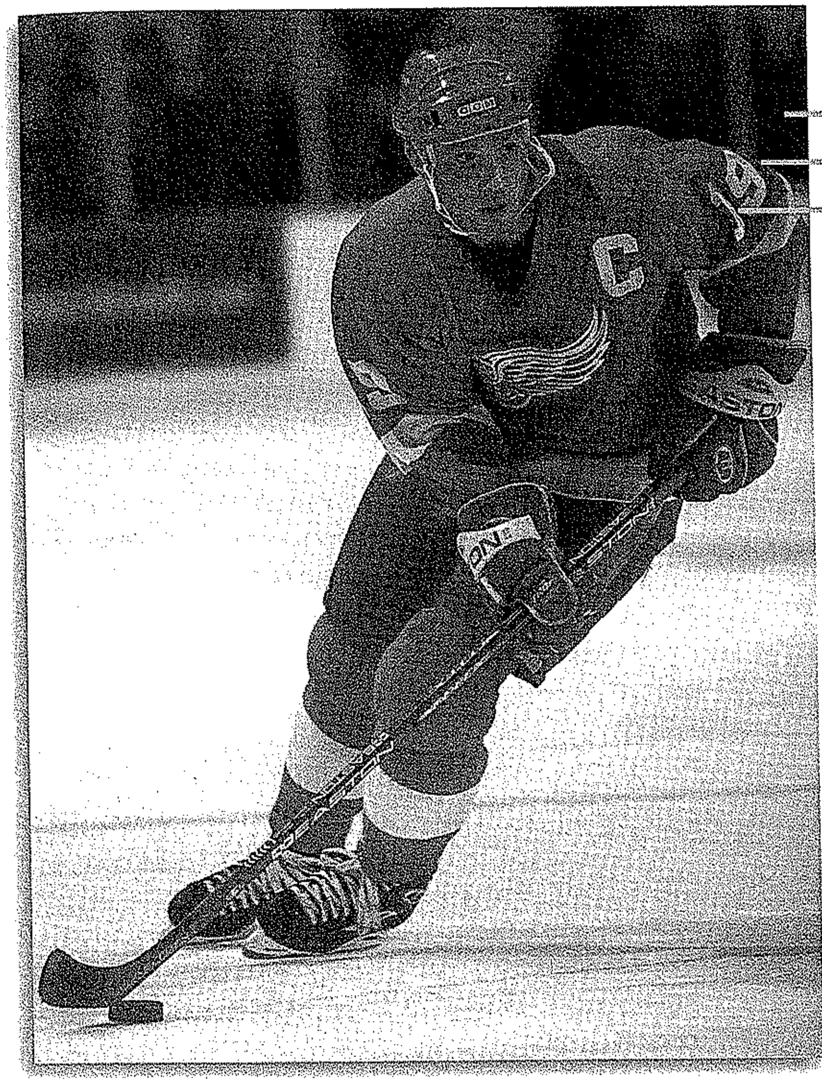


chapter 2

Baseline Sports-Fitness Testing

Gray Cook

Testing is used throughout athletics to document, assess, and predict sports performance. A review of the current literature reveals many interpretations of testing philosophy and methods. It is first necessary to define the intent of baseline testing and then develop a practical model for application. Miller and Keane (1997) define *base* as "the lowest part or foundation of anything." *Baseline* is defined as "an observation or value that represents the normal background level of measurable quality." The operative words in these two accepted definitions are *foundation*, the fundamental or essential components of a system or structure, and *quality*, a range, degree, or grade of excellence. Note that the word *quality* is used—not *quantity*. Most current testing methods are quantity based (time, distance, force, etc.), not quality based. The purpose of baseline testing is to demonstrate the fundamental building blocks of athleticism and preparedness for sport. Each building block should have specific relevance to athletics. The word *function* has become popular as a term to represent movements that are specific to a given activity. It is important to reconstruct testing using the terms *quality*, *foundation*, and *function* to represent accurately the purpose of baseline testing.

The goal of this chapter is to present a model that makes use of principles consistent with motor learning. Early testing practices focused on physiological energy systems and sport-specificity. This chapter will introduce functional movement patterns and motor control as key building blocks of performance. Examples of testing are presented; however the reader is encouraged to create new tests or to adapt conventional tests to fit within the proposed model.

CONSTRUCTING A TESTING MODEL

Baseline testing should ask three questions, regardless of the athlete's sport or position:

1. What is the status of fundamental or functional movement quality? Fundamental movement quality includes range of motion, balance, body control, and stability.
2. What is the status of fundamental or functional performance quantity? This describes functional movements, which are graded by time or distance. Examples of fundamental performance are the 40-yard sprint, the vertical leap, and so on. These movements should look at performance from a general viewpoint and not be sport specific; this will allow the comparison of all athletes before sport specificity is considered.
3. What is the status of sport-specific skills? This describes specific proficiency, ability, or dexterity with movements that define a sport and one of its positions. These tests will usually look at quantity and quality. A good example is pitching. A radar gun will measure speed (quantity), while the strike zone will measure accuracy (quality).

These considerations will improve problem solving by establishing a more refined breakdown of information. For the purposes of this chapter and to provide quick identification of performance problems, athletic movement will be observed in three categories:

1. Functional movement quality—basic fundamental movements that demonstrate full range of motion, body control, balance, and basic stability
2. Functional performance quantity—general, nonspecific performance demonstrating gross power, speed, endurance, and agility
3. Sport-specific skills—skills demonstrating sport-specific movement patterns

This chapter will not go into depth for sport-specific skill training because of the large volume of information concerning each sport. The focus will be on the first two categories because they are common to all sports.

If two athletes have poor 40-yard sprint times, and no fundamental assessment of movement quality has been conducted, then it must be assumed that both athletes are slow and need more speed training. If fundamental movement testing, however, reveals that athlete 1 has good flexibility, good core stability, and good balance and that athlete 2 does not, then the two athletes do not have the same problem. Athlete 1 has the fundamental building blocks but is not using them well for speed generation. Therefore, a speed-development program would be appropriate. Athlete 2 does not have the fundamental movement patterns necessary for speed development. Placing athlete 2 on a speed program will have some positive results but, as discussed later in this chapter, doing so would break a major rule about the neuromuscular system (see page 23 on functional movement). The test deduction and result for the two athletes is as follows:

Athlete 1: Basic speed (performance work) and plyometric work

Athlete 2: Basic mobility (fundamental movement work) and stability work progressing to speed and plyometric work

Focus is often placed only on the quantity (functional performance) aspect of movement and not the quality (foundation or functional movement). Those who develop conditioning programs commonly make two mistakes:

1. Placing minimal importance or emphasis on fundamental movement patterns
2. Confusing quality of movement and quantity of movement

Fundamental movement and the importance of quality will be examined in this chapter. A model called the performance pyramid, designed to help coaching and training staffs interpret baseline data, will be presented. The model will help coaches, trainers, and conditioning specialists develop a hierarchy of importance and an objective approach for managing athletes and teams. The first order of business is to identify the weakest link in movement through testing.

Roles of the Staff

The certified athletic trainer will be provided with data that is based in prevention, which facilitates better tracking of athletic function and movement efficiency. The trainer should identify and monitor any weak link, such as poor flexibility or muscle imbalances resulting from a previous injury or a poor training program. The trainer should be concerned with functional movement quality.

The same data will assist the conditioning specialist with performance-based problem solving for better prioritization of training. The strength coach must also focus on the weak link but more from a performance basis. The model will demonstrate a systematic progression designed to improve general performance. The conditioning specialist should be concerned with functional movement and functional performance.

Sports skill is the concern of the head coach and assistant coaches. It is their job, with the help of the certified athletic trainer and the conditioning specialist, to identify and understand the way in which the weak link will affect skill and sport-specific performance. A look at functional movement quality and functional performance quantity will help explain sport-specific skill data.

Baseline Testing Considerations

Baseline test data along with a sports medicine history (previous injuries) and sport-specific data (performance and skills) should be considered equally when setting goals. In case of injury the athletic trainer can use baseline measurements to guide and direct rehabilitation toward preinjury performance. The strength coach can use baseline data to direct the athlete's focus toward his or her weak link. Baseline testing must encompass a format that can both assist the strength and conditioning specialists and sports medicine team by predicting which athletes are predisposed to injury and provide performance tests that look at raw power, speed, agility, coordination, and endurance.

The appropriate time for baseline testing for sports is between the preparticipation physical (medical screen) and the sport-specific testing. Baseline testing should address general athleticism and physical preparedness. The testing should identify both attributes of and detriments to athletic performance and competition. The modern strength and conditioning program commonly employs baseline testing for athletes, but distinguishing between the athletes who test well (in the weight room and on the field) and those who perform well (in the competition arena) is often difficult. This means that current testing methods are sometimes poor predictors of true sports performance. Furthermore, no specific relationship has been drawn between an individual's performance-based test scores and the individual's tendency to sustain noncontact injuries—injuries that can be prevented because they result from tightness, weakness, poor coordination, and the compensatory strategies athletes use to perform in spite of these problems. Therefore, the athletic trainer has no reliable predictor of these unnecessary injuries. The trainer cannot be expected to prevent them unless a screening tool is implemented (Cook and Athletic Testing Services 1998).

THREE FORMATS FOR BASELINE TESTING

Baseline testing can be broken into three distinct formats. The first format looks at functional movement quality, the second at functional performance quantity, and the third at sport-specific skills.

Do not be surprised when highly skilled athletes do not test well for functional movement or functional performance. This should in no way diminish their skilled accomplishments. The fact that they are good attests to how well their neuromuscular systems have compensated for a particular weakness. But it is the responsibility of those in authority to expose limitations and forecast potential problems before they become reality. All athletes will ultimately make certain compensations. As they become more seasoned and specialized, their focus is usually on accomplishment (quantity), not functional movement and technique (quality). This is one reason why all great coaches stress skill fundamentals. Movement fundamentals should receive the same attention. The compensatory patterns are numerous and not readily detectable. It is better to identify the reasons for compensation through continual baseline testing.

The performance pyramid (figure 2.1) demonstrates how each level of baseline testing builds on the other. Consider the skills involved in throwing a baseball or softball:

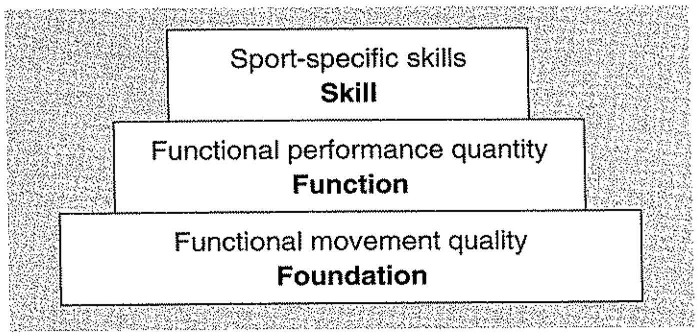


Figure 2.1 The performance pyramid shows how each level creates a stable base for the next.

1. The athlete must first possess good general mobility, especially in the shoulder region. Next, the athlete must have enough stability in the lower body to shift weight from one foot to the other to generate rotary movement while maintaining balance.
2. When the athlete adds speed and power to the weight shift, he or she is able to generate greater ball speed. The athlete will learn to transfer power from the hips to the trunk and from the trunk to the arm, a process known as kinetic linking.
3. Last, the athlete will learn control and skill. This will improve accuracy, conserve energy, and allow the athlete to become more relaxed and consistent.

One level creates a stable base for the next, and this sequence represents the way the brain prioritizes and processes movement information. Although this is an oversimplification of true motor learning, it will help the athlete understand that he or she must develop each level before moving to the next.

The first block (lowest) on the pyramid represents fundamental mobility and stability. Strength is not included because it is a subcomponent of stability measured only in force with no consideration control, time, or distance. The second block on the pyramid represents movement efficiency and productivity, including power, speed, agility, and endurance. The third block (highest) on the pyramid represents skill, movement timing, coordination, body control, muscle memory, motor learning, and consistency.

FUNCTIONAL MOVEMENT

Functional movement relates to fundamental mobility and stability, the building blocks for all other measurable physical fitness attributes. They represent the underlying quality of movement. Although these fundamental movement patterns are present in normal growth and development, the athlete can sometimes lose them when he or she focuses on only one aspect of human movement or performance.

Mobility

The term *mobility* represents much more than simple muscular flexibility as identified in a sit-and-reach test. It includes the way multiple body segments, such as the hips, pelvis, and trunk region, interact in functional situations. Individual assessment of one specific joint and muscle complex will not yield sufficient data to describe the athletic body in motion; sitting and reaching has limited functional application and little correlation with true functional movement. Mobility represents muscle flexibility, joint range of motion, and multisegmental interaction of the body parts in functional positions and movement patterns.

Stability

Stability, on the other hand, is not a representation of strength. It is more a representation of body control through strength, coordination, balance, and efficiency of movement. Stability can be divided into static and dynamic categories. Static stability is the maintenance of posture and balance. Dynamic stability is the production and control of movement and includes the following components:

- Mobility and flexibility
- Strength
- Coordination
- Local muscular endurance
- Cardiovascular fitness

Note that by definition dynamic stability cannot be optimal if mobility and flexibility are not optimal (because they are components of dynamic stability). Note also that strength is only *one* component of dynamic stability. To create efficient movement, all five components must work together. In the presence of normal mobility, the neuromuscular system will selectively use muscular contractions (isometric, eccentric, and concentric) to stabilize one body segment while creating motion in another body segment. This process is a result of timing and coordination and it explains why athletes with less than impressive weight-room statistics (isolated strength) can have impressive statistics in the vertical leap (power), medicine ball throw (power), and 40-yard dash (speed). These athletes demonstrate efficiency with maximal use of all segments in a unified and synergetic fashion to produce power, speed, and quickness. Raw force (strength) that the athlete cannot use efficiently demonstrates only the ability to move weight, not the body.

The foundations of mobility and stability are evident in human growth and development. The infant enters the world with unlimited mobility and selectively learns to stabilize first the core and then the extremities. Movement control and stability proceed in a head-to-toe progression (cephalo-caudal) as well as a core-to-extremity progression (proximal-distal). This simple law of the neuromuscular system produces a rule of thumb that should be the cornerstone in strength and conditioning programs:

> Proximal stability (control) must precede distal mobility (movement).

This means that the athlete must train the muscles of the core and trunk adequately before focusing on the extremities. Therefore, movements like the bench press, although excellent for shoulder development and muscular hypertrophy for the upper extremities, will do little to train the core or educate the neuromuscular system about its role during upper-extremity patterns in a standing or functional posture. The simple push-up is more functional because it involves the core (if performed correctly). We must add a second rule to the first:

If a mobility problem exists it must be dealt with and rectified before true stability can occur.

Training or testing on fixed-axis equipment in a seated or lying position often breaks both rules. Usually the region of questionable stability is compensating for the region of poor mobility. The knees, lower back (lumbar spine), and shoulders are good examples of areas that commonly develop poor stability. Before an attempt is made to stabilize these areas, the mobility of the ankles, hips, and upper back (thoracic spine) should be established. Testing functional movement allows the sports medicine and conditioning team to understand the interaction between mobility and stability. The combination of poor mobility and stability is the source of many common athletic problems. Athletes demonstrating poor functional movement patterns and poor mobility and stability should seek to regain these fundamental building blocks before focusing on other attributes of fitness such as strength, speed, power, and endurance. Innumerable unnecessary injuries have occurred because athletes have focused more on the quantity of their workout statistics (sets, reps, and weight) than the quality and technique of their movements. A common example is the squat. Many athletes will continue to lift greater amounts of weight with a poor-mobility (figure 2.2) squat even though they cannot perform a deep, full-range-of-motion squat with no weight at all (figure 2.3).

The most common mistake in sports conditioning today is training a movement pattern before achieving full range of motion and control in that movement. Poor technique and inadequate ankle and hip mobility will lead to poor posture and body mechanics during the conditioning session. The compensations that will occur because of a lack of mobility in the hips and ankles will not only create stress on the knees and spine but will also change the motor program for the squatting movement. These compensations will then become engrained into the central nervous system, adversely affecting timing, coordination, and

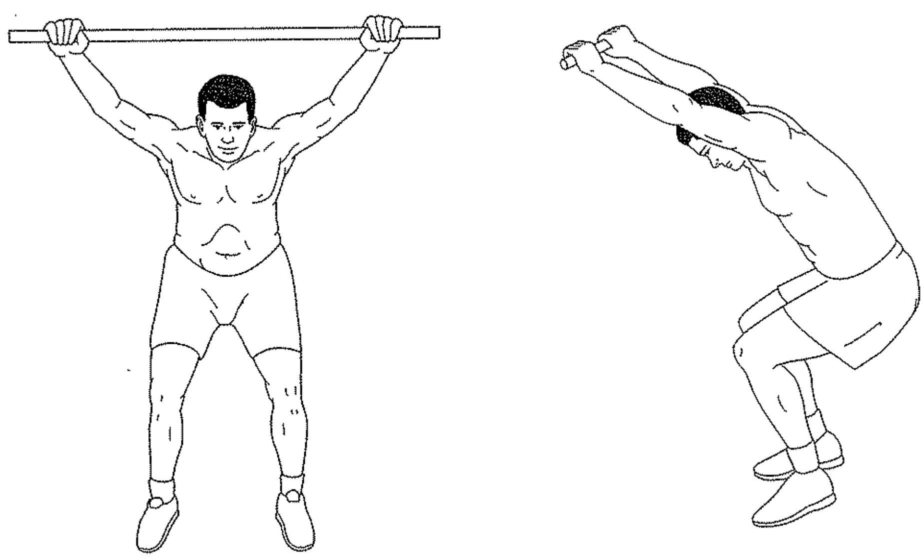


Figure 2.2 Poor-mobility squat.

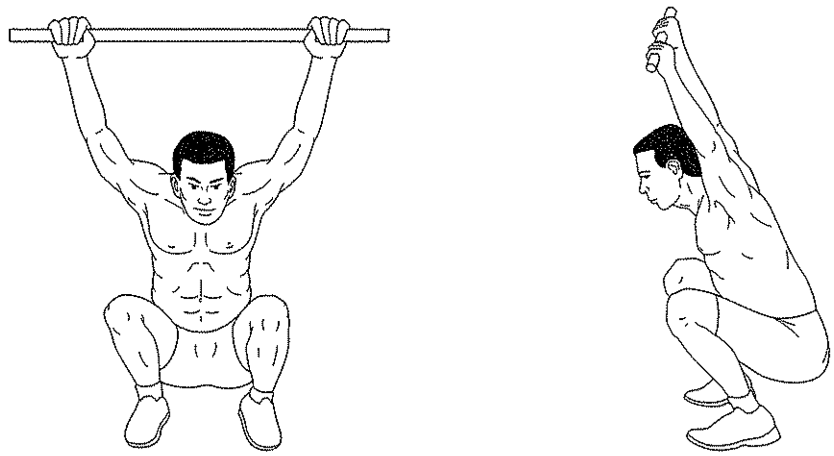


Figure 2.3 Full-mobility squat.

efficiency. Baseline testing must therefore always assess functional movement first to reveal *potential efficiency*. Once an athlete demonstrates functional movement through reliable and valid testing, performance testing can demonstrate *actual efficiency*.

When mobility and stability are poor, potential efficiency is poor, yielding less than optimal performance and a greater chance of injury during athletic conditioning and competition. Potential efficiency takes into account all aspects of human movement; it is not a predictor of any single performance parameter. An athlete may have poor mobility and stability and yet be an elite competitor in a given sport. This circumstance is becoming more prevalent as athletes specialize in one sport, and even one position, at an early age. If such an athlete is asked to perform another movement parameter or to change technique, he or she will have fewer movement options from which to choose. The highly specific movement patterns will cause imbalances by overdeveloping some areas and neglecting others, as well as increasing the potential for injury. Efficient rehabilitation in the event of an injury is also reduced because the system is already compensating in one form or another. Mobility and stability provide a buffer zone that allows adaptability of movement patterns.

FUNCTIONAL MOVEMENT SCREEN

The functional movement screen (FMS) was developed in an attempt to quantify movement quality and fulfill the first requirement of baseline testing (mobility and stability assessment). The screen uses seven movements that represent the mobility and stability milestones in human growth and development—squatting, stepping, lunging, reaching, striding or kicking, and two movements that require trunk stability for anterior-posterior stress (pushing) and rotary stress (segmental stabilization). These movements have been placed in a format that is cost effective, time efficient, reproducible, and representative of the basic foundation for human movement. The functional movement screen assigns a specific score to each athlete. Each sport and position will require a minimum level and optimum level of baseline function. Over time, a movement screen database will reveal how certain injuries correlate with functional movement rankings, which can serve as predictors for the sports medicine team. The screen assists coaches, athletic trainers, and strength coaches in communicating with one another by providing common ground for discussing an athlete's functional status and future potential.

Scoring

The scoring criteria for the test are quite simple. If the athlete is able to produce the required movement without any of the common compensations described, he or she receives a score of 3. If the athlete reproduces the movement but has one or more of the common compensations or any difficulty, the athlete scores a 2. If the athlete is unable to reproduce the movement as described, the athlete receives a score of 1. If pain is present during the test, regardless of the athlete's performance, he or she receives a 0 for that particular movement. A perfect score for all 7 movements is 21.

Interpretation

Interpretation of this scoring system is done on a priority basis. Any 0 scores will be considered first by the team physician and athletic trainer, who will conduct a sports medicine evaluation of the painful site considering the movement pattern that produced the pain. Next, the score of 1 demonstrates that an athlete does not have a functional base of mobility and stability and is therefore probably experiencing microtrauma, poor efficiency, and poor technique with common athletic movements (even if performance seems adequate). This score may also indicate a relatively higher degree of stress during normal activities because a basic movement pattern is absent. A sports medicine professional should specifically evaluate the flexibility and strength of the areas in question (even though the athlete reports no pain). A score of 2 demonstrates areas of priority in conditioning and flexibility. It is advisable that the athletic trainer, strength coach, and sport coach work together to develop complementary exercise, conditioning, and sport-specific training programs around these areas of limitation. A score of 3 demonstrates appropriate or optimal mobility and stability for a particular movement pattern; screening is still periodically necessary to check for common imbalances acquired in training. Five of the seven screens are performed on the left and right sides of the body, allowing for comparison. If testing on one side of the body produces a lower score, then that is the score given for the test.

Besides the seven movement screens, three clearing screens have been added. The clearing screens are for the shoulder and lumbar spine areas (which can sometimes go undetected in routine movement screening). Research and literature reviews have shown that these areas hide potential problems unless specifically addressed. The clearing screens are scored as pass or fail for pain. A 0 score is assigned to the movement screen when pain occurs regardless of the previous score. An impingement clearing screen is added to the shoulder exam. An individual who scores 3 on shoulder mobility but has a positive impingement screen is given a 0. This simple addition to the shoulder movement screen will pick up potential shoulder problems. A spine-flexion clearing screen and a spine-extension clearing screen are added to each of the trunk-stability tests to look at passive spine range of motion in an unloaded position (Cook and Athletic Testing Services 1998).

Deep Squat

Purpose

The deep squat assesses bilateral, symmetrical, and functional mobility of the hips, knees, and ankles. The dowel held overhead assesses bilateral, symmetrical functional mobility of the shoulders as well as the thoracic spine.

Description

1. The athlete places the feet slightly farther than shoulder-width apart and places the hands on the dowel so as to form a 90-degree angle at the elbows with the dowel overhead.

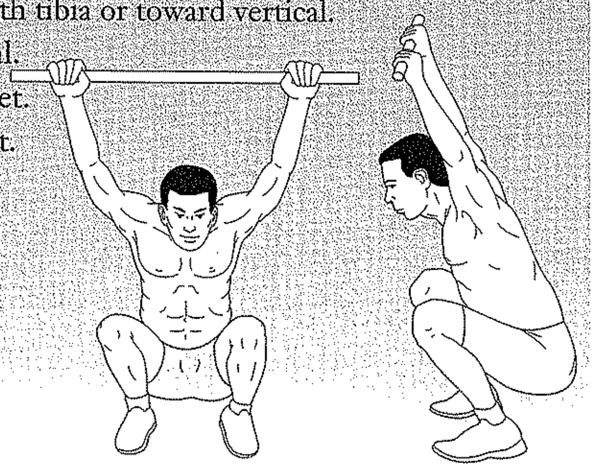
2. The athlete presses the dowel overhead with the shoulders flexed and abducted and with the elbows extended, then descends slowly into a squat position with the heels on the floor, the head and chest facing forward, and the dowel maximally pressed overhead.

3. The athlete is allowed up to three chances to perform the test.

4. If the athlete does not achieve the criteria for a score of 3, he or she then performs the test with a 2 × 6 board under the heels.

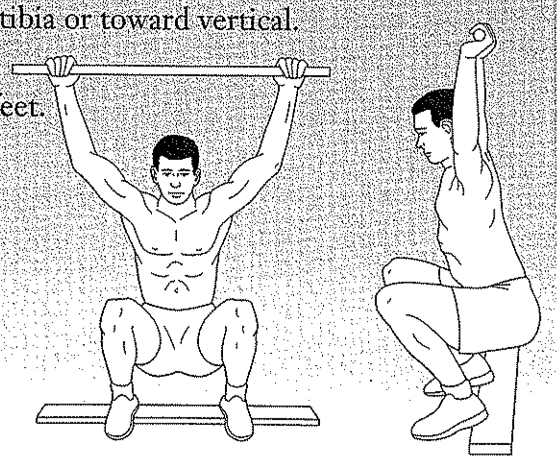
3 POINTS

- Upper torso is parallel with tibia or toward vertical.
- Femur is below horizontal.
- Knees are aligned over feet.
- Dowel is aligned over feet.



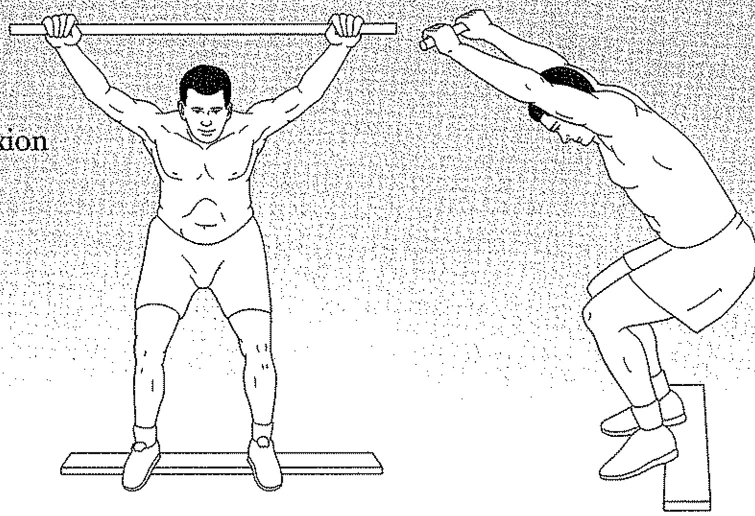
2 POINTS

- Upper torso is parallel with tibia or toward vertical.
- Femur is below horizontal.
- Knees are not aligned over feet.
- Dowel is aligned over feet.



1 POINT

- Tibia and upper torso are not parallel.
- Femur is not below horizontal.
- Knees are not aligned over feet.
- Lumbar flexion is noted.



0 POINTS

The athlete will receive a score of 0 if pain is associated with any portion of this test. A medical professional should perform a thorough evaluation of the painful area.

Clinical Implications for the Deep Squat

The ability to perform the deep squat requires closed kinetic-chain dorsiflexion of the ankles, flexion of the knees and hips, and extension of the thoracic spine, as well as flexion and abduction of the shoulders.

Poor performance on this test can be the result of several factors. Limited mobility in the upper torso can be attributed to poor glenohumeral or thoracic-spine mobility. Limited mobility in the lower extremity including poor closed kinetic-chain dorsiflexion of the ankle or poor flexion of the hip may also cause poor test performance.

When an athlete achieves a score less than 3, the limiting factor must be identified. Clinical documentation of these limitations can be obtained by using standard goniometric measurements.

Previous testing has indicated that when an athlete achieves a score of 2, minor limitations most often exist with either closed kinetic-chain dorsiflexion of the ankle or extension of the thoracic spine. When an athlete achieves a score of 1 or 0, gross limitations may exist with the motions mentioned above as well as flexion of the hip.

Hurdle Step

Purpose

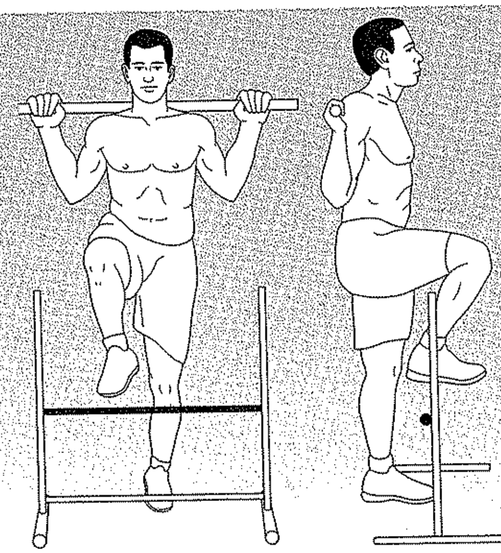
The hurdle step assesses bilateral functional mobility and stability of the hips, knees, and ankles.

Description

1. The athlete places the feet together and aligns the toes directly beneath the hurdle.
2. The hurdle is adjusted to the height of the athlete's tibial tuberosity, and the dowel is positioned across the athlete's shoulders below the neck.
3. The athlete slowly steps over the hurdle and touches the heel to the floor while keeping the stance leg in an extended position. Weight should remain on the stance leg.
4. The athlete then slowly returns to the starting position.
5. The athlete is allowed up to three chances to perform the test.
6. Have the athlete perform the test again, using the opposite leg. If testing produces a lower score for one leg, record the lower score.

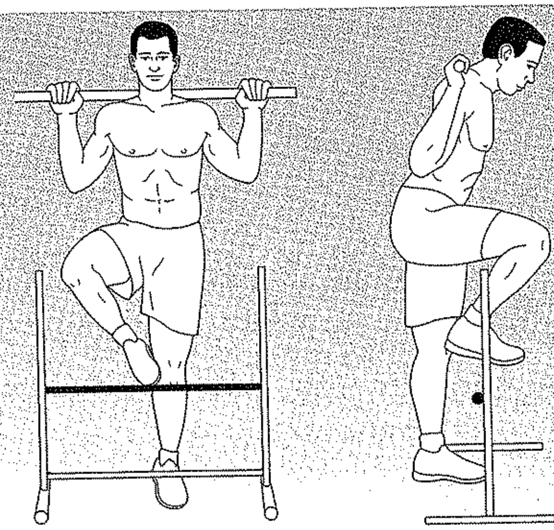
3 POINTS

- Hips, knees, and ankles remain aligned in the sagittal plane.
- Minimal to no movement is noted in lumbar spine.
- Dowel and hurdle remain parallel.

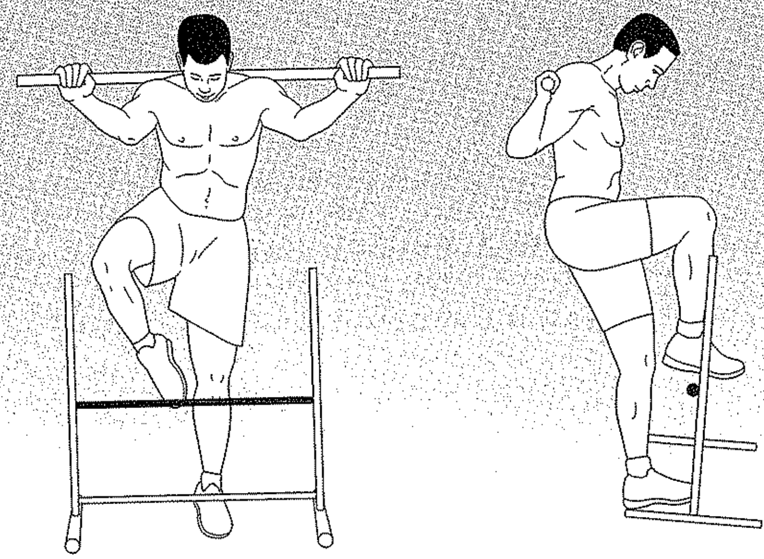


2 POINTS

- Alignment lost between hips, knees, and ankles.
- Movement is noted in lumbar spine.
- Dowel and hurdle do not remain parallel.



1 POINT
- Contact between foot and hurdle occurs.
- Loss of balance is noted.



0 POINTS The athlete will receive a score of 0 if pain is associated with any portion of this test. A member of the sports medicine staff should perform a thorough evaluation of the painful area.

Clinical Implications for the Hurdle Step

Performing the hurdle step test requires stance-leg stability of the ankle, knee, and hip as well as maximal closed kinetic-chain extension of the hip. The hurdle step also requires step-leg open kinetic-chain dorsiflexion of the ankle and flexion of the knee and hip. In addition, the athlete must display adequate balance because the test imposes a need for dynamic stability.

Poor performance on this test can be the result of several factors. It may simply be due to poor stability of the stance leg or poor mobility of the step leg. Imposing maximal hip flexion of one leg while maintaining apparent hip extension of the opposite leg requires the athlete to demonstrate relative bilateral, asymmetric hip mobility.

When an athlete achieves a score less than 3, the limiting factor must be identified. Clinical documentation of these limitations can be obtained by using standard goniometric measurements of the joints as well as muscular flexibility tests such as the Thomas test or Kendall's test for hip flexor tightness (see Cook and Athletic Testing Services 1998).

Previous testing has indicated that when an athlete achieves a score of 2, minor limitations most often exist with ankle dorsiflexion or hip flexion with the step leg. When an athlete scores a 1 or 0, relative asymmetric hip mobility may exist secondary to an anterior tilted pelvis.

In-Line Lunge

Purpose

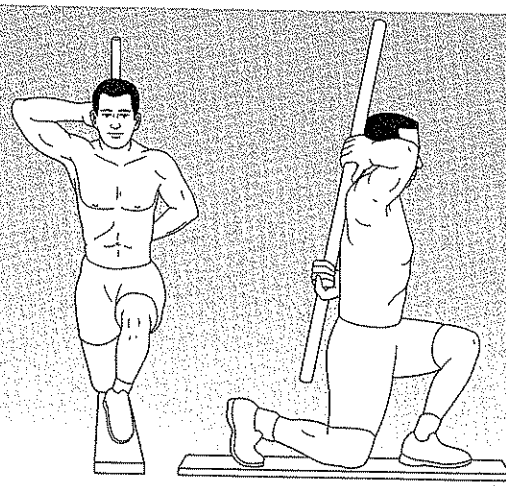
The in-line lunge assesses hip mobility and stability, quadriceps flexibility, and ankle and knee stability.

Description

1. The tester measures the length of the tibia with a yardstick.
2. The athlete places one foot on the end of a 2 × 6 board and holds the dowel behind the back, with the right arm up and the left arm down, so that it is touching the head, thoracic spine, and sacrum.
3. The tester then places the yardstick at the end of the athlete's toes and makes a mark on the board equal to the length of the tibial height.
4. The athlete takes a step with the left leg and places the heel on the mark, then lowers the back knee enough to touch the board behind the front foot. The feet should be on the same line and pointing straight throughout the movement.
5. The athlete is allowed up to three chances to perform the test.
6. Have the athlete perform the test again, with arms and legs in the opposite positions. If testing produces a lower score with either the left or the right leg in front, record the lower score.

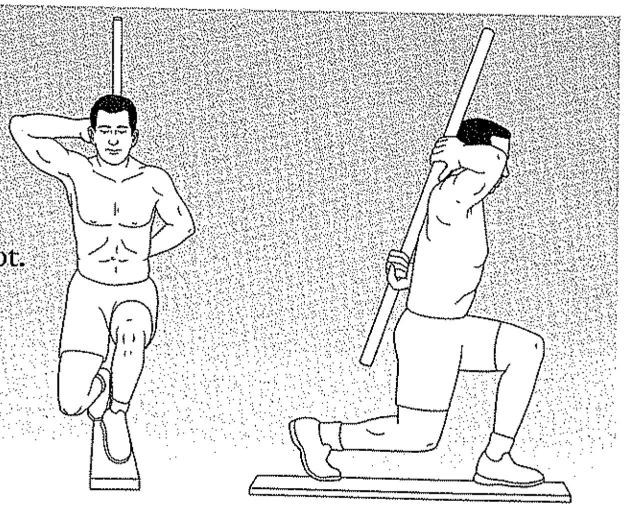
3 POINTS

- Minimal to no torso movement is noted.
- Feet remain in sagittal plane on the 2 × 6.
- Knee touches the 2 × 6 behind heel of front foot.



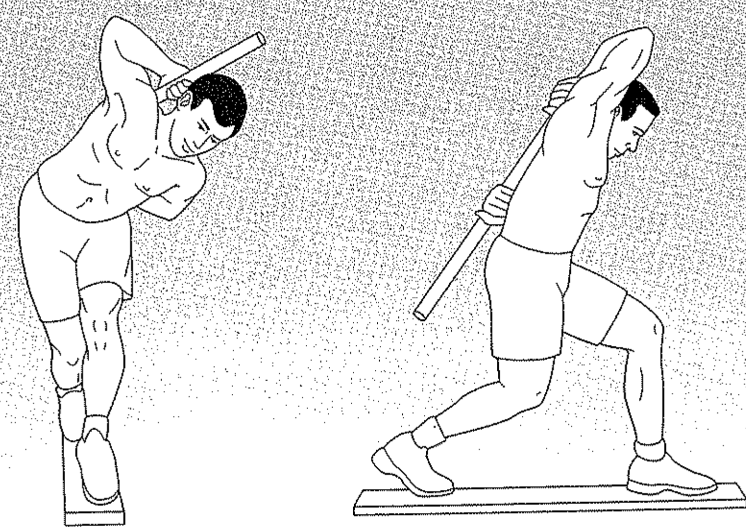
2 POINTS

- Movement is noted in torso.
- Feet do not remain in sagittal plane.
- Knee does not touch behind heel of front foot.



1 POINT

• Loss of balance is noted.



0 POINTS

The athlete will receive a score of 0 if pain is associated with any portion of this test. A member of the sports medicine staff should perform a thorough evaluation of the painful area.

Clinical Implications for the In-Line Lunge

The ability to perform the in-line lunge test requires stance-leg stability of the ankle, knee, and hip as well as apparent closed kinetic-chain hip abduction. The in-line lunge also requires step-leg mobility of hip adduction, ankle dorsiflexion, and rectus femoris flexibility. The athlete must also display adequate balance because the test imposes lateral stress.

Poor performance in this test can be the result of several factors. First, hip mobility may be inadequate in either the stance leg or the step leg. Second, the stance-leg knee or ankle may not have the required stability as the athlete performs the lunge. Finally, an imbalance between relative adductor weakness and abductor tightness in one or both hips may cause poor test performance.

When an athlete achieves a score less than 3, the limiting factor must be identified. Clinical documentation of these limitations can be obtained by using standard goniometric measurements of the joints as well as muscular flexibility tests such as the Thomas test and the Ober test (see Cook and Athletic Testing Services 1998).

Shoulder Mobility

Purpose

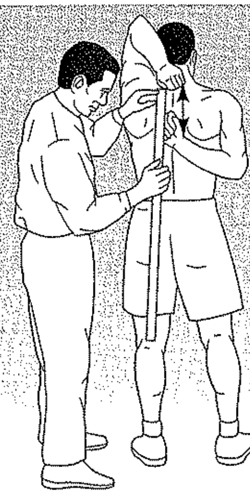
The shoulder mobility screen assesses bilateral shoulder range of motion, combining internal rotation with adduction and external rotation with abduction. It also requires normal scapular mobility and thoracic spine extension.

Description

1. The tester determines the athlete's hand length by measuring the distance from the distal wrist crease to the tip of the third digit.
2. The athlete makes a fist with each hand, placing the thumb inside the fist, and assumes a maximally adducted and internally rotated position with one shoulder and an abducted and externally rotated position with the other. In one movement the athlete places the hands on the back. During the test the hands should remain clenched.
3. The tester then measures the distance between the two fists.
4. Have the athlete perform the test again, with arms and hands in the opposite positions. If testing produces a lower score with either the left or the right arm up, record the lower score.

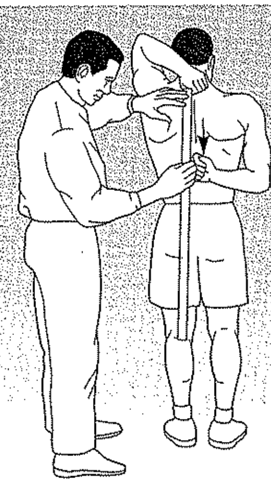
3 POINTS

- Fists are within one hand length.



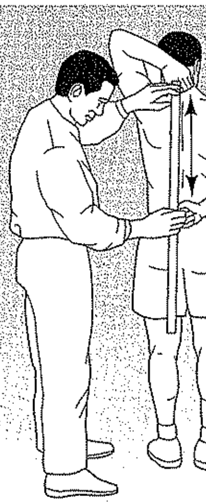
2 POINTS

- Fists are within one and a half hand lengths.



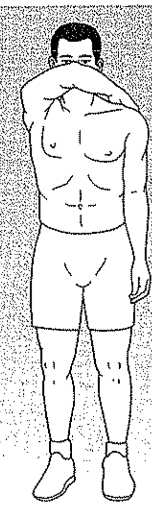
1 POINT

- Fists are not within one and a half hand lengths.



0 POINTS

The athlete will receive a score of 0 if pain is associated with any portion of this test or if pain is noted during the shoulder stability screen. A member of the sports medicine staff should perform a thorough evaluation of the painful area.



Shoulder Stability Screen

A shoulder stability screen should be performed even if the athlete scores a 3. The athlete places his or her right hand on the opposite shoulder and then attempts to point the right elbow upward. If the athlete experiences pain or is unable to perform this movement, a score of 0 will be given for the shoulder mobility test and the shoulder should be evaluated more thoroughly. This screen should be performed bilaterally.

Clinical Implications for Shoulder Mobility

The ability to perform the shoulder mobility test requires shoulder mobility in a combination of motions including abduction–external rotation and adduction—internal rotation. It also requires scapular and thoracic spine mobility.

Poor performance during this test can be the result of several causes, one of which is the widely accepted explanation that increased external rotation is gained at the expense of internal rotation in overhead-throwing athletes. Excessive development and shortening of the pectoralis minor or latissimus dorsi muscles can cause postural alterations of forward or rounded shoulders. Finally, a scapulothoracic dysfunction may be present, resulting in decreased glenohumeral mobility secondary to poor scapulothoracic mobility or stability.

When an athlete achieves a score less than 3, the limiting factor must be identified. Clinical documentation of these limitations can be obtained by using standard goniometric measurements as well as Kendall's test for pectoralis minor and latissimus dorsi tightness (see Cook and Athletic Testing Services 1998).

Previous testing has indicated that when an athlete achieves a score of 2, minor postural changes or shortening of isolated axiohumeral or scapulohumeral muscles exists. When an athlete scores a 1 or 0, a scapulothoracic dysfunction may exist.

Active Straight-Leg Raise

Purpose

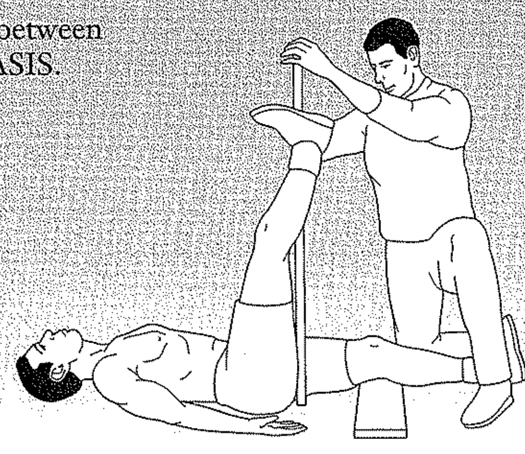
The active straight-leg raise assesses active hamstring and gastroc-soleus flexibility while maintaining a stable pelvis and active extension of the opposite leg.

Description

1. The athlete assumes the starting position by lying supine with arms at the sides, palms up, and head flat on the floor; a 2 × 6 board is placed under the knees.
2. The tester identifies the athlete's anterior superior iliac spine (ASIS) and the jointline of the knee (usually midpatella).
3. The athlete lifts the test leg with a dorsiflexed ankle and an extended knee. During the test the opposite knee should remain in contact with the board, and the lower back and head should remain flat on the floor.
4. Once the athlete has achieved the correct position, the tester aligns a dowel through the medial malleolus of the athlete's test leg perpendicular to the floor.
5. Have the athlete perform the test again, raising the opposite leg. If testing produces a lower score for raising either the left or the right leg, record the lower score.

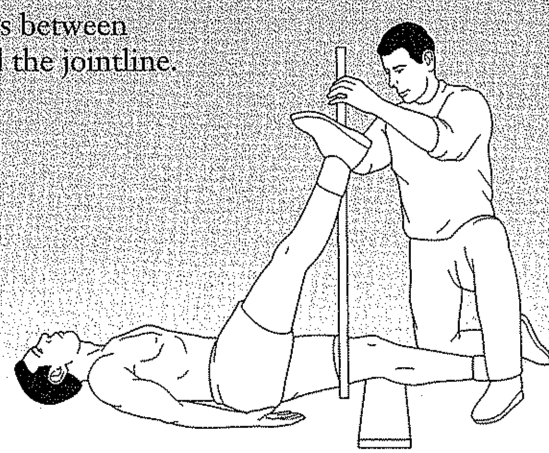
3 POINTS

- Dowel resides between midthigh and ASIS.



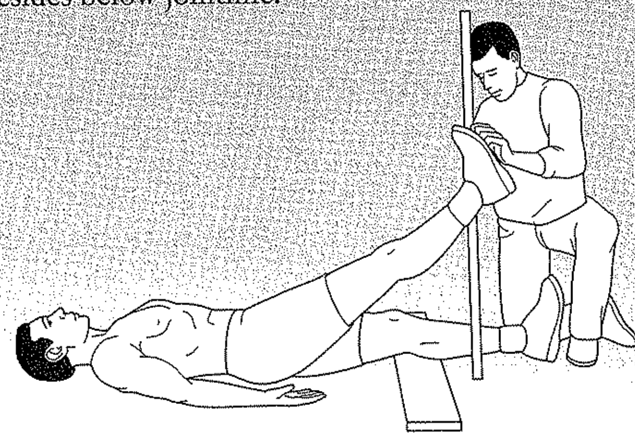
2 POINTS

- Dowel resides between midthigh and the jointline.



1 POINT

• Dowel resides below jointline.



0 POINTS

The athlete will receive a score of 0 if pain is associated with any portion of this test. A member of the sports medicine staff should perform a thorough evaluation of the painful area.

Clinical Implications for the Active Straight-Leg Raise

The ability to perform the active straight-leg raise test requires functional hamstring flexibility, the flexibility that is available during training and competition. This is different from passive flexibility, which is more commonly assessed. The athlete is also required to demonstrate adequate hip mobility of the opposite leg as well as lower-abdominal stability.

Poor performance during this test can be the result of several factors. First, the athlete may have poor functional hamstring flexibility. Second, the athlete may have inadequate mobility of the opposite hip stemming from iliopsoas tightness associated with an anteriorly tilted pelvis. If this limitation is gross, true active hamstring flexibility will not be realized. A combination of both factors will produce relative bilateral, asymmetric hip mobility. Like the hurdle step test, the active straight-leg raise test reveals relative hip mobility; however, this test is more specific to the limitations imposed by the muscles of the hamstrings and the iliopsoas.

When an athlete achieves a score less than 3, the limiting factor must be identified. Clinical documentation of these limitations can be obtained by Kendall's sit-and-reach test as well as the 90-90 straight-leg raise test for hamstring flexibility. The Thomas test can be used to identify iliopsoas flexibility (see Cook and Athletic Testing Services 1998).

Trunk-Stability Push-Up

Purpose

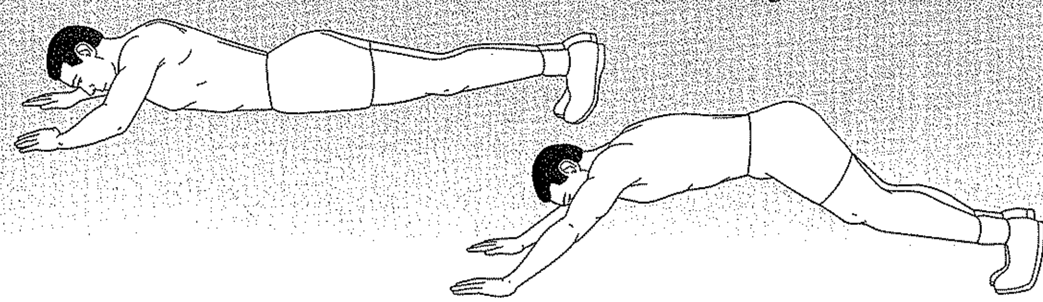
The trunk-stability push-up assesses trunk stability in the sagittal plane while a symmetrical upper-extremity motion is performed. Scapular stability is assessed indirectly.

Description

1. The athlete assumes a prone position with the hands spaced shoulder-width apart.
2. The athlete places the hands so that the thumbs are alignbed with the top of the head and fully extends the knees. The female athlete should lower the hands so that the thumbs are aligned with the chin.
3. From the appropriate position, the athlete performs one push-up, lifting the body as a unit with no lag in the lumbar spine.
4. The male athlete who cannot perform a push-up from the standard starting position lowers the hands so that the thumbs are aligned with the chin and then performs a push-up. If the female athlete cannot perform a push-up from this position, she lowers the hands so that the thumbs are aligned with the clavicle and performs a push-up.

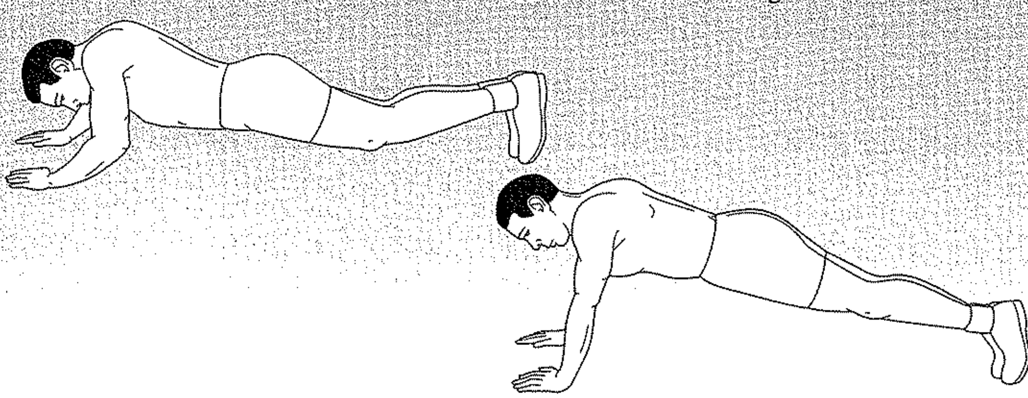
3 POINTS

- Males perform one repetition with thumbs aligned with the top of the head.
- Females perform one repetition with thumbs aligned with the chin.

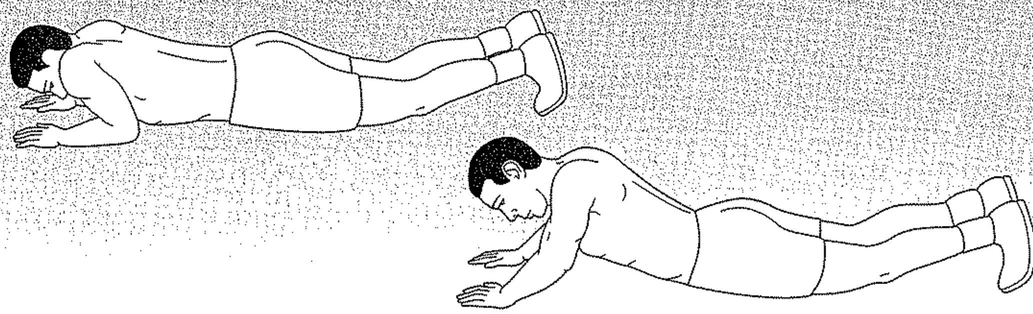


2 POINTS

- Males perform one repetition with thumbs aligned with the top of the head.
- Females perform one repetition with thumbs aligned with the chin.



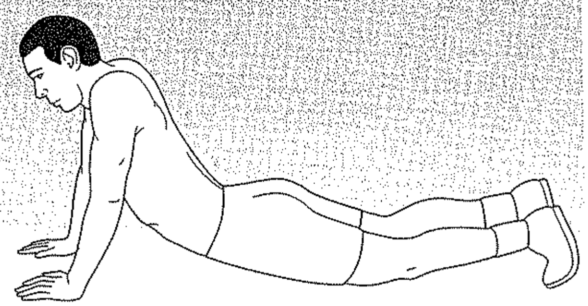
1 POINT
- Males are unable to perform one repetition in modified position.
- Females are unable to perform one repetition in modified position.



0 POINTS
The athlete will receive a score of 0 if pain is associated with any portion of this test. A member of the sports medicine staff should perform a thorough evaluation of the painful area.

Lumbar Extension

Lumbar extension should also be cleared after this screen, even if a score of 3 is given. Performing a press-up in the push-up position will clear spinal extension. If pain is noted during the lumbar extension, a score of 0 will be given for the trunk-stability push-up.



Clinical Implications for the Trunk-Stability Push-Up

The ability to perform the trunk-stability push-up requires trunk stability in the sagittal plane during a symmetric upper-extremity movement. Many functional activities in sports require the trunk stabilizers to transfer force symmetrically from the upper extremities to the lower extremities and vice versa. Movements such as rebounding in basketball, overhead blocking in volleyball, or pass blocking in football are common examples of this type of energy transfer. If the trunk does not have adequate stability during these activities, kinetic energy will be dispersed, leading to poor functional performance as well as increased potential for injury.

Poor performance during this test can be attributed simply to poor stability of the trunk stabilizers. When an athlete achieves a score less than 3, the limiting factor must be identified. Clinical documentation of these limitations can be obtained by using Kendall's test for upper- and lower-abdominal strength (see Cook and Athletic Testing Services 1998).

Rotary Stability

Purpose

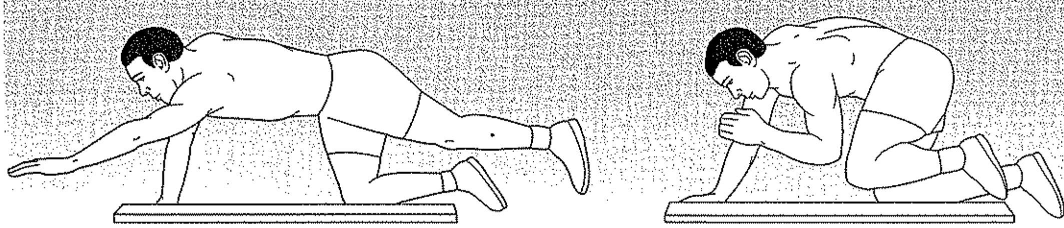
The rotary-stability screen assesses multiplanar trunk stability during a combined upper- and lower-extremity motion.

Description

1. The athlete assumes a quadruped position with the shoulders at 90 degrees relative to the upper torso and the hips and knees at 90 degrees relative to the lower torso; the ankles remain dorsiflexed.
2. A 2 × 6 board is placed between the knees and hands so that the knees and hands are in contact with the board.
3. The athlete flexes the shoulder and extends the same-side hip and knee. The athlete raises the leg and hand just enough to clear the floor by approximately six inches. The lifted elbow, hand, and knee should all remain in line with the board. The torso should remain in the same plane as the board.
4. The athlete then flexes the same-side shoulder and knee (left-left) enough for the elbow and knee to touch.
5. The athlete is allowed up to three chances to perform the test.
6. If the athlete does not attain a score of 3, he or she performs the drill in a diagonal pattern, using the opposite-side shoulder and hip (left-right).
7. Have the athlete perform the test again, with arms and legs in the opposite positions. If testing produces a lower score with either the left or the right arm elevated, record the lower score.

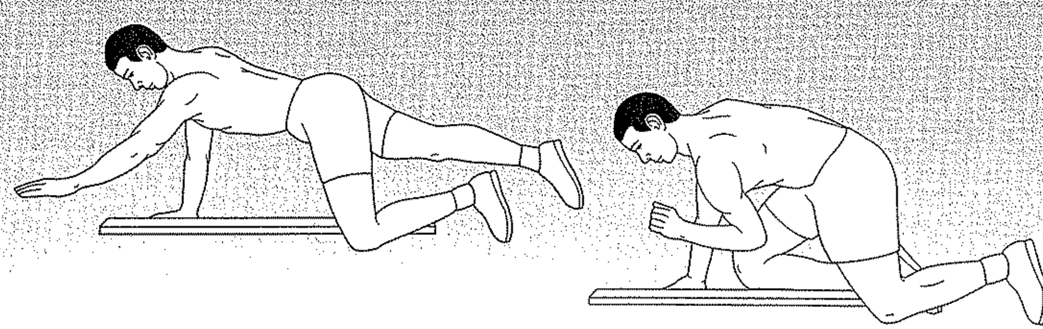
3 POINTS

- Athlete performs one correct repetition while keeping torso parallel to the board and elbow and knee in line with the board.



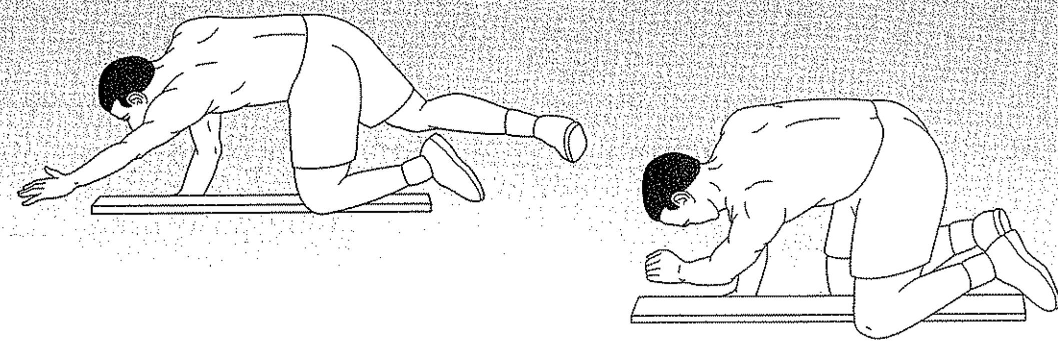
2 POINTS

- Athlete performs one correct diagonal, flexion, and extension lift while maintaining torso parallel to board and floor.



1 POINT

- Athlete is unable to perform diagonal repetition.

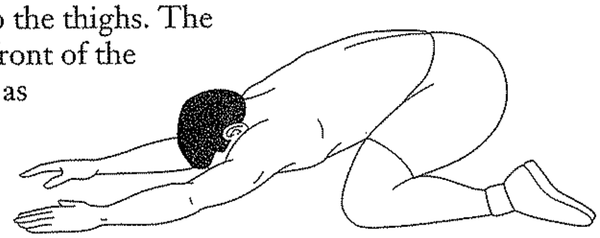


0 POINTS

The athlete will receive a score of 0 if pain is associated with any portion of this test or if pain is noted during lumbar flexion. A medical professional should perform a thorough evaluation of the painful area.

Lumbar Flexion

Lumbar flexion should be cleared after this screen, even if a score of 3 is given. To clear spinal flexion, the individual assumes a quadruped position, rocks back, and takes the buttocks to the heels and the chest to the thighs. The hands should remain in front of the body, reaching out as far as possible; feet and toes should be plantar flexed. If pain occurs, a 0 is given.



Clinical Implications for Rotary Stability

The ability to perform the rotary-stability test requires trunk stability in both sagittal and transverse planes during asymmetric upper- and lower-extremity movement. Many functional activities in sports require the trunk stabilizers to transfer force asymmetrically from the lower extremities to the upper extremities and vice versa. Running and exploding out of a down stance in football and track are common examples of this type of energy transfer. If the trunk does not have adequate stability during these activities, kinetic energy will be dispersed, leading to poor functional performance as well as increased potential for injury.

Poor performance during this test can be attributed simply to poor asymmetric stability of the trunk stabilizers. When an athlete achieves a score less than 3, the limiting factor must be identified. Clinical documentation of these limitations can be obtained by using Kendall's test for upper- and lower-abdominal strength.

FUNCTIONAL MOVEMENT SCREEN™
SCORING SHEET

Name: ______________________ School: ______________________

Age: ________ Height: ________ Weight: ________ ☐ Male ☐ Female

Address: ______________________ Phone: ______________________

City: ______________________ State: ________ Zip: ________

Sport: ______________________

Position: ______________________

Hand dominance: L R Leg dominance: L R Eye dominance: L R

Previous injuries: ______________________

____

____

____

____

Previous score: ________

Test and score					Comments
Deep squat	3	2	1	0	________
Hurdle step	3	2	1	0	________
In-line lunge	3	2	1	0	________
Shoulder mobility	3	2	1	0	________
Active straight-leg raise	3	2	1	0	________
Trunk-stability push-up	3	2	1	0	________
Rotary stability	3	2	1	0	________

Total: ________

Tester or group: ______________________

FUNCTIONAL PERFORMANCE TESTING

Functional performance is a representation of actual efficiency through specific testing of gross performance (power, speed, etc.). The athlete can be ranked and monitored by comparison with normative data. Functional performance data bridge the gap between foundation movements and skill. Foundation testing will identify basic human movement patterns. Functional performance testing will help assess the way the athlete generates, transfers, and controls power.

Performance testing for athleticism must assess and quantify the way the athlete uses his or her body in forceful, explosive movements without being biased toward a particular skill or activity. To look at the way the human body works as a functional unit to produce movement, tests are commonly done for three primary movements: jumping, throwing, and running.

The jumping test involves a vertical jump and tests for explosion. The characteristics of jumping include the following:

- Upper-body pulling movement
- Lower-body extension movements
- Trunk transfer of energy from upper body to lower body
- Trunk extension stability
- Top to bottom coordination

The throwing test involves a medicine ball chest pass and tests for propulsion. The characteristics of throwing include the following:

- Upper-body pushing movement
- Lower-body stability
- Trunk transfer of energy from lower body to upper body
- Trunk flexion stability
- Bottom-up coordination

The running test involves a 40-yard sprint and tests for locomotion. The characteristics of running include the following:

- Upper-body and lower-body countermovement
- Transfer of energy from upper body to the trunk and from one leg to the other
- Trunk rotary stability
- Simultaneous coordination of upper body and lower body

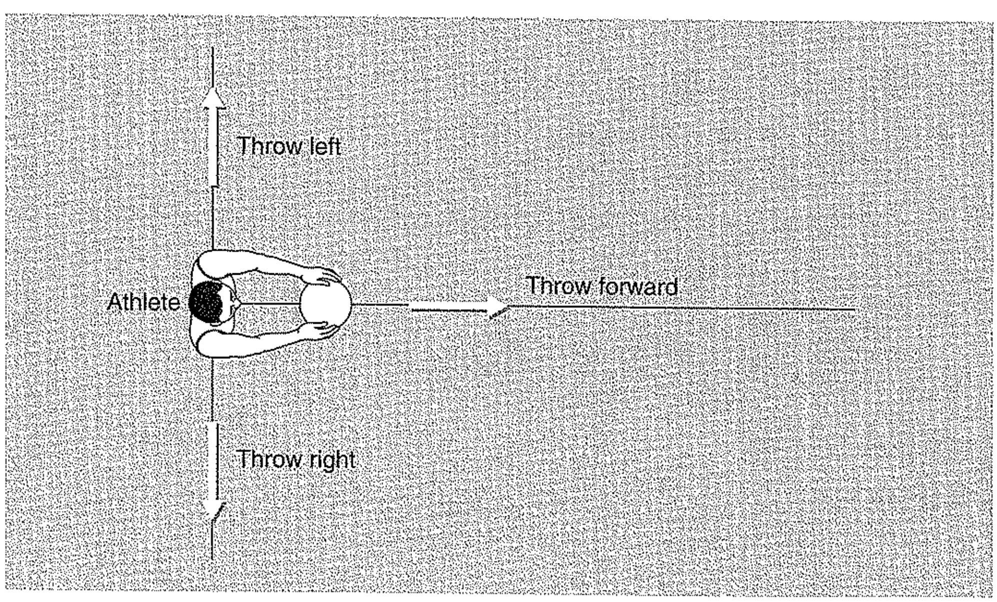
Each test relies heavily on sound motor programming—the way the brain and body interact. The three tests also represent kinetic linking—the timing and sequencing of each specific movement to complement the next.

Vertical Jump

The vertical jump is commonly considered the true test of human power because the force of gravity affects the body of each athlete equally. An athlete who has the ability to summon the strength of the body in a quick, coordinated, and balanced fashion will accelerate past the pull of gravity and achieve greater height than an athlete who does not have equal ability, regardless of size. The role of the upper body in jumping is considerable. The difference between good jumpers and great jumpers is usually the ability of the upper body to contribute with forceful movements of the arms and dynamic stabilization of the trunk. Jumping must also be considered a top-down recruitment activity because the upper body and trunk are loaded before the lower extremities. Testing the vertical jump is quick and efficient, and numerous standards are available for sex, age, and sport specificity. Right and left differences can be measured in special cases by performing a single-leg vertical jump. The landing should still be on two legs to avoid unnecessary stress. Differences between left and right should not be greater than 15 percent.

Standing Medicine Ball Chest Pass

In this test, instead of propelling the body against gravity, the athlete propels another object. The goal is not to look at sport-specific throwing movements in this test; rather, it is to look at general athleticism and the ability to produce power from a bottom-up transition. Throwing a medicine ball from a standing chest pass position (without a step) will allow the tester to identify power and coordination generated in a bottom-up fashion. The athlete must load the legs and trunk and maintain stability before achieving any vigorous movement of the upper body to propel the medicine ball. Unlike the vertical leap, which looks at extension dynamic stability (with respect to the trunk), a chest pass with a medicine ball looks at flexion dynamic stability (with respect to the trunk). The vertical leap is body relative, meaning that gravity treats all bodies equally. But the medicine ball throw is not body relative if a standardized-weight ball is used because that requires each athlete to propel a different percentage of body weight. The standing medicine ball chest pass can be performed without this bias by making a simple calculation; a medicine ball of approximately 2 percent of the



thrower's body weight provides a standard for all athletes with a similar amount of resistance to the throwing movement, thus allowing valid comparison of data. Using the same stance, differences between the right and left can be tested. The athlete should twist and throw left and then right. Compare the differences, using the 15 percent rule as a standard.

40-Yard Sprint

The third test is the 40-yard sprint. This test has come under criticism in the past because it is not sport specific. Most field and court sports have minimal opportunity for an all-out linear run for 40 yards. In many sports, however, large amounts of data have been collected on the 40-yard dash. Therefore, convenient comparison can be made about general athleticism for all field and court sports. Moreover, 40-yard dash speed represents the efficiency of the body. It allows the athlete to demonstrate the ability to store energy, using the plyometric abilities of each leg in propulsion. It illustrates mobility in the hips and legs through stride length, and it displays coordination through stride frequency. Last, it indicates the ability of the torso to provide dynamic stability and redirect the power generated in one leg directly to the other leg with minimal loss and maximum efficiency. Therefore, the sprint test does more than measure simple sprint speed; it allows the athlete to demonstrate efficiency, coordination, energy storage, and momentum management.

If time, space, and equipment allow, the 120-yard sprint presents an interesting way to understand athletic speed. The 120-yard dash is even less sport specific than the 40-yard dash, but it provides the strength and conditioning specialist with unique criteria when analyzing deficits in running. Running is a base movement for almost all sports. Distances shorter than 40 yards may be more specific, but they require electronic timers for true accuracy. By looking at the 120-yard dash, the tester can observe three unique and specific 40-yard sprints. The first 40-yard dash displays the athlete's ability to start and accumulate speed through acceleration. The second 40-yard dash measures the athlete's ability to maintain speed through efficient body mechanics. The last 40-yard dash demonstrates the athlete's speed endurance and ability to maintain efficiency, technique, and momentum as fatigue mounts. The 120-yard dash thus offers data to analyze quickness, speed, and speed endurance. It is easy to see how a problem with quickness could greatly affect all field and court sports. Field and court sports also require running and plyometrics as primary methods of conditioning. Problems with speed and speed endurance will affect training and reduce the benefits of conditioning. Athletes with such problems will not be able to improve running form or plyometric performance because fatigue will set in before adequate training can occur.

Other Functional Performance Considerations

In summary, the three tests represent basic movements for general athleticism and measure motor programming and efficiency. They look at two forms of power as well as linear speed. The tester can conduct the three primary tests quickly and efficiently, permitting their use throughout the year to monitor changes in performance. Other tests for general athletic performance consider anaerobic power, agility and body control, and aerobic power. These tests are more involved and take more time.

Anaerobic Power Tests

- Line drill for basketball (preferable for court sports)
- 300-yard shuttle run (preferable for field sports)

Agility and Body Control Tests

- T-test
- Edgren side step

Aerobic Power Tests

- 2-mile run
- 12-minute run
- 3-minute step test

SPORT-SPECIFIC SKILLS

Skill movements vary from sport to sport, but most coaches prefer sport-specific skills assessment and even position-specific assessment. It is, of course, important to use a test that is reliable and valid. Radar guns compute the speed of baseball pitches and tennis serves, and electronic timers measure baserunning and pass rushing. Most sports skills are assessed from a quantitative, not qualitative, perspective. Until recently, the eyes of coaches were the only quality standard. Current advances in movement analysis have linked photography and computers to bring greater objectivity to sports-skills analysis. Options for the future will be discussed later. For now make sure that analysis is objective and has qualitative parameters (accuracy, consistency, adaptability, etc.) as well as quantitative parameters (time, distance, etc.). Books dedicated to a single sport cover sport-specific skills testing in detail.

USING TEST DATA

Once data is collected, an individual performance pyramid can be constructed for each athlete (see figure 2.4, a-c). Figure 2.4a represents the athlete with poor mobility and stability scores but good functional performance and skill. This common situation represents a majority of athletes in field and court sports. Note that the foundation does not support the functional and skill activities. Injury potential is greater because the athlete's performance exceeds his or her mobility and stability. The athlete has the potential to produce greater momentum and power than he or she can potentially control. The athlete should first work on mobility and stability not only to broaden the movement foundation but also to improve efficiency and functional performance.

Figure 2.4b represents the athlete who is highly specialized and is skilled at one aspect of a position or sport but does not possess general athleticism. This individual does not test well but is an excellent competitor. He or she has invested a large amount of time honing sports skills but will now need to focus on the foundation base and functional base to see a significant change in performance.

Figure 2.4c represents an athlete who has good mobility and stability but poor function. This individual will benefit greatly by focusing on functional performance deficits. This individual is ready for all the benefits that periodization, plyometrics, interval training, and sport-specific conditioning can offer. He or she possesses the basic framework and foundation movements to start functional training. This athlete will need supervision because he or she may demonstrate poor technique. The individual may also have less energy-storing capability than the athlete in figure 2.4a. Therefore, supervision is needed with explosive and ballistic training.

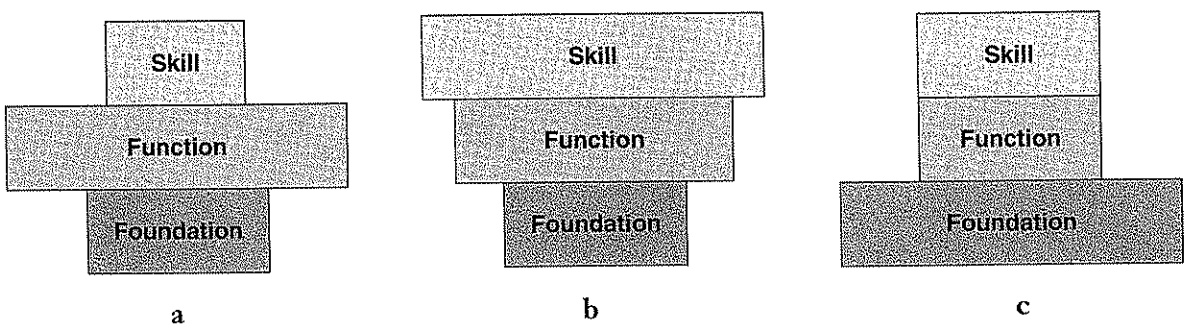


Figure 2.4 Individual performance pyramids.

Constructing a team performance pyramid is also beneficial in identifying team attributes and detriments compared with other teams or previous teams. Doing so creates a philosophy and methodology for the athletic trainer and strength and conditioning professional. Pyramids act as a compass to direct individual athletes and teams to the areas of greatest weakness. Historically, a distinguishing characteristic of a good athlete versus an elite athlete has been a focus on his or her weaknesses, rather than strengths. Good athletes focus on their strengths, maximizing potential benefits while ignoring, covering up, and compensating for weaknesses. Elite athletes confront their weaknesses and focus on them in their conditioning programs. These athletes will enter competition with the physiological and psychological advantages that come from knowing that they have confronted and rectified their weakest links. Because athletes don't always intuitively adopt such a mindset, the coaching and training staff must use baseline testing to expose the weakest link and direct the progression of the training program. Follow-up testing can validate the rehabilitation or conditioning techniques employed. Testing also serves as a continuous monitor to expose other potential weak links that commonly arise as athletes become more specialized and experienced.

SUMMARY

Technology will continue to progress, but human movement will always obey neuromuscular, biomechanical, and physical laws. Therefore, the conditioning specialist must focus on the job, not the tool. Technology (testing tools) should always be subservient to an objective testing philosophy based on sound principles.

The performance pyramid illustrates an athlete's functional strengths and weaknesses. This simple diagram is an effective teaching tool for athletes and coaches alike. Athletes must be continually reminded that reaching the top of the pyramid is possible only after building a good foundation. This simple pyramid demonstrates the necessary priority and progression of baseline testing and analysis to develop high-performance sports conditioning.