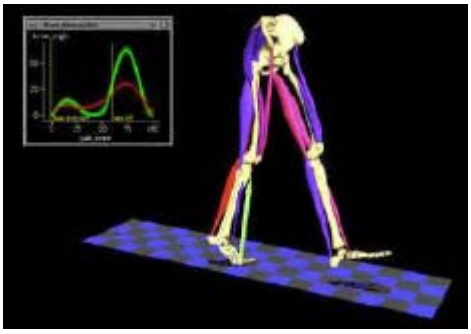
Analysis of the Posterior Thigh Part I



Researched and Composed by Jacob Wilson, BSc. (Hons), MSc. CSCS, and Adam "Old School" Knowlden

Abstract

The posterior compartment of the thigh houses three muscles of particular interest to the athlete: The biceps femoris, Semitendinosus, and Semimembranosus: collectively known as the hamstrings. Each can be classified as polyarticulate, which adds a spin of complication to the mechanical aspects contained within this system. Extension moments of the hip are affected by knee positioning, while flexion at the tibiofemoral joint is enhanced or weakened, depending on the angle between the anterior femur as related to the pelvic/belly surface of the body. It is our intent to discuss what has been accepted generally by the scientific community, and then to move out to our most recent research in hamstring mechanics. Moreover, an applied section will be presented under discussion. Further subjects include: the role of the gastrocnemius in knee flexion, length tension optimization of the hip extensors, ACL stabilization research, aesthetic applications in the sport of bodybuilding, imbalances between muscle groups, and exercise techniques ascribed to specific goals.

Introduction

Balance is essential to each day of our lives. Biblically, the Lord Jesus instructed us to strive in our relationship with Him, mentally, physically, and spiritually (Matthew 22:37). The apostle Paul further delved into a fact that the Creator designed the body to work in harmony. That is, each body part is affected by its neighboring body part, no matter how small (1 Corinthians 12:12-26). A man whom many would consider the greatest athlete of our time, Arnold Schwarzenegger, worked an entire career so that, "every body part would fit together, such that to increase a muscle one inch, would require an adjustment in the whole body."

It is through this theorem of symmetry that we begin our trip into the posterior compartment of the thigh; a compartment which, on average, breaks the balance between the quadriceps and the hamstrings.

Insertion Points and Aesthetic Properties

Imagine, if you will, attempting to perform a side triceps pose with underdeveloped triceps. If you brought that to a contest, your scoring would be docked tremendously. Though people realize the basic principle of triceps development for side poses, they fail to apply it to their posterior thigh. Nothing is more revealing than a flat, underdeveloped hamstring region during any shot which reveals such a lack of precise training, and indeed artistic insight. Hamstrings serve to divide the rear and frontal compartments of the leg, with a clear and almost majestic line created by the lateral musculature of the knee flexors and the vastus lateralis, or outer quadriceps sweep.

Note the almost majestic curvature of the leg biceps. Note also how they actually accentuate the vastus lateralis. You are viewing a clear example of years of superior mindset and artistic prowess.

Further, no matter how freaky your back complex is, a severe debt will be paid

during all rear poses when lacking in this critical area.

Biceps Femoris Attachment Points

The left illustrates the short head while the right shows the long head. Note that it is the latter which crosses both the hip and knee joints.

Right now you are sitting on your ischial tuberocities. These are posteriorly large protrusions on the pelvic region. If you sit on a hard chair, you will get a greater feel for these projections. The long head crosses both the hip and knee joint, and can therefore create torque actions at each. However, the short head has its origin on the lateral mid shaft of the femur (on the linea aspera). Dr. Henry Grey, the greatest anatomist of the last several centuries, illustrates verbally how the separation discussed above is achieved: "The femoral, or short head, arises from the outer lip of the linea aspera, between the adductor magnus and Vastus externus, extending up almost as high as the insertion of the Gluteus maximus (4)." Both join distally to form a belly, and each share a common tendon, which inserts on the lateral leg bone known as the fibula. You can palpate your fibula, on the outside, just below the knee. More technical names for these muscles are as follows:

Biceps long head - Biceps Femoris Longus

Biceps short head - Biceps Femoris Brevis

Biceps Femoris - Leg Biceps (actually this is the less technical name)

One final heading is the lateral hamstrings. Their positioning is of key importance, as you will see shortly.

Semitendinosus and Semimembranosus

To the left is the Semimembranosus
and on the right is an illustration of the Semitendinosus.

Extend at the knee joint, and reach behind to the distal aspect of the femur. You should be able to easily palpate a long tendon medially. That tendon belongs to its namesake, the Semitendinosus. Its co-medial cousin, the Semimembranosus, begins as a membranous sheath, before its musculature becomes apparent, distal to its origin. Both originate, like the biceps femoris longus, on the ischial tuberocity. The ST inserts on the posteromedial condyle of the tibia (it is vital that you read our article on the hip and knee complex), while the SM inserts on the superomedial shaft of the tibia.

Both muscles are multiarticulate and act at the hip and knee joints, while their medial insertion points have tremendous clinical applications.

Muscular Functions

We begin our discussion of actions by introducing core concepts, from here we will move into numerous studies which capitalize and enlighten these concepts.

Direct Knee Action

Recall that the hamstrings can be separated into medial and lateral divisions. From the article - "Analysis of the Muscles Which Act at the Hip and Knee," you should realize that the knee, or tibiofemoral joint, can a) flex, b) extend, c) medially rotate, and d) laterally rotate the knee. The respective divisions are responsible for medial and lateral rotation. If, for example, the biceps femoris longus and brevis were to contract, without the medial division, both flexion and simultaneous external rotation of the knee would occur, and vice versa for the medial hamstrings absent of lateral contractile influence. It is the combined aspects of these divisions which lead to pure knee flexion. That is, all three muscles need to contract together, or flexion without rotation will not occur. Studies below will introduce clinical concepts involved with the aforementioned paradigm.

Direct Hip Action

It is interesting to note that the three muscles which cross the hip joint are all innervated by aspects of the tibial nerve, while their uniarticulate cousin below is innervated by the common peroneal nerve (both are branches of the sciatic nerve). As a unit, the multiarticulate unit acts to extend the hip joint (3), or decrease the angle between the anterior femur, and the trunk/pelvic region. It is reported that 30 to 50 percent of hip extension is hindered with de-innervation of the hamstrings (14). Finally, the lateral long head rotates the hip outward, while the medial unit rotates the hip inward (12, 4, 8).

Mechanics of Joint Actions and Their Influence on the Hamstrings

Why would a muscle whose action opposes a working muscle contract? There are several reasons, one of which we will demonstrate. You see, as a poly-articulate muscle contraction of the hamstrings simultaneously extends the hip. How then can you isolate the knee flexation moment? To accomplish this, the nervous system recruits the hip flexors, such as the illiopsoas, which cancels out the hamstrings' effects on hip extension.

It is through an understanding of this co-contractile mechanism, that such activities as the squat can be understood. When you squat, think of what occurs. First, as you descend, what muscles do you need to activate to flex the knee joint? The answer is none. The weight of a) your upper body, and b) the barbell are sufficient enough to flex the knee joint. However, you need a mechanism to decelerate these external forces, lest you crash into the ground and shatter your bones! Think about what counters knee flexion, and you will have the answer. Exactly: the quadriceps contract eccentrically to slow the movement.

Then why is it that people say you need your hamstrings when squatting? The answer is more complex than a simplistic view of the knee joint. You see, the hip is also flexing along with its inferior counterpart. If you cannot control this flexion, caused by the barbell, then you would buckle forward and injure your spine. What is it that counters hip flexion? The answer is, of course, the multiarticulate hamstrings.

When concentrically rising, these muscles also act to extend the hip to the upright position, which is why they are worked during this movement. However, as you will soon find out, the squat is not enough for complete hamstring development.

This principle also applies to good mornings, as well as stiff-legged deadlifts. The hamstrings act to stabilize/control descent by resisting hip flexion on the way down, while extending concentrically to return to the starting phase.

Further mechanics include knee/hip positioning. As the hamstrings are lengthened, optimal contraction of the muscle increases drastically which, in turn, increases the muscular growth stimulus (13). During knee flexion, when the hip flexes, it makes the hamstrings reach a greater length and thus, a greater contraction. This is why you see people lift their behinds in the air when performing hamstring curls. Such a protocol is inefficient. A machine, which naturally curves the bench downwards, is optimal; and opposite to this, when the hip is extended, the hamstrings become slack and these posterior flexors lose their ability to contract at optimal levels.

Another way to test this fact out is to see how much easier it is to extend your knee when the hip is extended, as opposed to when it is flexed. The latter is easier because the hams are looser and provide less resistance to knee extension moment; which leads us to our next discussion. That is, hamstring strains occur to a great majority when the hip is flexed and the knee is violently extended. This is why you want to be careful on the end range of motion of a good morning and stiff-legged deadlift. Several studies illustrate our point. Jonhagen S, Nemeth G, and Eriksson E, in the American Journal of Sports Medicine, wanted to see what the actual difference between hamstring injury-prone athletes and their healthy counterparts. "The flexibility of the hamstrings and the eccentric and concentric muscle torque were measured in the hamstrings and quadriceps muscles at different angular velocities." It was found that "Sprinters with a previous hamstring injury had significantly tighter hamstrings than uninjured sprinters had. The uninjured sprinters had significantly higher eccentric hamstring torques at all angular velocities. They also had significantly higher concentric quadriceps and hamstring torques at 30 deg/sec."

Thus, sprinters are:

A. Prone to injury,

B. Have tighter, less flexible hamstrings

C. Are weaker both eccentrically and concentrically

Which again goes back to the article, "Mobility Training and the Application of Proper Warm-up for Body Builders." We cannot emphasize the principles of this article enough!

Interestingly enough, when the hamstrings contract, they tend to retrovert, or move the pelvis backwards. This makes sense from an anatomical standpoint, due to their positioning on the posterior land mark of the ischium. Recall that retroversion of the pelvis flattens the arch in the lumbar spine, and places it in vulnerable position to injury (see An Analysis of the Muscles Which Act at the Hip and Knee Joints Part I). Tight hamstrings will tend to continually retrovert the pelvis when standing, which is the cause of back pain (11, 7).

Moving ahead, we realize that knee extension increases the hamstrings ability to extend the hip. Although the hamstrings are such a necessary extensor that they are active even when the knee is bent (3), they do not optimally assist in extensor moment at this time. However, it does illustrate the importance of hyperextensions and, again, good mornings for developing this region.

Strength Ratio

Training the agonist (i.e., quadriceps) without training the antagonist can result in undesirable muscle imbalance and may increase the likelihood of injury (18).

Unfortunately, agonist-antagonist strength ratios do not exist for isotonic exercises. However, a desirable isokinetic agonist-antagonist strength ratio of 3:2 has been suggested for quadriceps/hamstring (18).

The further this muscle balance ratio is from 1:1, the greater the concern about muscle imbalance and possible injury (18).

The hamstring muscle group, except for the short head of the biceps femoris, consists of 2 joint muscles crossing the knee and hip joints (3).

As a result, the hamstrings may be at a greater risk of injury because of increased stresses made possible by the interactions of the 2 joints ().

Hamstring injuries are common when the stresses in these muscles are high, such as in athletic events requiring high speed, acceleration, or strength (5).

Therefore, a lack of strength or a strength imbalance between the hamstring and quadriceps groups has been shown to be a predictor of hamstring injury (2).

Additionally, it appears that the strength ratio of the hamstrings to quadriceps varies over specific movements. To illustrate, we analyze a study which broke down this muscle group from a histological view point. That is, they studied the cellular structure and its component makeup. Garrett and colleagues obtained muscular specimens from seven locations on the hamstrings (5). It was found that “the hamstring muscles are shown to have a relatively high proportion of Type II fibers. Type II fibers are more involved with exercise of higher intensity and force production and it is postulated that the hamstrings are capable of high intrinsic force production.”

It is protocols such as this that have led scientists such as Dr. Hamil to postulate different strength ratios for various movements when comparing the posterior thigh to the anterior thigh (quadriceps). He postulates that during slow contraction, the ratio would be at lowest 2:1 in favor of the quadriceps, however, he states that since this muscle is specialized for explosion, faster contractions would tend to rely on a 1:1 ratio, while static contractions would require a similar ratio to the 3:2 listed above.

To test this, perform various rhythmic forms of hamstring curls, and see how great the imbalance is. Realize that the farther it is from a 1:1 ratio, the closer you may be to injury. If you see over a 2:1 ratio, you are in trouble, and we will present a

further study which shows what we deem as optimal ratios, which are much harder to match than 2:1. The point is, many of you reading this face this problem, and it is highly advisable to correct it. It is for this reason, as well as others, that we are presenting an entire program for the target musculature.

Many also fail to realize that the hamstrings are largely responsible for maintaining integrity of the knee joint.

Applications

The Hamstring muscle is often overlooked in the body builder's leg training session, and is rarely prioritized. When it is trained it is often targeted late into a routine, receiving less intensity, and less volume. Moreover, the hamstring may be totally overlooked, as many feel the back squat is sufficient in actively training the hamstrings.

Consequently, research has shown (9) the back squat to be inferior to leg curls and stiff-legged deadlifts regarding activation of the hamstrings.

These findings indicated that performing the back squat resulted in approximately half of the motor unit activity compared with the leg curl and stiff-legged deadlift. The reason for this is due to its action at two joints. Studies indicate that the hamstrings are more active when the knee joint is mobilized during hip extension, rather than extending concurrently with hip extension, as is seen in the squat (3). Mobilization would occur in SLDLs however. Yamashita found similar results, and found that hip extension and knee extension simultaneously lowered muscular activity of the hamstrings. He proposed that the reason for this was due to the hamstrings double role in the movement. When rising concentrically, the hamstrings must extend the hip as a direct role, but their role in flexion of the knee is antagonistic to the extension that must inevitably take place. This may be the reason for inhibition of the musculature.

In conjuncture with Yamashita's hypothesis, we researched studies which may shed more light on how the nervous system co activates the hamstrings during knee extension moments as lifters increase in strength. One such study conducted by B. Carolan and E. Cafarelli researched 20 male university students, and sought to understand what the primary mechanism by which knee extensor strength increases in the first several weeks of training was (1). They found that after 8 weeks of knee extensor strength training, maximum voluntary contraction increased by 32 percent, and yet "there was no change in vastus lateralis maximal integrated electromyographic activity." What occurred then? "The most important finding was that the degree of hamstring co activation during extension MVC decreased by approximately 20%." This was statistically significant at the .05 level. "A reduction in hamstring coactivity in the trained and untrained legs indicates that these muscles provide less opposing force to the contracting quadriceps."

Glenn Wright noted that when studying emg activity in the squat, that less-skilled participants would lean forward, and the emg data in the hamstrings would simultaneously increase (20), yet those who did not rely on the forward lean, did not receive as great a stretch in the hamstrings, and therefore less activity. I would also note that as a set in the squat continues, more and more motor unit recruitment from the posterior thigh would be needed. Therefore, the squat and leg press are

still of extreme value. The point we are emphasizing is that research suggests that they are limited as an exercise for training the hamstrings, and more hamstring-specific exercises are needed for maximal stimulation, especially when the focus of the athlete's training session is the inducement of hypertrophy/hyperplasia-specific responses.

The above study also revealed a further fascinating finding in the squat, as compared to the leg curl/SLDL. As you know, during eccentric contractions, a lower number of motor units are recruited (20). You may have a 2:1 ratio, for example, meaning twice the number of motor units is recruited concentrically compared to eccentrically. Out of the three exercises, the squat had the lowest ratio. This indicates that the hamstrings' main role in the squat may be in the stabilization of the knee on the eccentric portion. In addition to this, the medial hamstrings seemed to elicit the greatest ratio within this movement (see 8 session program for detecting an imbalance in the hamstring musculature).

Aside from the symmetrical achievements this muscle group plays to the sport of body building, hamstring development is important to ensure muscle balance between the quadriceps and hamstrings and to prevent injury (19).

It is for this reason that the prioritization principle will be applied to hamstring training over the athlete's next eight leg training sessions (see program), with the intentional focus of increasing both strength and size in the region.

Categorically, hamstring-specific exercises can be placed into two functions: knee flexion and hip extension.

Knee flexion involves bending the knee. Exercises involving this movement consist of all varieties of leg curling motions. As such, knee flexion movements should be a cornerstone to any successful hamstring training program.

Hip extension entails kicking the leg back as in the sprinting motion. Stiff leg dead lifts, Good Mornings, Back extensions, and other such exercises fall into classification.

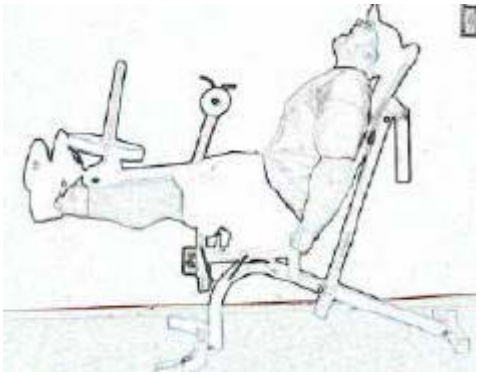
Knee Flexion Techniques

Note the position of knee flexion above. If you have a home gym with a leg curl that attaches to a bench, you can mimic this by adjusting the bench so as to emulate this set up.

Knee Flexion can be described as bending the joint in such a way as to result in a decrease of angle. This would include moving the lower leg toward the back of the thigh.

Knee flexion

Knee extension involves straightening the joint, causing an increase of angle, distancing the lower leg away from the back of the thigh.



Knee extension

In review, the knee joint is a bicondylar joint, which means that it is formed by the joining together of the superior condyles of the femur, and the inferior condyles of the tibia. Pure flexion targets both the medial and lateral hamstrings, while lateral rotation superimposed on flexion works the biceps femorus longus and brevis. Rhe opposite works the medial region which houses the semis (membranosus and tendinosus).

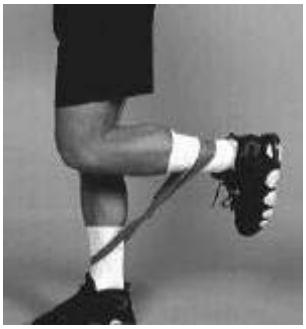
In isolation, the most basic of exercises includes lying machine leg curls. From our assessment of the length tension curve, the hamstrings will contract maximally when utilizing a seated leg curl machine. This has the effect of flexing the hip joint, and increasing the tension-producing forces of the musculature. Lying flat would not yield as optimal a contraction, thus, machines which allow the athlete to lie with superimposed hip flexion will also work well.

When performing standing curls, an incline is best suited to the length tension curve.

At home this can be mimicked with a standard leg curling machine that attatches to a bench. You simply incline the bench for support, and curl one leg at a time while standing.

The above would not be optimal, if he were to incline his bench so that he could flex the hip joint, a more favorable LT curve would be attained.

There are numerous methods to target knee flexion. For constant tension, you will want to utilize cables from the lying, standing, and seated position. From the seated position, you would simply set a chair such that you face the low cable pulley. The low attachment should be placed on the machine and, after hooking the attachment to the ankle, you would perform normal curls. For home training, I recommend purchasing several therabands.



These allow you to attack the posterior flexors from numerous angles. Arnold used to wake up with a dumbbell next to his bed so that he could hit a weak point immediately upon waking. The same principle can apply here.

Perhaps an all-time favorite knee flexion technique involves the utilization of a set of barbell plates. For example, you might take a 45 pound plate and set it such that the 45 heading is facing upwards. You will need the groves to dig your heel into. Simply lie down, and stick your heel into the opening which normally goes around the end of a barbell. This is the starting position. From here, drag the plate towards you, using a leg curling motion. Then push the weight back to the starting position and begin again. To further the difficulty, your partner might grasp the edge of the plate and resist you on the way there and back. This also makes for an excellent theraband exercise. Attach a theraband to the wall and tie one end into the hole of the plate. From here curl the plate toward you, just as you would without the band, and continue until failure is reached. This provides a constant tension stimuli like you will not believe!

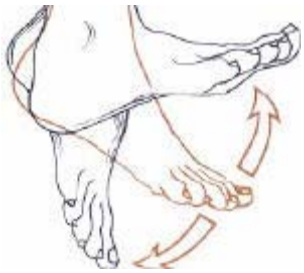
Friction Force - In this exercise, the athlete can use one or two legs at a time. All you need is a sofa and your training partner. Lie in a supine position away from the sofa, with your leg extended and your heel pressed firmly into the cushion. From here your partner secures your ankle into the cushion, as if you were going to perform a situp. Now simply flex the knee using your own body as resistance. This can also be called body drag, because you are literally using your hamstrings contractile force to drag your body across the floor and toward the sofa!

Partner assisted repetitions - We prefer to do these one leg at a time. They are performed lying, and the execution is simple. Once you are in a prone position, your partner will press straight down on your heel, while you curl against this resistance.

Gastrocnemius

This muscle inserts via the tendo calcaneus into the heel bone (calcaneus). It originates on the condyles of the femur. This gives it a substantial knee flexion moment. Its mechanical advantage actually increases from a fully extended to 90 degrees of knee flexion ( ). Thus, when testing hamstring strength, clinicians will ask the patient to relax the gastrocnemius (calf muscle), as a flexed gastrocnemius will assist the hamstrings in knee flexion.

There are two techniques when considering this relationship. The first, as stated, is to simply relax the posterior calf muscle when performing hamstring curls. The second, however, is to increase resistance by dorsi flexing at the ankle joint.



dorsi flexion is upwards plantar flexion is downwards

Dorsi flexion would actually lower activity of the gastrocs. Additionally, it would pull on the Achilles heel, which would then pull on the gastrocnemius in the opposite direction of knee flexion, thus resisting the movement. Begin the set (such as lying leg curls), by dorsi flexing the ankle while flexing the knee. When failure is reached, plantar flex the ankle so as to bring in the gastrocs. You will be able to get more repetitions, in a forced manner. We call this the sling shot method!

Medial Vs. Lateral Hamstrings

To work the medial hamstrings, you will want to perform leg curls with your knees rotated inward, such that the toes point at a slight angle inward. To work the lateral hamstrings, you will want to rotate the knee outward while performing leg curls. We discuss how to utilize medial and lateral hamstring movements within the eight session program. A great example of a medial movement would be the dumbbell leg curl.

Sartorius Curls

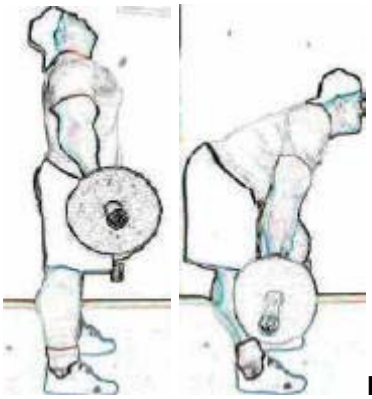
Sartorius curls are an outstanding example of a lateral rotation movement. Lateral, or external, rotation involves rotating around the longitudinal axis of the bone away from the center of the body; with the knee bent, turning the lower leg outward (see 8 session guide for details of the exercises execution).

Medial rotation concerns rotary movement around the longitudinal axis of the bone toward the center of the body; with the knee bent, turning the lower leg inward.

Working the Hamstrings at the Hip Joint

Actively working the hamstring relies on hip extension.

Hip Extension entails straightening the joint, resulting in an increase of angle, or moving the thigh or top of the pelvis backward.



Hip extension

Conversely, hip flexion entails the opposite motion: bending the joint, resulting in a reduction of angle. In review, during a movement such as the stiff-legged deadlift, the weight of the barbell, as well as your upper body, creates a flexor moment at the hip without assistance from the hip flexors. To control or decelerate this moment, the hip extensors, which include the posterior hamstrings, contract while lengthening (eccentric force). When raising back upward, the extensors act as the force which actually overcomes the barbell. It is for this reason that stiff-legged deadlifts, hyperextensions, and reverse hyperextensions are so powerful. It is therefore conducive to review such movements in detail.

SLDL

The SLDL, when performed improperly, places the athlete at a high risk for injury. Three factors are of paramount importance when executing this movement.

1. Grip Strength - A vice like grip is a must. When lifting substantial loads, the focus on griping the bar can be so high, that form actually breaks down. To increase the grip, you would do well to utilize 8 Weeks To Bigger Forearms II - Workout! . The most basic way to train the grip is to directly train it. That is, every five days at least, work in 6-12 grip exercises to failure as a minimum. A workout is as follows

A. Rest pause training Grip - Set barbell on a safety rack. Choose a weight you can only hold for 20-30 seconds. Now, rest pause for 60 seconds straight. Repeat for 3 sets, shaving 10 seconds off each set.

B. Weighted static hangs - Simply put on a weight belt, and hang on the bar above you until failure, for three sets.

C. Repeat exercise one

By training the grip, you will find an immediate increase in your ability to work the hamstrings through their most vital movement.

2. Flexibility - Recall that the hamstrings are most likely to be injured when extension of the knee and flexion of the hip occurs, as this can strain the muscle group severely. To accommodate for this, you will need to lengthen your sarcomeres in series, as well as increase flexibility. Sarcomere units are repeating contractile packets, if you will, across the length of the hamstrings. One sarcomere will not be able to accommodate the length change that two sarcomeres can. To increase

these, you will need to work on movements which lengthen the muscle while contracting. These include heavy eccentric movements, such as double negatives on hamstring curls, as well as focusing on the negative on hip extension moments. Finally, you will need to incorporate the principles covered in Mobility Training and the Application of Proper Warm-up.
That article discusses several mechanisms which immediately enhance flexibility.

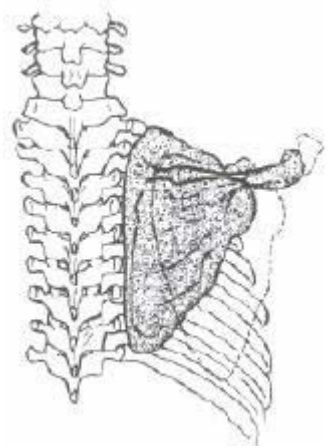
3. Spinal Stability – Fortunately, we have covered this in detail. You not only need strong erectors, but a properly trained nervous system, as well as endurance-trained transversus abdominus, internal obliques, etc. For a massive guide on this subject, click here. The principles found therein are mandatory for responsible lifting!

Proper Form

1. When performing the SLDL, realize what the two opposing forces are. Once again, these include the actual weight of the barbell and your extensor muscles, which oppose/overcome this weight. In this position, the moment arm of the barbell is substantially large, which requires the extensor muscles, such as the sacrospinalis, to exert as much as 10 times the force required to counteract this great mechanical advantage (6)!
Such a realization only further confirms the importance of 360 degrees of spinal stability, as well as stability caused by increased pressure of the abdominal cavity.

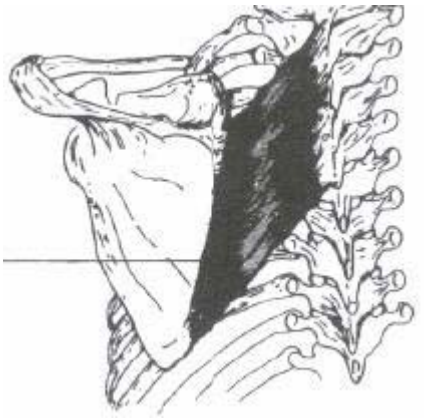
2. Realize that when you put the spine into flexion during the SLDL, your ligaments take the load (21). It is in this region that injury to the spine is most likely to occur (22). This is why we recommend against allowing the spine to round. Keep the lordodic curve throughout the entire movement.
In addition to this, you will want to avoid any form of bouncing. Many not only flex the spine, but then bounce on the bottom range of motion. Such actions are extremely dangerous! We call this an attempt to bounce off of the ligaments' elastic properties. It also has the effect of calling into play reflex mechanisms. There are numerous mechanoreceptors in the posterior longitudal ligaments of the spine. In fact, studies indicate that their main role in stabilization may be the reflex arc formed between ligamentous neural elements, and the central nervous system (10, 17). Muscles such as the multifidus also act to stabilize the spine via reflex arcs. Essentially, sudden lengthening or stretching of these structures immediately calls large motor units into play to counteract such hostile conditions. By bouncing on the bottom of the range of motion, athletes hope to call these mechanisms into play. However, the risk associated with such protocols is not worth the numerous injuries, which can potentially end careers. Due to such heavy loads, it may be conducive to only train the lower back heavy, such as with the SLDL 3 times within a two week period (15).

3. To avoid flexion of the spine, and maintain extension of the spine, you will want to retract the scapula the entire movement.



Shoulder (scapular) retraction - Performed when you squeeze the shoulder blades together. By keeping the shoulders back, you maintain stability of the thoracic region of the vertebral column.

Also note that the rhomboids and trapezius are responsible for this retracting moment.



The Rhomboids

4. To execute the movement, you need to check the following list:

A. Forearms should be inline with the shoulders.
B. A slight bend in the knee to avoid injury.
C. Movement should occur at the femoral-acetabular joint (hip) and not at the tibiofemoral. That is, though the knee is slightly bent, do not increase or decrease this position, but rather keep it static.
D. Do not bend the elbow joint during the SLDL. People have a tendency to almost upright row the bar. Your arms should be thought of as hooks.
E. Keep the weight close to the legs to decrease your risk of injury.
F. Do not flex the spine.
G. Keep the gut sucked in, so as to activate the TVA. In fact, the first thing you should do is suck in the gut.
H. Flexibility will limit this movement. This means that you should never allow the body to go past the point which flexes the spine.
I. Imagine the spine as a chain that must work in unison. This means that the neck and lumbar region should maintain their curvature. Do not look down at any time

during the movement, but keep the neck slightly extended.
J. For heavy lifts, use a deadlift grip. This means one palm is pronated, while the other is supinated. Switch grips each lift. When using light weight, you can utilize an overhand grip.

Variations of a Theme

- The SLDL has several variations. One that is rarely used is the unilateral variation. It is difficult to use, but works well. Simply grasp a dumbbell, place it in front of the thigh, and perform SLDLs on one leg.
- Another variation is to cup the bar, much like a Zercher squat.

From here, perform a normal hip extension exercise. The movement is stupendous!
- Stiff-legged deadlifts can be performed with dumbbells

· As well as with cables

Further Extension Techniques

One of the most basic extension movements is the one-legged extension. To perform, you simply lean against a wall, and extend one leg backwards as far as possible with the knee straight.

This is further accentuated when utilizing a cable attachment. I prefer to get allow the cable to tug my leg, such that the hip is flexed to begin the movement. I then pull the leg back (extension) until I have reached the end of the range of motion. This also has the effect of tying in the glutes to the hamstrings.

A rarely used extension movement, which takes advantage of starting in hip flexion, is the high cable pulley moment. Attach the cable to the high pulley, and then attach it to your ankle. From here, simply perform hip extensions.

pull-throughs - This is an outstanding movement for extension. You place a rope attachment on a low pulley system. Stand facing away from the attachment. Now reach backwards, and grasp the handles. You should be bent over similar to the last part of a stiff-legged deadlift. From here, with the hip, extend upwards. Squeeze at the top and then lower back under control.

Other exercises include reverse hyperextension (one- and two-legged), and hyperextensions also work amazingly to build the hammies.

An All Time Favorite!

Perhaps our all time favorite are platform extensions. Simply find a high platform. When you wake up in the morning, your bed will even do. Lie on the ground and place your heels on the edge of the bed, with your glutes on the ground. Now extend the hips so that they straighten out and your glutes are off the ground, and in line with your knees. Now lower under control.

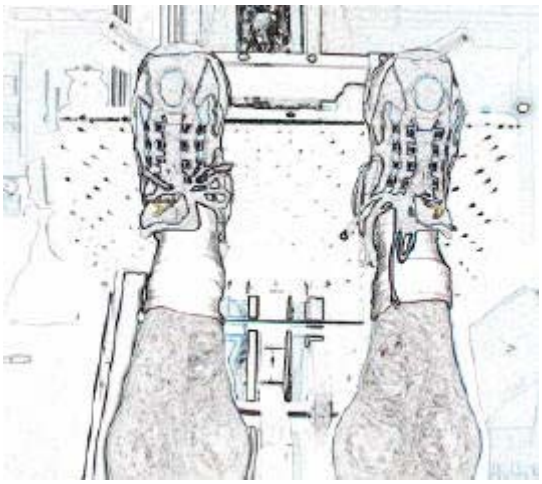
Tips

1. Start with one leg and go to failure, then finish the set off with two legs!

2. Try performing this on a Swiss ball

Key Compound Movements

Movements which emphasize single joints will be the base of your program. However, secondary movements which work well are the leg press with feet high on the pad.



As well as box step ups, and any form of lunge. The key is to focus deeply on the hamstrings.

Another method is to pre-fatigue the hamstrings. I like beginning with knee joint movements, where all three muscles are the primary movers. Then move to extension moments, followed by compound movements.

Repetition Ranges

Actively targeting a muscle for prioritization has been thoroughly discussed in, Monumental Masterpiece - Creating a Cerebral Portrait.

The bicep femoris, both the long and short heads, along with the Semitendinosus and Semimembranosus are composed primarily of fast twitch fibers.

See: Muscle Fibers of the Posterior Thigh.

This illustrates a desired repetition range necessary for achieving our prioritization goals!

Lower Rep numbers, with a more controlled and slower negative, are desirable traits for this type of fiber.

Conclusion

The biceps femoris longus, brevis, semitendinosus, and semimembranosus are complex muscles. We have laid an in-depth guide before you to assist and stress the importance of the posterior knee flexors/hip extensors. Finally, a comprehensive 8 session training program has been assembled, which is tailor-made to sky rocket your gains!

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