The Functional Movement Screen

The Functional Movement Screen (FMS) is a predictive, but *not* diagnostic, functional screening system. The FMS is an evaluation or screening tool created for use by professionals who work with patients and clients for whom movement is a key part of exercise, recreation, fitness, and athletics. It may also be used for screening within the military, fire service, public safety, industrial laborers, and other highly active workers. This screening tool fills the void between preparticipation/preplacement screening and specific performance tests by examining individuals in a more general dynamic and functional capacity. Research suggests that tests that assess multiple facets of function such as balance, strength, range of motion (ROM), and motor control simultaneously may assist professionals in identifying athletes at risk for injury.[10-12]

The FMS, described by Cook et al,[13,14] is composed of 7 fundamental movement patterns that require a balance of mobility and stability for successful completion. These functional movement patterns were designed to provide observable performance tasks that relate to basic locomotive, manipulative, and stabilizing movements. The tests use a variety of common positions and movements appropriate for providing sufficient challenge to illuminate weakness, imbalance, or poor motor control. It has been observed that even individuals who perform at high functional levels during normal activities may be unable to perform these simple movements if appropriate mobility or stability is not present.[10,11] An important aspect of this assessment system is its foundation on principles of proprioception and kinesthesia. Proprioceptors must function in each segment of the kinetic chain and associated neuromuscular control must be present for efficient movement patterns to occur.

The FMS is not intended for use in individuals displaying pain during basic movement patterns or in those with documented musculoskeletal injuries. Painful movement is covered subsequently in the section on the SFMA. The FMS is for healthy, active people and for healthy, inactive people who want to increase their physical activity. Interrater reliability of the FMS has been reported by Minick et al[15] to be high, which means that the assessment protocol can be applied and reliable scores obtained by trained individuals when there is adherence to standard procedures.

The FMS consists of 7 movement patterns that serve as a comprehensive sample of functional movement (Box 17-1). Additionally, 3 clearing tests, each associated with one of the FMS movement patterns, assess for pain with shoulder rotation motions, trunk extension, or trunk flexion.

A kit for FMS testing is available commercially (www.performbetter.com); however, simple tools such as a dowel, 2 × 6 board, tape, tape measure, a piece of string or rope, and a measuring stick are enough to complete the testing procedures. When conducting the screening tests, athletes should not be bombarded with multiple instructions about how to perform the tests; rather, they should be positioned in the start position and offered simple commands to allow achievement of the test movement while observing their performance. The FMS is scored on an ordinal scale, with 4 possible scores ranging from 0 to 3 (Table 17-3). The clearing tests mentioned earlier consider only pain, which would indicate a "positive" clearing test and requires a score of 0 for the test with which it is associated.

Box 17-1 Seven Movement Patterns of the Functional Movement Screen

- Deep squat
- Hurdle step
- In-line lunge
- Shoulder mobility test
- Active straight-leg raise
- Trunk stability pushup
- Rotatory stability test

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Table 17-3 **Scoring System for the Functional Movement Screen**

A Score of . . .	Is Given if . . .
0	At any time during testing the athlete has pain anywhere in the body. *Note:* The clearing tests consider only pain, which would indicate a "positive" clearing test and requires a score of 0 for the test with which it is associated.
1	The person is unable to complete the movement pattern or is unable to assume the position to perform the movement.
2	The person is able to complete the movement but must compensate in some way to complete the task.
3	The person performs the movement correctly, without any compensation.

Three is the highest or best score that can be achieved on any single test, and 21 is the best total score that can be achieved.

The majority of the movements test both the right and left sides, and it is important that the sides be scored independently. The lower score of the 2 sides is recorded and used for the total FMS score, with note made of any imbalances or asymmetry occurring during performance of the task (Figure 17-1). The creators of the FMS suggest that when in doubt, the athlete should be scored low.

Seven Movement Patterns of the Functional Movement Assessment

The Deep Squat (Figure 17-2) The squat is a movement needed in most athletic events; it is the "ready position" that is required for many power movements such as jumping and landing. The deep squat assesses bilateral, symmetric mobility and stability of the hips, knees, ankles, and core. The overhead position of the arms (holding the dowel) also assesses the mobility and symmetry of the shoulders and thoracic spine. To perform a deep squat, the athlete starts with the feet at approximately shoulder width apart in the sagittal plane. The dowel is grasped with both hands, and the arms are pressed overhead while keeping the dowel in line with the trunk and the elbows extended. The athlete is instructed to descend slowly and fully into a squat position while keeping the heels on the ground and the hands above the head.

FMS™ Test	Right	Left	Score	(for bilateral tests, eboose lowest score to record)
Overhead deep squat	X	X		
Trunk stability push-up	X	X		
Hurdle step (droped by among LE)				
In-line lunge (droped by forward LE)				
Shoulder mobility (droped by upper UE)				
Active straight leg raise				
Rotary stability (droped by among LE)				
		Total Score ______/21		

Figure 17-1 **Functional Movement Screen scoring sheet**

LE, Lower extremity; UE, upper extremity

The Hurdle Step (Figure 17-3) The hurdle step is designed to challenge the ability to stride, balance, and perform a single-limb stance during coordinated movement of the lower extremity (LE). The athlete assumes the start position by placing the feet together and aligning the toes just in contact with the base of the hurdle or 2 × 6 board. The height of the hurdle or string should be equal to the height of the tibial tubercle of the athlete. The dowel is place across the shoulders below the neck, and the athlete

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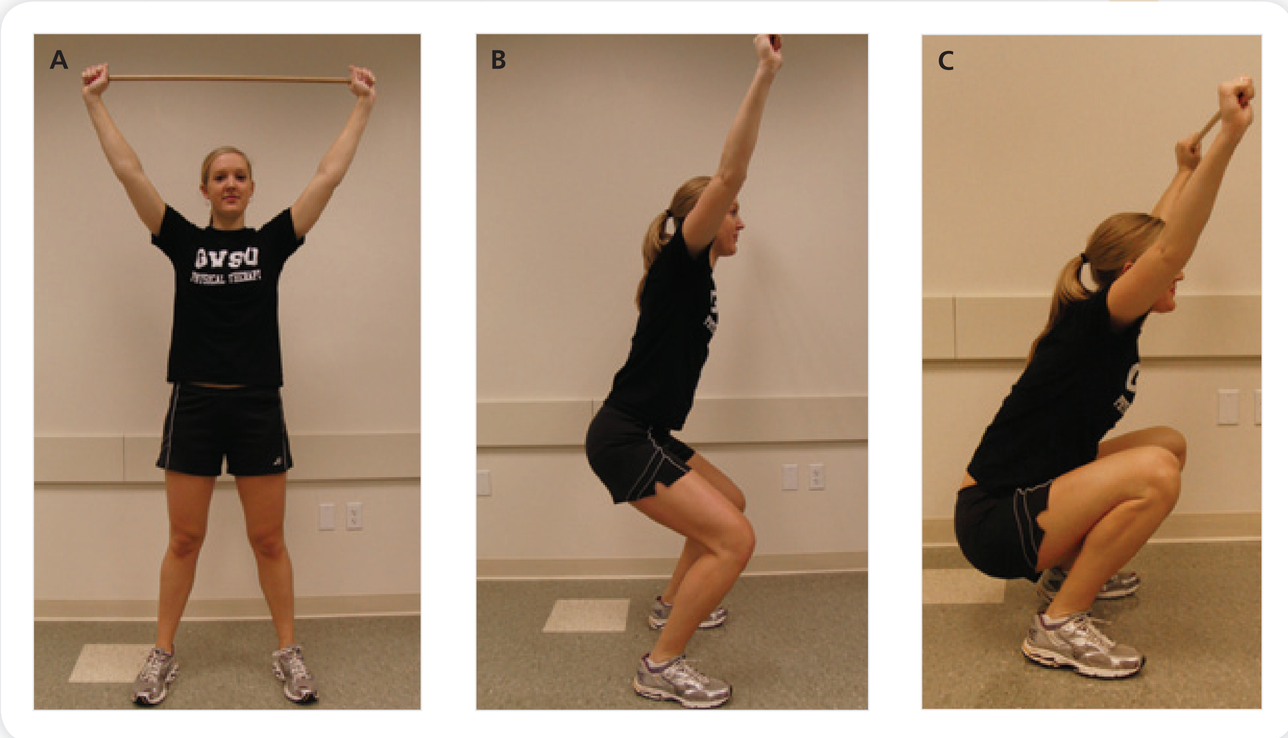

Figure 17-2 **Overhead deep squat maneuver**

Beginning (**A**) and end (**B**) of movement, frontal view, and midrange, side view (**C**).

Figure 17-3 **Hurdle step maneuver**

Midmotion (**A**) and end motion (**B**) before return.

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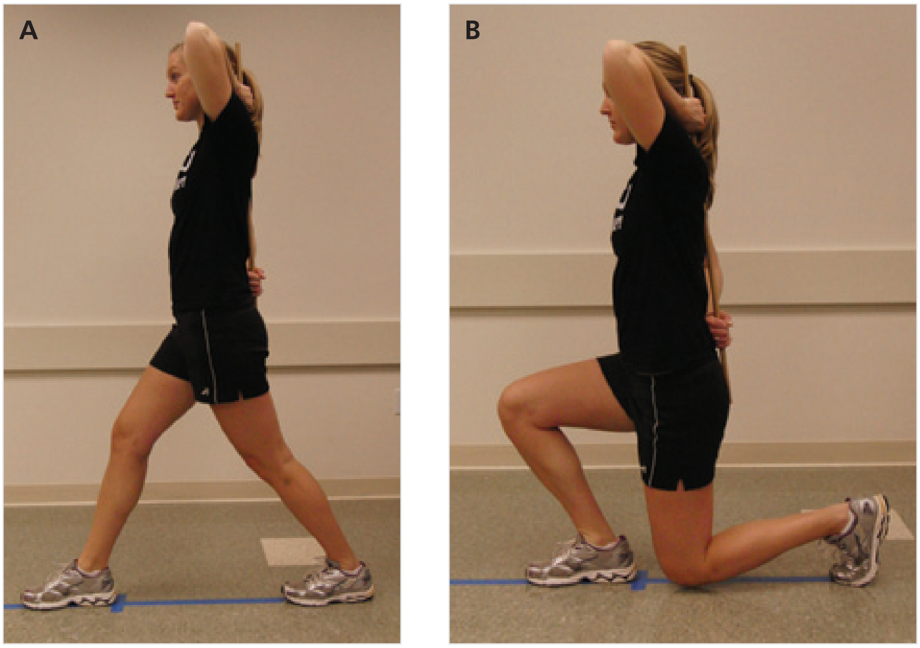

Figure 17-4 In-line lunge

Beginning (**A**) and end (**B**) of maneuver.

is asked to step up and over the hurdle, touch the heel to the floor (without accepting weight) while maintaining the stance leg in an extended position, and return to the start position. The leg that is stepping over the hurdle is scored.

In-Line Lunge (Figure 17-4) The in-line lunge attempts to challenge the athlete with a movement that simulates dynamic deceleration with balance and lateral challenge. Lunge length is determined by the tester by measuring the distance to the tibial tubercle. A piece of tape or a tape measure is placed on the floor at the determined lunge distance. The arms are used to grasp the dowel behind the back with the top arm externally rotated, the bottom arm internally rotated, and the fists in contact with the neck and low back region. The hand opposite the front or lunging foot should be on top. The dowel must begin in contact with the thoracic spine, back of the head, and sacrum. The athlete is instructed to lunge out and place the heel of the front/lunge foot on the tape mark. The athlete is then instructed to slowly lower the back knee enough to touch the floor while keeping the trunk erect and return to the start position. The front leg identifies the side being scored.

Shoulder Mobility (Figure 17-5) This mobility screen assesses bilateral shoulder ROM by combining rotation and abduction/adduction motions. It also requires normal scapular and thoracic mobility. Begin by determining the length of the hand of the athlete by measuring from the distal wrist crease to the tip of the third digit. This distance is used during scoring of the test. The athlete is instructed to make a fist with each hand with the thumb placed inside the fist. The athlete is then asked to place both hands behind the back in a smooth motion (without walking or creeping them upward)—the upper arm in an externally rotated, abducted position (with a flexed elbow) and the bottom arm in an internally rotated, extended, adducted position (also with a flexed elbow). The tester

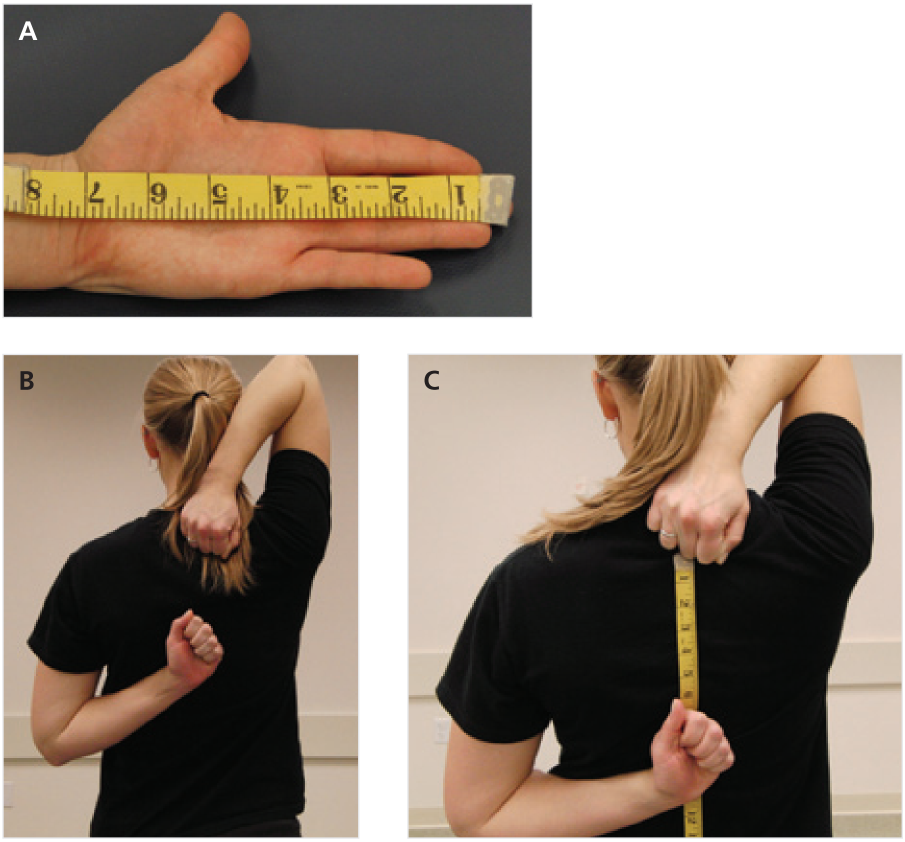

Figure 17-5 **Shoulder mobility test**

Hand measurement (**A**), at end of motion (**B**), and how motion is related to hand measurement (**C**).

measures the distance between the 2 fists. The flexed (uppermost) arm identifies the side being scored.

Shoulder Clearing Test (Figure 17-6) After the previous test is performed, the athlete places a hand on the opposite shoulder and attempt to point the elbow upward and touch the forehead (Yocum test). If painful, this clearing test is considered positive and the previous test must be scored as 0.

Active Straight-Leg Raise (Figure 17-7) This test assesses the ability to move the LE separately from the trunk, as well as tests for flexibility of the hamstring and gastrocnemius. The athlete begins in a supine position, arms at the side. The tester identifies the midpoint between the anterior superior iliac spine and the middle of the patella and places a dowel on the ground, held perpendicular to the ground. The athlete is instructed to slowly lift the test leg with a dorsiflexed ankle and a straight knee as far as possible while keeping the opposite leg extended and in contact with the ground. Make note to see where the LE ends at its maximal excursion. If the heel clears the dowel, a score of 3 is given; if the lower part of the leg (between the foot and the knee) lines up with the dowel, a score of 2 is given; and if the patient is only able to have the

Figure 17-6

Screening test for shoulder, also known as the Yocum test. If positive for pain, the athlete scores 0 on the shoulder mobility test.

Figure 17-7

Active straight-leg raise test, end of motion.

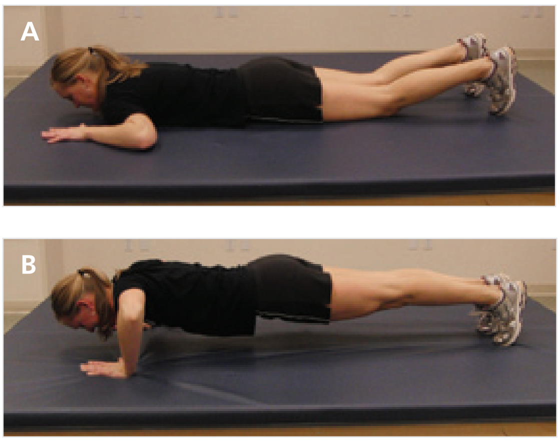

Figure 17-8 **Trunk stability pushup test**

Beginning of motion (**A**) and midmotion (**B**). Note that the hand position is for a score of 3 for females (thumbs at chin); to score a 2, females start with the thumbs at clavicular height. In males, a score of 3 is achieved with the thumbs at forehead level and a 2 with the thumbs at chin level.

thigh (between the knee and the hip) line up with the dowel, a score of 1 is given.

Trunk Stability Pushup (Figure 17-8) This test assesses the ability to stabilize the spine in anterior/posterior and sagittal planes during a closed-chain upper-body movement. The athlete assumes a prone position with the feet together, toes in contact with the floor, and hands placed shoulder width apart (level determined by gender per criteria described later) (Table 17-4), as though ready to perform a pushup from the ground. The athlete is instructed to perform a single pushup in this position with the body lifted as a unit. If the athlete is unable to do this, the hands should be moved to a less-challenging position per criteria and a pushup attempted again. The chest and stomach should come off the floor at the same instance, and no "lag" should occur in the lumbar spine.

A clearing examination is performed at the end of the trunk stability pushup test and graded as pass or fail, failure occurring when pain is experienced during the test. Spinal extension is cleared by using a full-range prone press-up maneuver from the beginning pushup position (Figure 17-9); if pain is associated with this motion, a score of 0 is given.

Rotary Stability (Figure 17-10) The rotary stability test is a complex movement that requires neuromuscular control of the trunk and extremities and the ability to transfer energy between segments of the body. It assesses multiplane stability during a combined upper extremity (UE) and LE motion. The athlete assumes the staring position of quadruped with the shoulders and hips at 90 degrees of flexion. The athlete is instructed to lift a hand off the ground and extend the same-side shoulder (allowing the elbow to flex) while concurrently lifting the knee off the ground and flexing the hip and knee. The athlete needs to raise the extremities only approximately 6 inches from the floor while bringing the elbow and knee together (see Figure 17-10*A* and *B*) until they touch and then return them to the ground. The test is repeated on the opposite side. The UE that moves during testing is scored. Completion of this task allows a score of 3. If unable to perform, the athlete is cued to perform the same maneuver with

Table 17-4 **Alignment Criteria for a Trunk Stability Pushup by Gender**

Position Level	Male	Female
III	Thumbs aligned with the forehead	Thumbs aligned with the chin
II	Thumbs aligned with the chin	Thumbs aligned with the clavicle

The athlete receives a score of 1 if unable to perform a pushup at level II.

the opposite LE and UE (see Figure 17-10*C* and *D*), which allows a score of 2 to be awarded. Inability to perform a diagonal (level II) stability results in a score of 1.

A clearing examination is performed at the end of this test and again is scored as positive if pain is reproduced. From the beginning position for this test, the athlete rocks back into spinal flexion and touches the buttocks to the heels and the chest to the thighs (Figure 17-11). The hands should remain in contact with the ground. Pain on this clearing test overrides any score for the rotary stability test and causes the athlete to receive a score of 0.

A total score of 21 is the highest possible score on the FMS, which implies excellent and symmetric (in tests that are performed bilaterally) performance of the variety of screening maneuvers. Total FMS scores have been investigated in relation to injury in National Football League football players[11] and in female collegiate soccer, basketball, and volleyball players.[10] Kiesel et al[11]

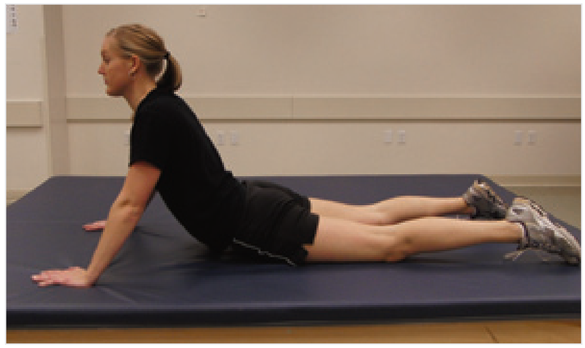

Figure 17-9 **Screening (clearing) test for spinal extension**

If positive for pain, the athlete scores 0 on the trunk stability pushup.

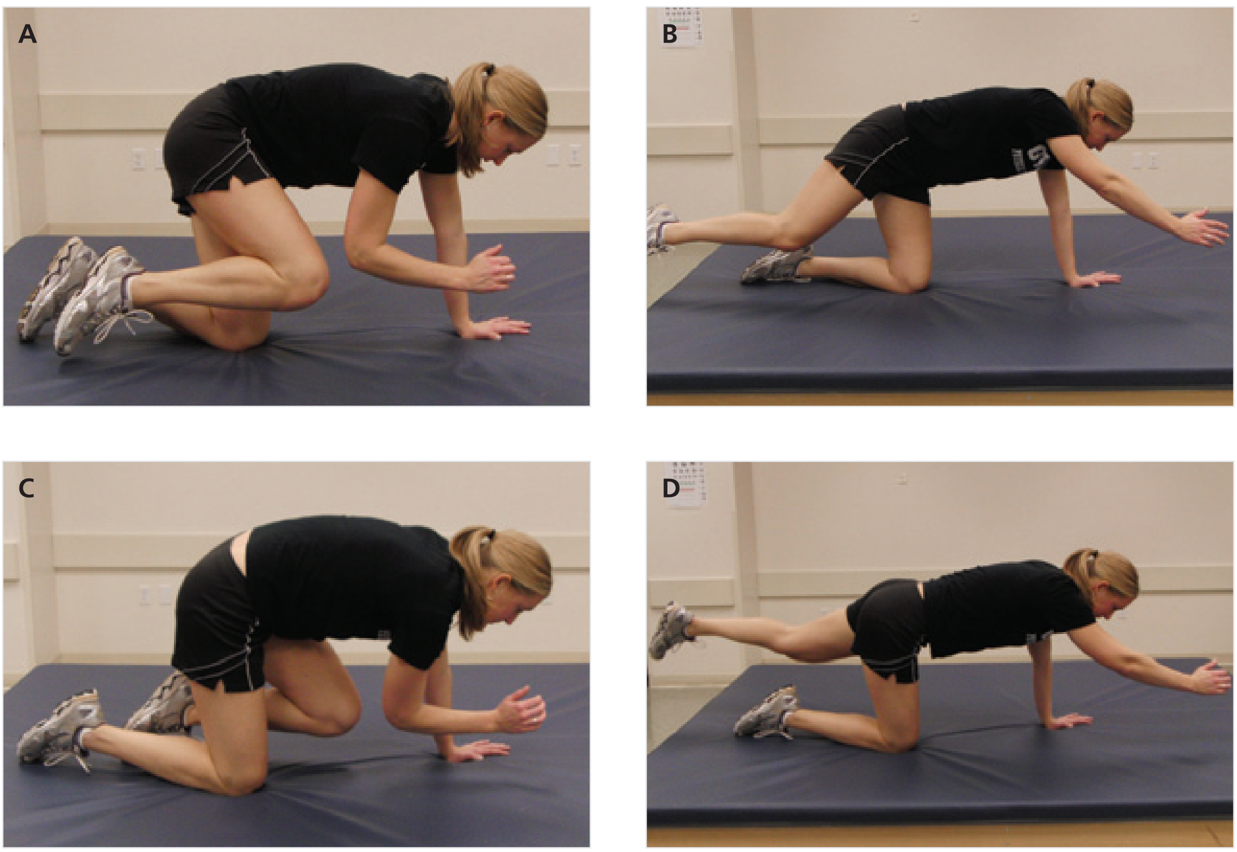

Figure 17-10 **Rotary stability test**

Flexed position for a score of 3 (**A**), extended position for a score of 3 (**B**), flexed position for a score of 2 (**C**), and extended position for a score of 2 (**D**).

Figure 17-11 Screening test for spinal flexion

If positive for pain, the athlete scores 0 on the rotary stability test.

reported a 51% probability of football players sustaining a serious injury over the course of 1 season, and Chorba et al[10] found a significant correlation between low FMS scores (<14) in female athletes and injury. Furthermore, a score of 14 or less on the FMS resulted in an 11-fold increase in the chance of sustaining injury in professional football players and a 4-fold increase in the risk for LE injury in female collegiate athletes.[10,11] Okada et al[16] investigated the relationship between the FMS and tests of core stability and functional performance. Significant correlations between some of the FMS screening tests and performance tests of the upper and lower quarter were reported, but these correlations were not consistent among all screening maneuvers. No significant correlations were found between measures of core stability and FMS variables.

The Selective Functional Movement Assessment

Musculoskeletal pain is the reason that most patients seek medical attention. The contemporary understanding of pain has moved beyond the traditional tissue damage model to include the cognitive and behavioral facets. Most scientists accept that pain alters motor function, although the mechanism of these changes has not been clearly identified. The central nervous system response to painful stimuli is complex, but motor changes have consistently been demonstrated and seem to be influenced by higher centers, consistent with a change in transmission of the motor command. The human body migrates to predictable patterns of movement in response to injury and in the presence of weakness, tightness, or structural abnormality. Richardson et al[17] summarized the evidence that pain alters motor control at higher levels of the central nervous system than previously thought by stating,

> Consistent with the identification of changes in motors planning, there is compelling evidence that pain has strong effects at the supraspinal level. Both short- and long-term changes are thought to occur with pain in the activity of the supraspinal structures including the cortex. One area that has been consistently found to be affected is the anterior cingulated cortex, which has long thought to be important in motor responses with its direct projections to motor and supplementary motor areas.[17]

The SFMA is a movement-based diagnostic system for clinical use. This system is used by professionals working with patients experiencing pain on movement. The goal of the SFMA is to observe and capture the patterns of posture and function for comparison against a baseline. It uses movement to provoke symptoms, demonstrate limitations, and offer information regarding movement pattern deficiency related to the patient's primary complaint. The SFMA uses a series of movements with a specific organizational method to rank the quality of functional movements and, when suboptimal, identify the source of provocation of symptoms during movement. The SFMA has been refined and expanded to help the health care professional in musculoskeletal examination, diagnosis, and treatment geared toward choosing the optimal rehabilitative and therapeutic interventions. It helps the clinician identify the most dysfunctional movement patterns, which are then assessed in detail. By identifying all facets of dysfunction within multiple patterns, specific targeted therapeutic interventions designed to capture or illuminate tightness, weakness, poor mobility, or poor stability can be chosen. Thus, the facets of movement identified to most represent or