Clinical Movement Analysis to Identify Muscle Imbalances and Guide Exercise

Christopher J. Hirth, MS, ATC, PT, PES • University of North Carolina, Chapel Hill

MOVEMENT is an essential component of daily life and athletic performance. Human movement is influenced by an individual's structural alignment, muscle flexibility, muscle strength, and nervous system coordination of muscle responses to a changing environment. Observation of human movement can be used to develop strategies for prevention of injuries and enhancement of athletic performance.[1-3] The Overhead Squat Test can be used to qualitatively assess an individual's overall movement patterns. The results of this test can then be related to goniometric measures (muscle flexibility) and manual muscle testing (muscle strength) to develop a comprehensive view of the individual's movement characteristics.[1] The information can provide the basis for therapeutic exercise recommendations for stretching of potentially overactive and tight muscles and for strengthening of underactive and weak musculature. To optimize function, the individual should be progressed to an integrated functional exercise program.[1] The purpose of this report is to explain how to set up and use the Overhead Squat Test with associated measures of muscle length and strength. Common movement patterns observed during performance of the Overhead Squat Test will be explained, along with exercise recommendations for one compensation pattern.

Overhead Squat Test Setup

The Overhead Squat Test involves a two-legged squat with the arms raised overhead (see Figure 1). The athlete is instructed to (a) stand with feet hip-width to shoulder-width apart, (b) toes pointing straight ahead, and (c) arms raised above the head.

Figure 1 The individual performs a series of 5 double-legged squats a total of 3 times. The clinician views the individual from the anterior, lateral, and posterior view to assess for toe out, knee valgus, excessive forward trunk lean, arms falling forward, and foot pronation.

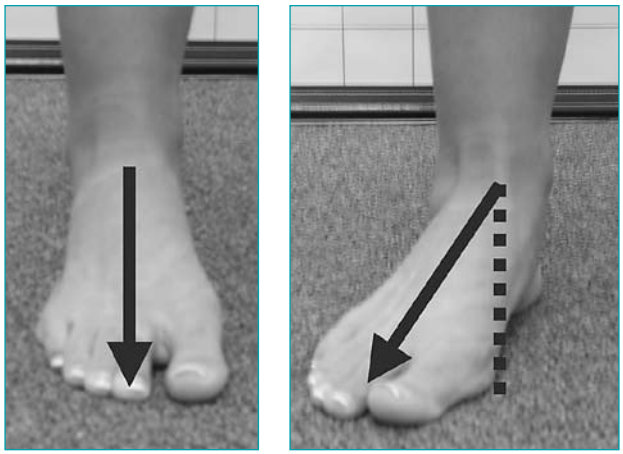
From this start position, the athlete is instructed to squat down as if sitting in a chair. The observation is made from three views: anterior, lateral, and posterior (Figure 1). After performing 5 squats for the anterior view, the athlete performs 5 squats for the lateral view and 5 squats for the posterior view. The clinician notes the movement pattern characteristics by recording whether or not a particular characteristic was identified during performance of the test (Table 1).

Table 1. Movement Pattern Characteristics

View	Movement Pattern Item
Anterior	**Toe Out** Yes ☐ No ☐
	Knee Moves Inward (Valgus) Yes ☐ No ☐
Lateral	**Arms Fall Forward** Yes ☐ No ☐
	Excessive Forward Trunk Lean Yes ☐ No ☐
Posterior	**Flattening of Medial Longitudinal Arch** Yes ☐ No ☐

Overhead Squat Observations

Anterior View: Observations made from the anterior view of the overhead squat are focused at the feet and knees. A common compensation at the feet is the foot turning outwardly (toe-out; Figure 2). When observing for the presence of toe-out, the clinician should assess the position of the first metatarsophalangeal (MTP) joint in relation to that of the medial malleolus. The 1st MTP joint will align with the medial malleolus in a normal foot, whereas the first MTP joint will appear lateral to the medial malleolus with foot turn-out. Table 2 lists potentially overactive/tight muscles and



Normal | Foot Turns Out (Toe Out)

Figure 2 Presence of Toe-Out is noted with the 2nd metatarsophalangeal joint rotates outward and appears lateral to the medial malleolus.

Table 2. Potentially Overactive/Tight Musculature and Underactive/Weak Muscles

Faulty Movement Pattern	Potential Overactive Muscles	Potential Underactive Muscles
Toe out	Soleus	Medial Gastrocnemius
	Lateral Gastrocnemius	Medial Hamstrings
	Biceps Femoris	Gluteus Medius
	Tensor Fascia Latae	Gluteus Maximus
		Gracillis
		Popliteus
Knee moves inward (Valgus)	Hip Adductors	Medial Gastrocnemius
	Biceps Femoris (short head)	Medial Hamstrings
	Tensor Fascia Latae	Gluteus Maximus
	Lateral Gastrocnemius	Gluteus Maximus
	Vastus Lateralis	Vasus Medialis
Excessive forward trunk lean	Soleus	Anterior Tibialis
	Gastrocnemius	Posterior Tibialis
	Hip Flexors	Erector Spinae
Arms fall forward	Latissimus Dorsi	Middle Trapezius
	Pectoralis Major	Lower Trapezius
	Pectoralis Minor	Rhomboids
	Coracobrachialis	Posterior Deltoid
		Rotator Cuff
Flattening of medial longitudinal arch	Peroneus Longus	Posterior Tibialis
	Peroneus Major	Lower Trapezius
	Peroneus Tertius	Medial Gastocnemius
	Lateral Gastrocnemius	Gluteus Medius
	Biceps Femoris	
	Tensor Fascia Latae	