Throwing the football

Michael Yessis, Ph.D.
Biomechanics and Sports Training Specialist
Editor/Publisher, *Soviet Sports Review*

There is one basic pattern of throwing the football. However, there are many throwing variants which are dependent upon distance and how fast the ball is to be thrown. In general, the further or faster the ball is thrown, the greater the number of body parts involved and the greater their range of motion. Short passes require fewer body parts and less range of motion, speeding up execution of the throw.

The number of movements and the range of the movements is related to accuracy. From biomechanics it is generally accepted that the fewer body parts involved, the greater the accuracy and the less the force; the greater the number of body parts involved, the greater will be the force and the less the accuracy. Since only the muscles of the body can create force, it is easy to understand why we must involve more body parts and their muscles in order to produce additional force. However, with more body parts being involved, precise coordination may become more difficult, and thus there may be a slight decrease in accuracy.

For example, in a very long pass, the quarterback throws the ball to an area and it is up to the receiver to make adjustments in his running pattern in order to get to the ball. In a short pass the quarterback throws to a specific spot and the receiver must be there for success.

Therefore, in the following description of throwing the football, keep in mind the changes that can and should occur depending upon the purpose of the throw. First examined will be the long pass, since it requires involvement of the maximum number of body parts to produce maximum force and, consequently, distance. The description will be for righthanded passers.

After getting set up, the quarterback steps forward with the left leg and places his body into a side-facing position, which is the initial throwing position. **(Figure 1)** At the same time, weight is shifted onto the left leg by right hip joint abduction, which involves the gluteus medius. **(Figure 2)** When all the weight is on the front leg, it becomes the new base of support and axis for rotation of the pelvic girdle and shoulder girdle. Also, as the weight is shifted onto the front leg, the leg muscles undergo isometric contraction to hold the leg stable and to support the body.

It should be noted that once the quarterback gets into the pocket, he raises the ball so that it is in a position for quick release in case of emergency. The ball is not, however, cocked for the throw, since the initial cocking action occurs when the forward stride is taken, and the final positioning (cocking) occurs after the shoulders come around.

As the weight shift is being completed, transverse pelvic girdle rotation occurs (hip rotation) with the axis through the left hip joint (left leg). **(Figure 3)** The muscles responsible for this action are the medial rotators of the left hip joint (gluteus minimus and tensor fasciae latae). As the pelvic girdle rotates forward, the right external oblique and left internal oblique muscles are being placed on stretch (eccentric contraction) and the shoulders remain in the side-facing position. When the pelvic girdle maximally decelerates to stop in the front facing position, which produces the longest force arm, the shoulder girdle begins rotating around an axis through the left side or, more specifically, the left shoulder joint. The shoulders are brought around by the concentric contraction of the right external and left internal oblique. Because the axis is through the left shoulder, the longest force arm for the shoulders is created when they stop in the front facing position (perpendicular to the flight line of the ball).

If the left shoulder rotated to the rear while the right shoulder was rotating forward, the forces would be greatly diminished. There would be a shorter force arm; there would be a force going to the rear, cancelling some of the forward force; and it would be more difficult to stop the shoulders from spinning around. The distance over which the ball can be accelerated would also be less. For maximum production of force, all forces must be directed in the direction of the throw, and the distance over which force can be applied must be maximal.

During movement of the shoulder girdle, the pelvic girdle is held stabilized via isometric contraction of the hip joint muscles. This is necessary in order to stabilize the lower attachments of the internal and external obliques and thus provide a more effective pull on the shoulder girdle.

As the shoulders maximally decelerate and stop when hitting the front facing position, the throwing arm is automatically thrown into lateral shoulder joint rotation. (Elbow joint remains about 90°.) This places the medial rotators of the shoulder joint on stretch. **(Figure 4)** The forearm usually achieves a position of being parallel to the ground, which provides maximum tension of the medial rotators, which will then create maximal force. The major muscles involved in this medial rotation are the anterior deltoid, latissimus dorsi, teres major, subscapularis and pectoralis major.

When the lateral shoulder joint rotation occurs very rapidly, the medial rotator muscles undergo maximal eccentric contraction in preparation for the maximal concentric contraction. Because of the great range of movement and the great forces encountered, injuries sometimes occur to the rotary cuff muscles. The injuries do not occur during

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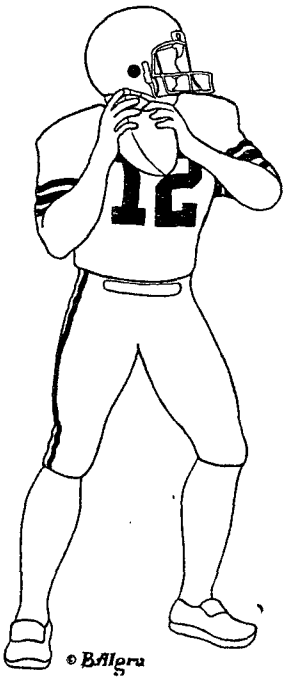
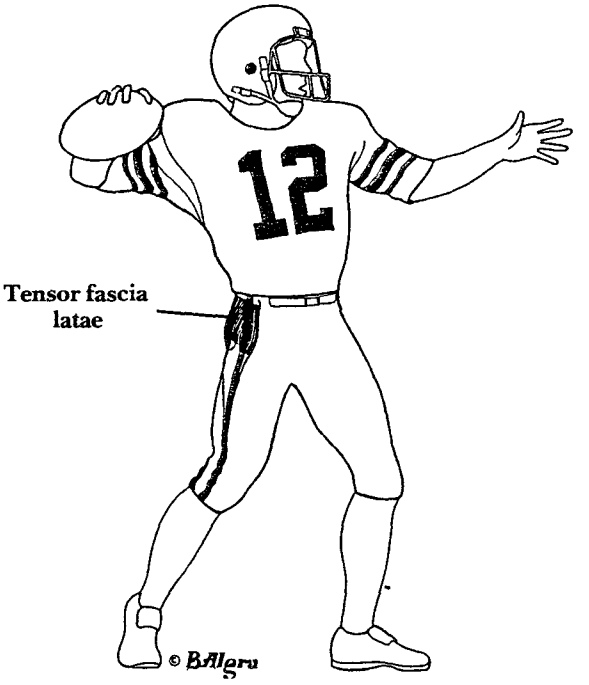


Figure 1:



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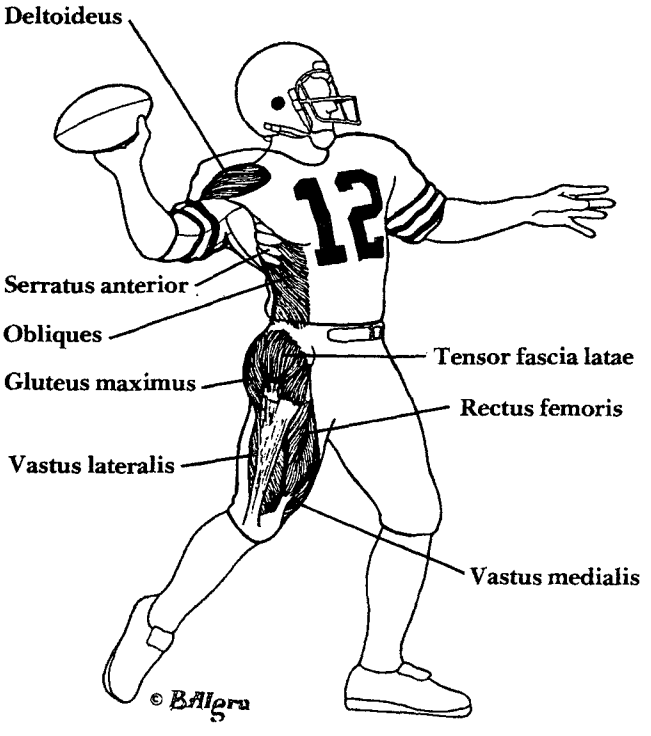

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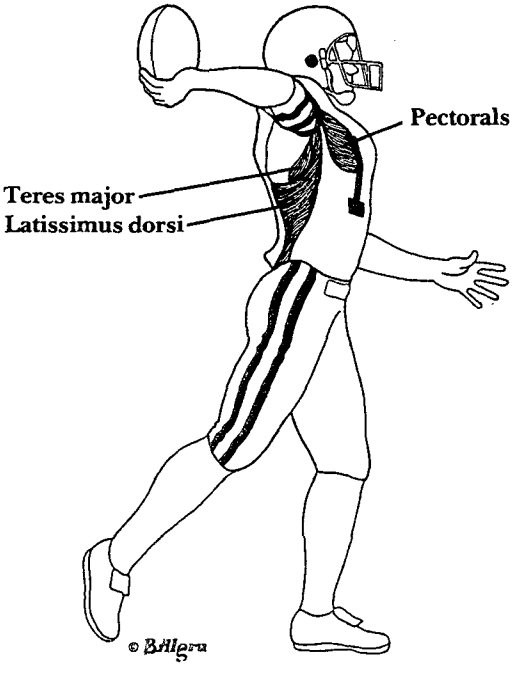

Figure 4:

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the forward throw, but just prior to it in the muscle and movement preparatory stage, and after release.

Elbow joint extension takes place as the medial shoulder joint rotation occurs but *not* to create additonal force. The elbow joint extension is used to straighten the arm above the head so that a higher release point can be achieved. In addition, the elbow joint extension is not executed quickly or forcefully. If it were, forces directed sideways would be produced away from the target.

As is known, it is very important that the quarterback have a high release. This is needed so that he can throw over the oncoming defenders. To achieve this high release point, in addition to elbow joint extension, the thrower remains erect and executes lateral flexion of the spine (left shoulder is lowered and the right shoulder is raised). This action does not contribute force to the throw. **(Figure 5)**

Because these actions are involved in the throwing, it is advisable to take into consideration the muscles of the elbow joint and spine. This includes the biceps and triceps brachii, quadratus lumborum, erector spinae, rectus abdominus and internal and external obliques.

As the medial shoulder joint rotation takes place, the wrist undergoes hyperextension, preparing the wrist joint flexors for the next action via an eccentric contraction. When the forearm approaches the same plane as the upper arm and shoulders (perpendicular to the ground when viewed from the side), wrist joint flexion and hand pronation (which is an effect of elbow extension after release) occur and the release takes place. **(Figure 6)** The muscles involved in wrist flexion are the flexor carpi radialis, flexor carpi ulnaris, flexor digitorum profundus, flexor policus longus, flexor digitorum superficialis and the palmaris longus. In pronation, the pronator quadratus and pronator teres are the major muscles involved.

The release is concluded 6-8" in front of the lateral plane of the body. There may also be some finger flexion occurring at this time. After release, the follow-through takes place in which the body parts again go into action. They follow after the hand and are needed to dissipate the forces developed.

And so, a sequence or chain of actions can be seen in which each movement adds additional force to the previously

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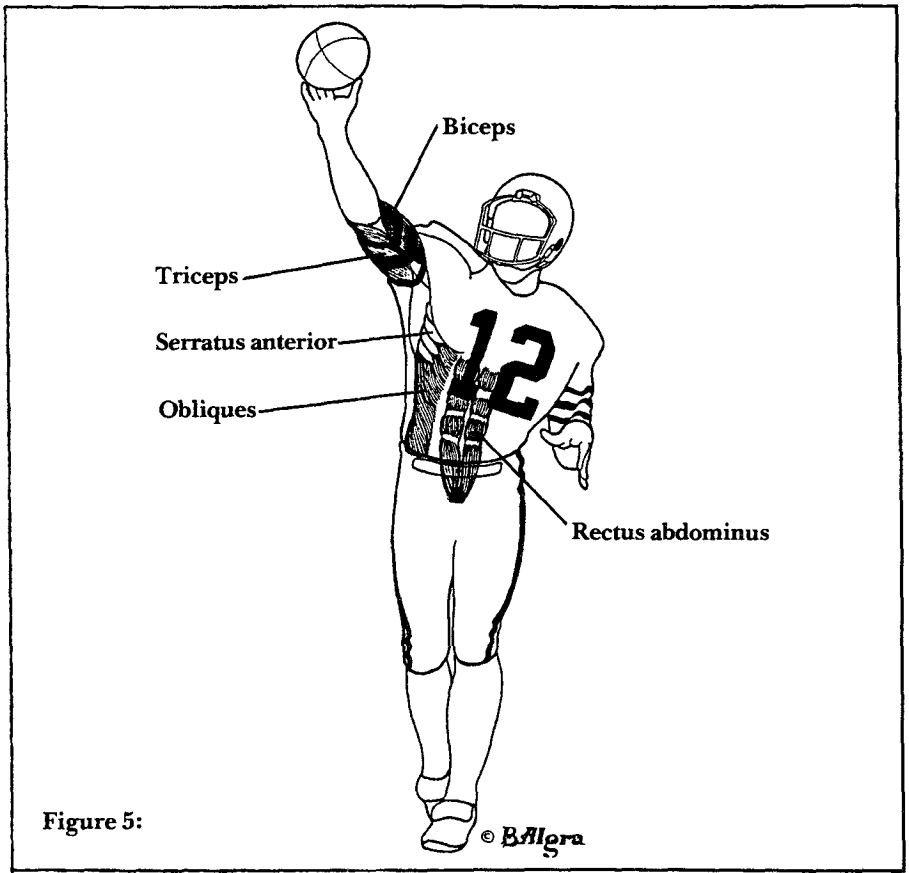

Figure 5:

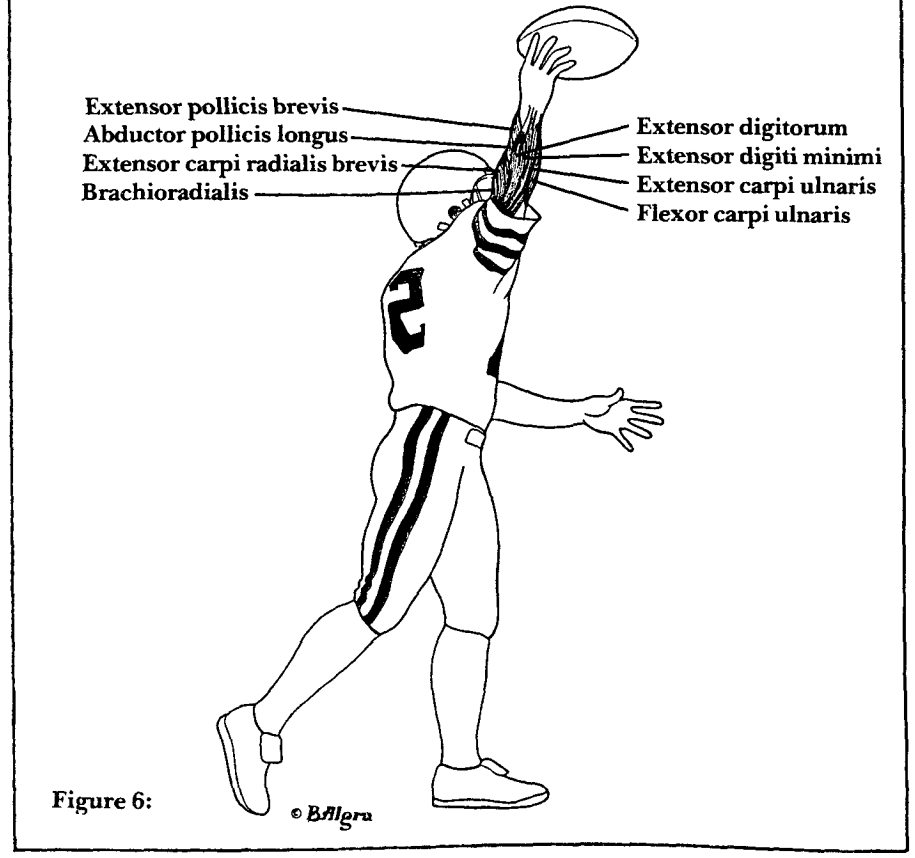

Figure 6:

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developed force, culminating in maximum force. This is known as a summation of forces. It begins with leg drive for forward weight shift, followed by transverse pelvic girdle rotation, shoulder girdle rotation, medial shoulder joint rotation, wrist joint flexion and hand pronation. Ideally, each movement begins with maximum acceleration and ends with maximum deceleration.

The timing of each action is very precise so that the next sequential action begins acceleration when the preceding action is undergoing deceleration. This allows for a smooth and maximal transfer of the forces generated.

Each joint action is accomplished by concentric contraction of the muscles involved. To allow for an effective muscular contraction, however, the prior body part in motion is stabilized via isometric contraction of other muscles. In preparation for the concentric contraction, the muscles first undergo stretching to develop eccentric tension which, when switched to concentric, allows for the maximal acceleration of the body part or the limb.

When throwing a short pass or a bullet pass, there is not enough time to go through all of the above-mentioned body actions to develop maximum force. The quarterback must rely on only a few actions to get the job done. Usually this consists of a short stride or, if not enough time, only shoulder girdle rotation (and not through the full range of motion), followed by the actions described above.

When the shoulder girdle rotation is 90 or more degrees and executed with maximal acceleration, it may provide over 50% of the total force generated. Because of this, it is most important in the throwing action, especially when force is needed. However, when there is little time to make the pass, the quarterback must rely mainly on medial shoulder joint rotation, wrist flexion and hand pronation, and limited shoulder girdle rotation.

Some throwers create additional force by including the abdominal muscles in spinal flexion prior to the release. This can be done if, when striding forward, the thrower leads with the pelvic girdle and holds the shoulders back. After transverse pelvic girdle and shoulder girdle rotation, the spine assumes a hyperextended position. From this arched position spinal flexion is effective; but, it should not bring the trunk much past the vertical position. Doing so will lower the point of release, even though the spinal flexion adds additional force.

Conditioning for throwing

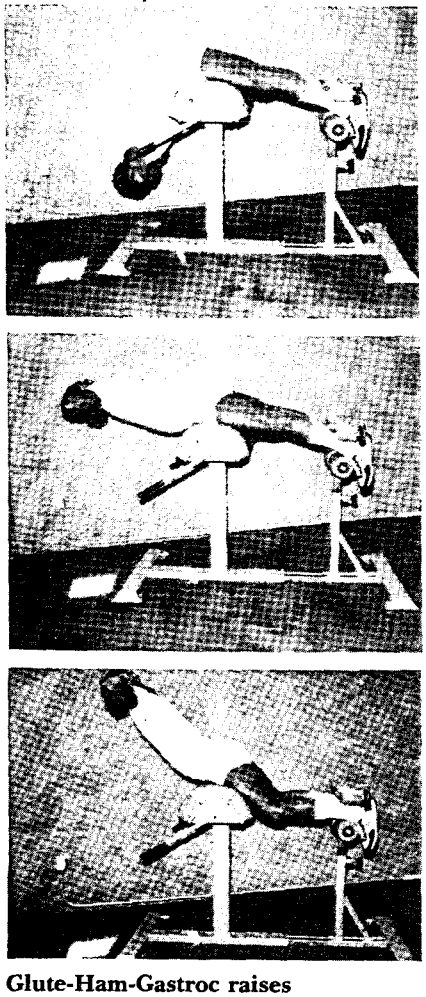
First and foremost in physical conditioning is that the quarterback be in good all-around condition. This is necessary not only for throwing but is needed for scrambling, running, dodging and handling the blows when tackled. The all-round general conditioning also serves as a base upon which specialized exercises can be executed.

Specific conditioning for throwing is more precise and is related to the actual actions involved during the throw. For example, as brought out, the muscles in

each of the joint actions first undergo preparatory eccentric contractions, then concentric in the main action, followed by isometric contraction for stabilization. Therefore, all three types of muscle contraction regimes must be included in the workouts. However, since concentric is the most important type of contraction, it should be predominant in the workouts. It is this author's opinion that concentric exercise regimes should comprise about 75% of the total muscle work done.

Some of the more beneficial specialized exercises for throwing, beginning with the legs and working up, are as follows.

- **Leg presses or parallel squats**, including holding positions (isometric) at the same angles which occur when the different throws take place.
- **Glute-ham-gastroc raises*** for total development of the hamstrings, for posterior stabilization of the knee (leg) and hip joint (pelvic girdle), and to prevent injury in the running and movement patterns.

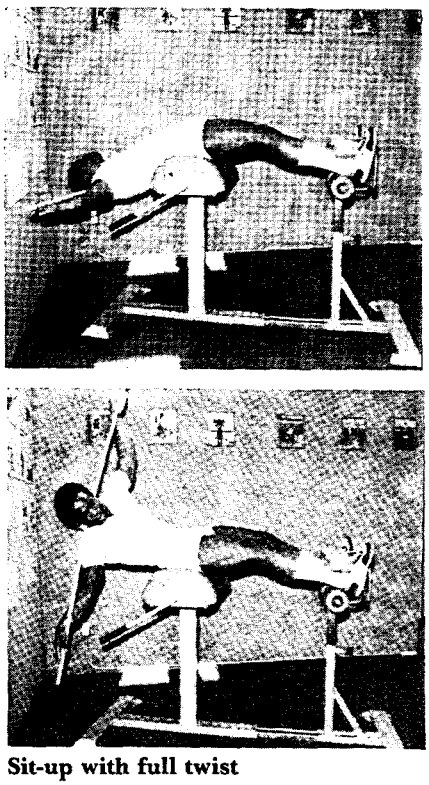


Glute-Ham-Gastroc raises

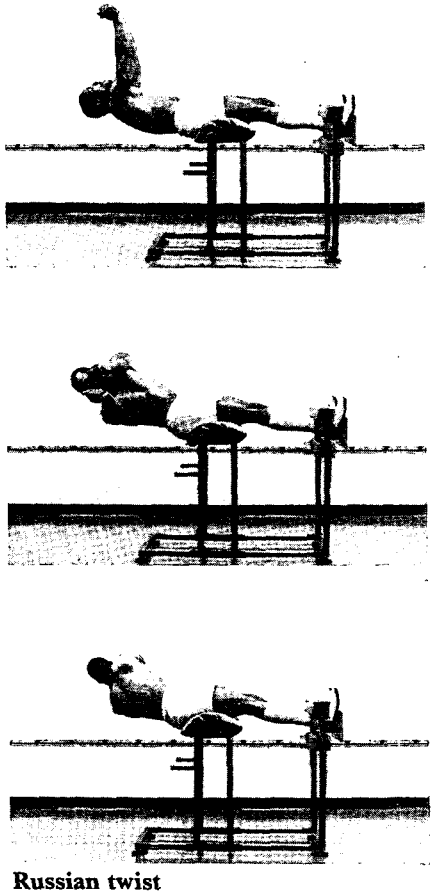
- **Hip joint abduction** for the initial stride (push-off).
- **Hip joint medial rotation** for strong transverse pelvic girdle rotation.

Hip joint medial rotation is a difficult exercise to do since there are no exercise machines or convenient free weight set-ups presently available. You will have to improvise by making a small harness to place over the ball of the foot to which weights can be attached. The thrower should lie on his left side on a table with the harnessed foot extended beyond. He keeps the knee locked and rotates the foot upward. This exercise can also be done on a low pulley station if you develop a harness for the front of the foot.

To develop the midsection rotators (internal and external obliques), which are responsible for bringing the shoulders around (and which are most important in the production of force), it is necessary to do *sit-ups with a full twist* on a Glute-Ham Developer (or on a Roman chair if it fits the thrower's body proportions). Use a bar across the shoulders to help ensure a full 90° twist of the shoulder girdle. The sit-up must be done so that the thrower starts in a slightly hyperextended position as occurs during the actual throw. To ensure that it is only the midsection rotational muscles involved, the buttocks or the pelvic girdle must be situated on the seat when the feet are secured. A position other than this either brings in different muscles or gives limited development. Since the Glute-Ham Developer has adjustable foot positions, it is preferred in order to ensure correct exercise positioning and thus, the most effective development of the rotational muscles. Another excellent exercise which is even more specific to the throw is the *Russian twist* with the pelvic girdle positioned fully on the support surface.



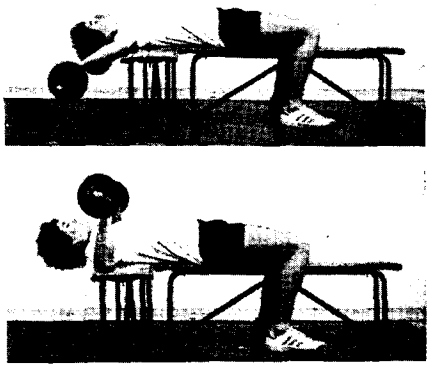
Sit-up with full twist



Russian twist

For the shoulder joint medial rotators, the best exercise to do is *medial shoulder joint rotations* with different angles in the elbow joint on a "T" bench set-up. Place two benches perpendicular to one another in the shape of a "T." Have the thrower lie down on the long bench with the arms out in the form of a capital "T." Arms should be on the top edge of the perpendicular bench. Flex the elbows 90° so that the hands are straight up. Place a barbell in the hands and drop it down (backward) as far as possible (90° or more). Raise back to the perpendicular position and repeat.

* See *NSCA Journal*, Vol. 4, No. 1, p. 6.



Medial shoulder joint rotation

Begin with only a light barbell until you become familiar with this exercise. Make sure that the elbow and upper arm remain in contact with the surface of the bench at all times. Gradually increase the amount of resistance and range of motion. When executing the exercise with weights, it will not only develop strength through the entire range, but it will also increase the range of motion. This is very important in injury prevention since injury may occur to the shoulder joint rotary cuff at the extreme limit of the lateral shoulder joint rotation. This exercise develops strength in the muscles at this point. Also, it is at this initial position that the muscle goes into maximum concentric contraction (arm undergoes maximal acceleration). This necessitates very strong muscles at this end point in the range of motion.

As the thrower gets proficient at this exercise, he can begin to widen hand position. Also, he can perform the exercise with dumbbells holding the hand in different positions (90–170° in the elbow joint). The upper arm and elbow, however, must always be in contact with the bench. The larger elbow joint angle more closely duplicates the position of the arm when releasing high.

For the wrist action, *wrist curls* and *hand pronations* are needed. These exercises should be done individually and jointly with dumbbells, i.e., as wrist joint flexion occurs, pronate the hand.

Although not specifically related to throwing, other strengthening exercises which involve the shoulder joint should also be done to help prevent injury. Included are lat pull-downs to chest level followed by medial shoulder joint rotation, bench press with a wide grip, lateral arm raises (to develop the supraspinatus which is most important in preventing dislocations), together with lateral or medial shoulder joint rotation and so on.•

For more information on the above, exercises, contact Dr. Michael Yessis, P.O. Box 2878, Escondido, CA 92025, or phone (619) 480–0558.