

Glute-ham-gastroc raises

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In this era of sports specialization it is becoming increasingly important to know the fine points of technique and the exact outcome of exercise execution. Only with this knowledge can effective conditioning programs be constructed. Working out according to these programs will, in turn, bring about maximum development of the athlete, an athlete who is totally prepared for his specific sport.

This is the basis upon which the Soviets and East Germans have developed such outstanding athletes. In some sports they have even modified and changed technique to fit the specialized physical training they presently give their athletes.

To illustrate this total concept of developing a high level athlete through sports technique, exercise evaluation and development, we will examine the ways in which the glute-ham-gastroc raise can be executed and specialized to some sports.

The glute-ham-gastroc raise was first developed by the Soviets for weightlifters, especially for execution of the press before it was eliminated from competition. Today, it is still used by weightlifters for execution of the first part of the barbell lifts, coming out of a deep squat, and development of strong lower back and gluteals. Because of its effectiveness, it is now also used extensively in track and

field (for all events but especially in running and jumping), cross-country skiing, boxing, wrestling, judo, cycling, soccer and other sports.

To execute the glute-ham-gastroc raise exercise, the Soviets use wall bars and a gymnastic buck or horse. In my recent trip to the Soviet Union as leader of a weightlifting study group conducted through Concordia University, I was amazed at the number of times I saw this set-up in various gyms. The athlete lies on the buck with support on the lower to mid-thigh, so that the pelvic girdle and trunk hang over the edge of the buck. The feet are placed between the wall bars with the feet against the wall. The athlete then raises the trunk, using the hip joint extensors until the trunk is in line with the legs. There is a slight arching of the lumbar spine analogous to the amount needed in the sport. When the straight body position is attained, the upward movement continues by knee joint flexion. Some well-conditioned East German athletes do this by the use of only one leg.

In this country this exercise can be done with a device called the **Glute-Ham Developer**, which has adjustable foot positions so that all performers can be properly positioned (**Figure 1**).

The major muscles involved in the glute-ham-gastroc raises are the erector spinae, gluteus maximus, hamstrings

and gastrocnemius. These muscles are involved in extension and hyperextension at the hip joint and lumbar spine, and flexion at the knee joint. The erector spinae is involved in some extension and hyperextension of the spine but it is used mainly to hold the spine rigid. The gluteus maximus is only involved in extension, and the hamstrings are involved in hip joint extension, hyperextension and knee joint flexion. The gastrocnemius muscle participates only as a knee joint flexor.

To see how this exercise closely duplicates the actions involved in various sports it is necessary to closely examine technique execution.

Football lineman coming off the line: From the 3-point stance the player first raises the body via knee and hip joint extension. (The deeper the stance, the more the hip joint extension is used and the higher the pelvic girdle (hips), the more the knee joint extension is involved.) However, the knee joint extension only raises the upper body straight up—it does not straighten the trunk to a vertical position nor bring the pelvic girdle over the feet. This is done by the hip joint extensors.

In addition, the erector spinae muscles are used isometrically to hold the back rigid and in a straight line. If they are shortened, it would result in a hyperextended spine, which would be

vulnerable to severe injury on a hit. Thus, the raising of the trunk by linemen via hip joint extension duplicates the action of the glute-ham-gastroc raises. Note that this action takes place *prior* to stepping out or making contact with the opponent.

Speed running: When the foot is placed on the ground after the flight phase in running (under the body in sprinting and in front of the body in long-distance running) there is flexion in the hip joint (and knee and ankle joints). After the phase of amortization, the hip joint extensor muscles go into action to propel the body forward. This

action is the same as that which occurs in execution of the glute-ham-gastroc raise.

It should be noted here that the latter part of the glute-ham-gastroc raise (knee joint flexion) also occurs in running (as the push-off leg breaks contact with the ground). But, the action in running is done with less intensity and, therefore, not identical to the action which occurs in the glute-ham-gastroc raise. However, the knee flexion is advantageous in the glute-ham-gastroc exercise because it ensures maximal extension and hyperextension in the hip joint, which is the key action in producing horizontal force.

Jumping for distance and height: Hip, knee and ankle joint extension is very important for jumping. However, before the knee and ankle joints go into action, the pelvic girdle and trunk must be directly above or in line with the legs and "target." To bring them in line (which is the initial part of the jump) requires hip joint extension. In every jump with an approach, the take-off leg(s) is placed in front of the body, the pelvic girdle is behind and the trunk is in a forward lean position. It is at this point that the hip joint extension takes place, in the same manner as executed in the glute-ham-gastroc raise. Because the angle in the hip joint does not always approach 90° in all jumps, it is not necessary to do the glute-ham-gastroc raise from a 90° position of flexion in the hip joint.

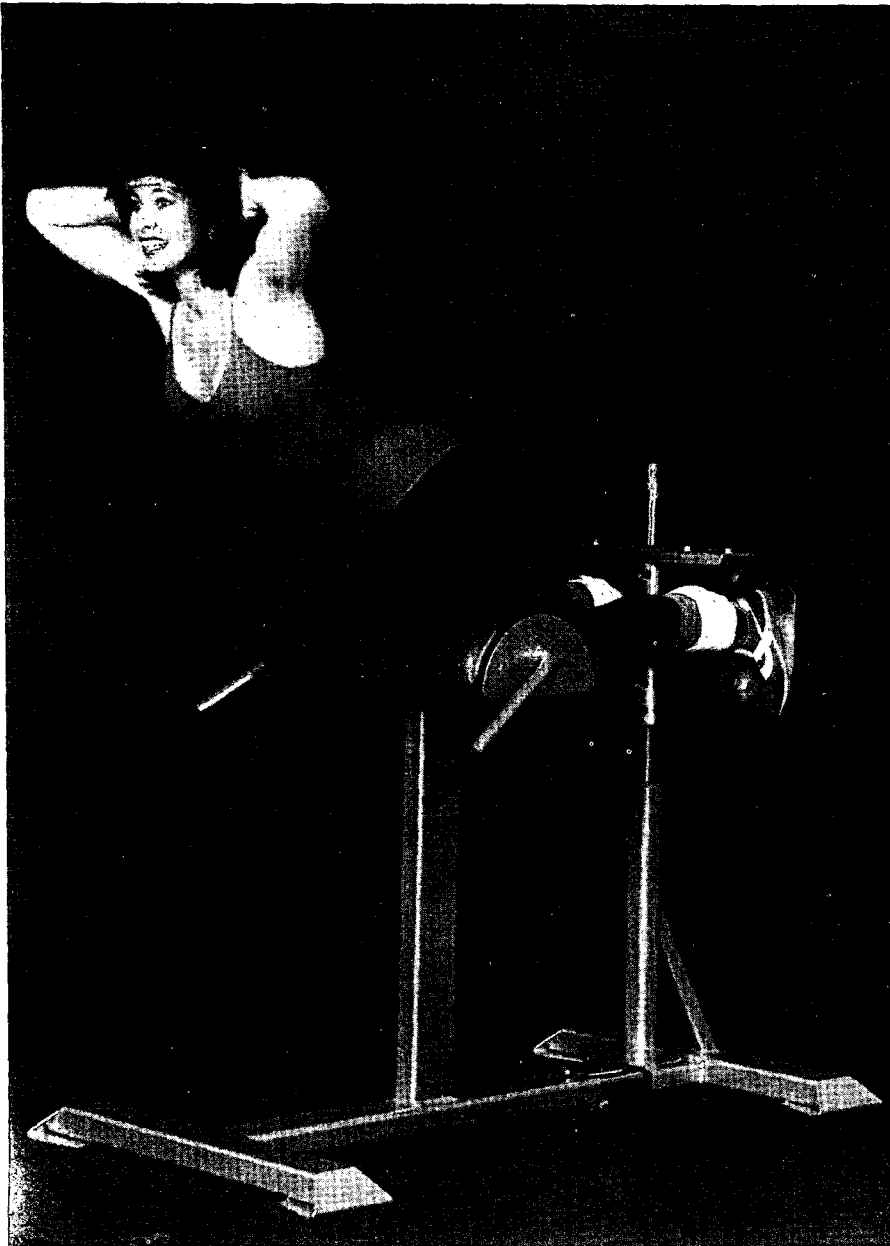
However, when jumping from a stationary position, as in volleyball blocking or in basketball rebounding, the jumper goes into a deeper crouch. Therefore, to duplicate this action more closely, the glute-ham-gastroc raise should start in the full range position (90°). The effectiveness of the glute-ham-gastroc raise exercise has been substantiated by its use by the U.S. Men's National Volleyball Team.

Top pull in the snatch and clean and jerk: The glute-ham-gastroc raise is especially suited for the top pull and is used extensively by all Soviet weightlifters. It is done for maximum strength development and for learning technique (learning to pull with hip joint extension). Alexeyev, the great Soviet lifter, executed 4-6 repetitions for 3-5 sets of this exercise with 60 kg (132 lbs). His maximum was around 200 lbs. Is it any wonder that he could lift such heavy weights?

The top pull begins after the bar is raised off the platform to about knee level. During the initial lift the back (trunk) is kept in the same position (angle to the floor) while knee and hip joint extension occurs. At knee level the bar is raised by hip joint extension in the same manner as occurs in the glute-ham-gastroc raise exercise.

Many progressive strength coaches are now including the Olympic lifts (or portions of them, such as power cleans and pulls, power snatches) in their training programs. This is excellent since such exercises duplicate many sports skills and, more importantly, develop speed, power and quickness.

However, for specific development of the muscles used in the power snatches, cleans or pulls, performance can be enhanced by first developing the muscles involved in the pull phases. This can be done by executing glute-ham-gastroc



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Figure 1: The Glute-Ham Developer has adjustable foot positions, allowing all performers to be properly positioned.

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raises. Not only will they develop the muscles as needed in proper technique execution, but it will help the athletes learn the proper technique before using the barbell. In addition, it may give the athletes greater confidence in attempting and using the Olympic lifts or portions of them.

Research is presently going on to determine the degree of specificity of this exercise to many different sports. The results of these studies may allow the glute-ham-gastroc raise to be specifically adapted to particular sports. In cycling for example, hip joint extension is a key element in producing pedalling force; but in contrast to the glute-ham-gastroc raise, the leg, not the trunk, is in motion.

But, even if the action is not always executed in the same manner, the glute-ham-gastroc raise exercise is also of great benefit in developing the strength of the muscles that are involved in the sports skill in the preparatory period of training. For example, in cycling, not only is the hamstring muscle involved in producing force in hip joint extension (with the gluteus maximus) but the hamstrings are also involved in knee joint flexion (with the gastrocnemius). However, both actions do not occur at the same time; they occur in sequence, which is most effective.

From physiology it is well known that a two-joint muscle such as the hamstrings, will contract most forcefully when only one end is in action (shortening). Simultaneous joint action at both ends of the two-joint muscle will produce a weaker contraction (when both ends of the muscle are being pulled to the belly of the muscle at the same time with opposite actions at the ends).

In the glute-ham-gastroc raise a sequence of hamstring muscle action occurs. The upper end of the hamstrings (which crosses the hip joint) contracts initially (together with the gluteus maximus), rotating the pelvic girdle backwards and raising the trunk. When the raised trunk is in line with the legs (straight line from the feet to the head or slightly arched in the lower back), the upper hamstrings go into isometric contraction to hold this position.

Upon attainment of this position, the lower end of the hamstrings begin to shorten, creating knee joint flexion (together with the gastrocnemius), which continues to raise the body. This shortening of the lower hamstrings occurs while the upper hamstrings are under maximum tension, resulting in a super maximal contraction. Both the lower

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and upper portions of the hamstrings end up in maximal shortening (contraction) at the end of the exercise.

It must be re-emphasized here that the lower and upper hamstrings are in action individually, in sequence (not simultaneously), as the exercise is performed. This sequence of actions culminates in a "double" maximal shortening contraction at the end. This is the main reason why the glute-ham-gastroc raise exercise is so effective for total hamstring development.

It should also be brought out that the gluteus maximus does not go into action in hip joint extension unless the hip joint is flexed approximately 25 or more degrees. Because of this, when first beginning the glute-ham-gastroc raise exercise, make sure that the upper body hangs almost straight down, creating approximately a 90 degree angle in the hip joint. This will provide for maximum development of the gluteus maximus, which is the major muscle for initiating the upward movement of the trunk when it is held rigidly in line with the pelvic girdle. However, before the body reaches the straight line position,

the gluteus maximus no longer participates in raising the trunk. The hamstrings now do the work.

Because of its great effectiveness in developing the entire hamstring muscle, the glute-ham-gastroc raise is also used in rehabilitation of hamstring (and lower back) injuries. These injuries are very common in many sports, especially those which require lifting maximal weights, maximal speed running, or maximal distance or height jumping.

It should also be pointed out that specialized exercises do not take the place of actual performance. The specialized exercises are used only to develop strength in the manner in which it is used in the sport. Also, specialized exercises are used to develop only one or two specific movements of an entire skill, not the total movement. When the total skill is executed, the maximum weights that are used are less than what can be used in segmental exercises. Because of this, total skill execution only, will not strengthen or improve the athlete to his maximum. (The maximum weights in the segmental exercises, however, must not change technique coordination.)

In conclusion, execution of the glute-ham-gastroc raise is of great value in maximally developing the hip joint extensors (gluteus maximus, hamstrings), spinal extensors (erector spinae) when slight adjustments in positioning are made, and the knee joint flexors (hamstrings, gastrocnemius). In addition, execution of the glute-ham-gastroc raises will specifically assist all athletes who must raise their trunks (kept straight), with and without weights, from a low bent-over position or from a deep crouch such as occurs in football (coming off the line), baseball (fielding grounders, catching high overhead balls), weightlifting (cleans) and powerlifting (deadlift). Also, the glute-ham-gastroc raises can be specifically adapted to all sports which require running and jumping, such as in track and field, volleyball, basketball, soccer, team handball and gymnastics. ◊

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