known muscle works both concentrically and eccentrically to move and stabilize your shoulder blade. Tennis players can strengthen this muscle by performing step-ups. Step-ups are similar to push-ups, only they do not place as much stress on the front of the shoulder. Start in a push-up position next to a 6-8 inch step such as those used in step-aerobics. Place the racquet arm up onto the step, and push the body up onto the step rounding the back like a cat. Then place both hands back down onto the ground and repeat the exercise. Some players need to

start this exercise on their knees first, then perform the exercise from their toes like a standard push-up as they get stronger.

Summary

So what does this all mean for Samantha? The information in this article shows how important muscular strength is for tennis players. It is important to realize that muscles work both concentrically (shortening) and eccentrically (lengthening). Therefore, when performing resistance training exercises, the weight should be moved in a controlled manner in both directions to work both types of muscular contractions. Another important point brought out in this article is that of muscular balance. Muscles work in pairs, and often times playing tennis develops one muscle or muscle group to a greater extent than another. Preventing muscular imbalances is an important goal in any tennis specific strength training program, and not only prevents injuries, but also enhances the ability of the muscles to perform.

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Who's Ready to Play... The Weakest Link

by Noel Gressner, MEd, ATC, CSCS, Administrator of Sport Science

Often, tennis players spend hours on the court improving the all-important technical and tactical components in pursuit of becoming a complete player. Technical and tactical components are indeed important to long-term development, but if the most fundamental physiological components that support technique and tactics are not developed, our players might become a victim of weak links.

Core Stability Concept

In tennis, there are common functional movements that are universal to all strokes. To support these functional movements there are foundational exercises that are important for coaches and players to employ. A concept in the field of sport medicine and strength and conditioning is **core stabilization**. For tennis players, core stabilization is the ability of the deep muscles of the spine and deep abdominal musculature to maintain control and support the spine while performing tennis-specific movements.

The purpose of this article is to explain a practical assessment that coaches can use to evaluate their player's level of core stability and to demonstrate the introductory exercises that can be performed to create the foundation for the performance of higher-level core stabilization exercises.

The goal is to support and enhance the physical components for the ultimate goal of producing a complete player. These initial exercises in a core stability-training program do just that. However, just as a coach uses a teaching progression when teaching new tennis skills, the same concept holds true in establishing a stable core. These exercises initially focus on motor control and high endurance.

What Muscles are Used?

The specific muscles to be activated are the deep underlying abdominal musculature, transverse abdominus (TA) and the deep underlying musculature of the low back (multifidus). The primary exercise is the drawing-in maneuver whereby the athlete is asked to gently draw in the belly button towards the spine. This drawing-in

activates the (TA), and the multifidus muscle creating an anatomical corset. This seems like an easy task, however if you are trying to perform this exercise right now while reading this article you can appreciate the difficulty. The player in figure 1 is demonstrating the drawing-in maneuver.

How Do I Know if a Player has Good Core Stability Strength?

A practical assessment can be as simple as utilizing the leg-lowering test. The athlete is put into a bent-knee position with knees to the chest while lying on his or her back. The drawing-in maneuver is performed and the athlete lowers the feet to the ground. If you notice that the lower back is arching off the floor, as the feet get closer to the ground, then this indicates a weakness in core stability. If the player is able to maintain the drawn-in position, as the feet get closer to the ground, then they have a basic level of core strength. Note figure 2 for the start position of the bent knee leg-lowering test. Figure 3 shows that the player is unable to control their core while lowering the feet to the ground while Figure 4 shows that the player has the core strength that enables him to maintain proper trunk mechanics.

Where Should We Start?

Good Control of the TA and Multifidus are essential to having a strong stable core. To begin this strengthening process, the player should perform the drawing-in maneuver as the first exercise in the progression (gently draw in the belly button towards the spine). Perform the drawing-in maneuver 15 to 20 repetitions with a hold of seven seconds.

After being able to increase the number of repetitions from 25 to 30 and maintaining a normal breathing pattern while holding the drawn-in position, the athlete may progress to a series of movements called *leg-loading exercises*. Following is a progression for the leg-loading exercises. These exercises should be performed with both legs.



Figure 1



Figure 2



Figure 3



Figure 4



Figure 5



Figure 6



Figure 7



Figure 8

- (A) With one knee bent and held stationary on the floor, slide the other leg out to an almost fully extended position. (Figure 5)
- (B) With one knee bent and held stationary off the floor, slide the opposite leg along the floor to an almost fully extended position. (Figure 6)
- (C) With one knee bent and held stationary off the floor, fully extend the other leg held about four inches off the floor. (Figure 7)
- (D) With both knees bent and held stationary off the floor, fully extend and return one leg at a time in a bicycle type fashion. (Figure 8)

These exercises seem easy enough, but maintaining the drawn-in position is very difficult when having to control the weight of one's leg out away from the body.

The Core and the Kinetic Link

You can see from the shots performed on the previous pages how many musculoskeletal components link together to produce the final result. This kinetic link can be defined as energy or

force generated by one part of the body that is in turn transferred to the next body part in the link. If the deep core muscles are not functioning properly, they will not be able to absorb, distribute and then contribute to the next link in the shot. Often times the more dynamic superficial musculature will overpower the deep stabilizing musculature that lie closest to the bones, taking away from the efficiency and performance of the shot. If this overpowering repeatedly occurs, the forces within this linkage system can create an environment where an acute or chronic injury could occur.

Prevention and Performance

Interwoven within this concept of stabilization before mobilization is the idea of prevention before performance. By preventing injury we enhance performance by creating a situation where the athlete is appropriately progressed from low intensity/high endurance exercises to more functional tennis-specific exercises. This mode of training can be applied to all aspects of the player's strength training and conditioning. Practice the exercises above and introduce them into your athletes' exercise routines, because nobody wants to be...The Weakest Link.



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USA Tennis High Performance Coaching Program Dates

Program Dates for 2002 & 2003

Date	Location	Application Deadline
August 13-18, 2002	College Park, Maryland	Full
November 12-17, 2002	Atlanta, Georgia	August 15, 2002
January 2-7, 2003	Key Biscayne, Florida	October 15, 2002

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