The squat, perhaps more than any other movement pattern, allows the opportunity for the analysis of an athlete’s mobility and stability as they perform the exercise. Subtle restrictions in mobility and stability can not only decrease strength and power, but may also increase an athlete’s risk of injury.

Many have written and discussed optimal squat technique, however, most fail to recognize that both anatomical and training goal variations can greatly impact how an athlete squats. There are several principles that I believe should be true for all athletes, which are laid out below. While all of these principles may not apply to all athletes’ training programs (ex: elite Olympic weightlifters often demonstrate an inward knee movement at the bottom of a squat), all athletes should have the ability to squat following these principles. If an athlete fails to properly execute a squat following these principles, I propose a series of tests to help an athlete or coach identify the most common mobility and stability faults that are limiting athletic potential.
The Five Principles That Should Be True With All Squats:

1. The athlete’s heels should remain flat on the ground. This most often occurs as a result of limited dorsiflexion or poor motor control but regardless of the cause, having the entire foot on the ground is incredibly important for creation of a stable base from which to develop power.

2. The athlete’s feet should not rotate out during the execution of the squat. It is normal for many athletes to demonstrate varying degrees of external rotation of the foot when squatting due to anatomical differences and training goals. The key is that this amount of rotation shouldn’t change from the start of the movement until then end. If the athlete is demonstrating an outward rotation during the squat, they are again sacrificing their stable base most likely because of dorsiflexion restrictions or motor control issues.
3. **The knees should not move into valgus collapse.** This inward movement of the knees has been associated with lower extremity injuries in multiple research studies. If an athlete demonstrates valgus collapse during a squat, they likely also demonstrate this fault during other athletic movements such as running and jumping. Correcting their squat is a good first step towards improving overall movement efficiency and safety.

4. **The hip crease should descend past the knee.** While all athletes may not need to train to this depth (and there is considerable debate surrounding this topic), all athletes should have the mobility and motor control to reach this squat depth.

5. **The low back remains in a neutral position during the entire squat.** A combination of mobility and motor control issues can impact an athlete’s ability to maintain a neutral spine while squatting. Regardless the cause, not maintaining proper spine positioning places unnecessary stress on the tissues of the spine (Potvin, McGill, Norman 1991; Schoenfeld 2010). Perhaps the most common fault seen here is often referred to as a “butt wink” when the athlete’s lower back and pelvis roll into flexion and posterior tilt as they reach the bottom of the squat.
Pass = performance of squat following all 5 principles

**Principles not met**

Dorsiflexion test

If athlete fails, address ankle mobility

Supine Knee to Chest Holding Shins

If failed, repeat while holding thighs. If this allows athlete to bring thighs to the chest, then knee flexion is restricted. If this does not change motion, hip flexion is restricted.

If passed both of the above tests then ankle, knee, and hip mobility have been cleared. Move on to testing of motor control, muscle activation.

Knee Valgus Correction

Knees collapse inward and dorsiflexion test is negative = assess squat with band around knees. If valgus improved with this, the athlete is not properly recruiting glutes. Include this test as a treatment in athlete's training plan and add glute activation work.

Goblet or Assisted Squat

If squat now normalized = Anterior/posterior stability problem. Will require progression of exercises to improve balance during squat

Spine Positioning Cueing

If correction of positioning corrects spinal positioning, drill this cueing daily and add core stability specific exercises to athlete's program
Dorsiflexion Range of Motion

Restriction in dorsiflexion mobility has been shown in multiple studies to be a risk factor for multiple injuries to the lower extremities. The test ankle mobility, assume a half kneeling position as shown below. The great toe of the forward foot should be one hand-width away from a wall (3-5" depending on an individual's body size). Adequate dorsiflexion is present if the athlete can touch their knee to the wall without the heel rising off the ground. Inability to do so would indicate a restriction within the ankle joint itself or the calf musculature.
**Knee Valgus Correction**

Knee valgus, or the collapse of the knees inward towards each other, is often considered a fault during athletic movements due to its association with a variety of lower extremity injuries. Limited mobility in dorsiflexion is often a culprit of knee valgus, but glute activation should be examined as well.

Placement of a band around an athlete's knees as demonstrated in the picture below is a great way to provide an external cue for the athlete to better activate their glutes and avoid their knees moving into valgus collapse. If this cue works, incorporate this exercise into the athlete's training and DECREASE the resistance of the band as they demonstrate better control of knee movement during the squat (think of the band as an assistance tool – a stronger band does NOT provide a better training stimulus). This may also allow some athlete's to squat lower if the gluteal activation results in further external rotation of the hip, allowing for increased hip flexion.
Supine Knee to Chest for Hip and Knee Mobility

Have the athlete lie on their back, lift their knees towards their chest, and pull their shins towards their body. If they are able to touch their thighs to their chest and the calves to their posterior thigh, adequate hip and knee flexion is present to squat to full depth.

If the athlete is unable to complete the above, perform the test again but with the athlete pulling from their thigh instead of their shins. Inability to touch their thighs to their chest would indicate hip flexion mobility restrictions. If now able to touch their thigh to chest, and their calves were unable to touch their posterior thigh in the earlier test, knee flexion mobility is limited.
Goblet Squat or Assisted Squat

The goblet squat or assisted squat both allow for the assessment of anterior-posterior balance assistance to improve squat depth or spine positioning. Perform a goblet squat by having the athlete hold a kettlebell (or other weight) in front of their chest and squatting. An assisted squat is performed with the athlete squatting while holding onto a coach’s hand for balance assistance. The coach must be careful to only provide a small amount of assistance for stability and NOT allow the athlete to use excessive pull on the coach to complete the squat. For this reason, I prefer the goblet squat to the assisted squat.
Cueing For Neutral Spine Positioning

Cueing for spine positioning may be the toughest of all the above tests for improving the squat pattern. For that reason, all the above should be cleared prior to this step. The below picture is a great example of poor spine positioning. The athlete begins with an overextended lower back. This puts their pelvis in a poor position that limits the amount of available hip flexion. As the athlete reaches increasing depths, this pelvis positioning must be reversed if the athlete is to descend any lower. This posterior tilt of the pelvis and resultant rounding of the lower back is commonly referred to as a “butt wink”. Both the overextended and flexed positions of the spine under load places unnecessary levels of stress on the spine and should be avoided.
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