

Biomechanics of the Squat, Lunge, Kick, and Pivot

Normal Squatting

Stance

- 1) Feet slightly wider than vertical jump position

Motion

Eccentric (lowering) Phase: consists of hip flexion, knee flexion, ankle dorsiflexion, and **slight** lumbar spine flexion

Concentric (standing) Phase: consist of hip extension, knee extension, ankle plantarflexion, and slight extension of lumbar spine

Motion Sequence

- 1) 1st motion should be to stick bottom back or bow forward.
- 2) Maintain neutral spine and begin to bend knees.
- 3) Keeping weight centered over heels **slowly** continue down to a point where thighs are parallel to floor or sacral roll under occurs.
- 4) Pause briefly at the bottom and then pressing through heels come up as quickly as good posture and technique dictate.

(1)



(2)



(3)



(4)



Abnormalities During Squat

Stance

- 1) Feet spread too far apart or too close together
- 2) Lower extremities are externally rotated too far

Motion

- 1) Bending the knees first:
 -
 -
- 2) Medial drift of knees: during eccentric (lowering) phase, and during initial portion of concentric (standing) phase.
- 3) Forward rounding of thoracic spine and early lumbar spine roll under.

Possible Reasons

- 1)
- 2)
- 3)
- 4)



Normal Lunge

Stance

- 1) Stride length is enough that when in the bottom position the back knee will be approximately 8-14" behind the front heel.
- 2) Feet should be approximately shoulder width apart.
- 3) Toes should be pointing straight ahead on both feet.
- 4) Body weight should be distributed 80-90% on front foot 10-20% on back foot.
- 5) Upper torso should be inclined forward (Athletic Position)

Motion

Eccentric (lowering) Phase: consists of hip flexion, knee flexion, ankle dorsiflexion.

Concentric (standing) Phase: consist of hip extension, knee extension, ankle plantarflexion (to neutral), and slight extension (to neutral) of lumbar spine

Motion Sequence

- 1) Maintain posture and slowly continue to bend knees.
- 2) Front knee travels forward to mid-step of front foot
- 3) Weight distribution is maintained as stated above with weight centered more over the heel of the front foot.
- 4) Slowly lower down to a point where the back knee lightly touches ("tickles") the ground.
- 5) Pause briefly at the bottom and then pressing through heels come up as quickly as good posture and technique dictate.

(1)



(2)



(3)



(4)



Video Clip

Abnormalities During A Lunge

Stance

- 1) Stride too long:
- 2) Stride too short:
- 3) Upper torso vertical:

Motion

- 1) Medial drift of knees: during eccentric (lowering) phase, and during initial portion of concentric (standing) phase.
- 2) Forward rounding of lumbar and thoracic spine.
- 3) Loss of balance

Possible Reasons

- 1)
- 2)
- 3)
- 4)

Normal Kick

Phases of a Kick (kicking leg)

1) Cocking

Eccentric phase: consist of slight trunk rotation towards the kicking leg, hip extension, slight hip external rotation, knee flexion, ankle plantarflexion

2) Swing

Concentric phase: consists of slight trunk rotation towards the plant leg, gradual backwards lean of trunk, hip flexion, slight internal rotation (to neutral), knee extension, ankle plantarflexion

3) Contact

Concentric phase: consists of continued slight trunk rotation toward the plant leg, backwards lean of trunk ends and forward moment begins, hip flexion with slight internal rotation, knee with slight flexion, ankle plantarflexion; (some try to brace/tense leg upon impact)

4) Follow through

Eccentric Phase: deceleration of trunk rotation hip flexion, hip internal rotation, knee extension

Main Muscles Involved

1) Quadriceps- work to flex hip and extend knee

2) Hip Extensors, Flexors, and Adductors- work to aid in force development, leg speed and in rotational control

3) Hamstrings- contract to keep knee flexed to clear during swing and then relax some what to allow knee extension upon impact

4) Internal/External Obliques- generate force through concentric phases and control stability and deceleration during eccentric phases

Plant Leg

- 1) Approach Stride:
- 2) During Swing:
- 3) At Contact:
- 4) Follow Through:

Abnormalities During A Kick

Approach (Straight vs Angled)

- 1) Straight approach:

-
-
-

- 2) Angled approach:

-
-
-

Cocking Phase

- 1) Trying to over-extended hip and leg:

-
-

- 2) Final stride length before the kick:

-
-

Swing

- 1) Not keeping leg compact:
- 2) Trunk Rotation: too much vs. too little

Contact

- 1) Reaching full knee extension too soon
- 2) Misplacement of contact point

Follow Through

- 1) Postural control issues: lack of core control
- 2) Hyperextension of plant leg

Possible Reasons:

- 1) Majority of kicking faults have to do with:
- 2) Other Factors
 -
 -
 -

Normal Pivot

Static Start

Stance

- 1) Feet slightly wider than shoulder width apart
- 2) Weight distribution is dependent upon sport and position

Motion

- 1) Lateral push off of the ball and mid-step of the foot that is on the side opposite of direction you are going.
- 2) Less than 90° rotation of upper body and hips initially
- 3) Foot dorsiflexion and replacement directly under the hip
- 4) After first two steps rotation continues until facing in desired direction.

Dynamic

Motion

- 1) Decelerate by:

- 2) As this occurs the athlete begins to turn feet underneath the body until body is poised to drive out in desired direction
- 3) Driving force with foot opposite of desired direction

Abnormalities During Pivoting

Static

Stance

- 1) Knees drifting to far medially
- 2) Poor upper body posture.

Motion

- 1) *Hip swivel:*
- 2) *First Step with Incorrect Foot:*
- 3) *Over striding:*

Dynamic

Motion

- 1) One step pivot:
 -
 -
 -
- 2) Posture collapse:
 -
 -

Possible reasons

- 1) Muscle Memory
- 2) Poor core control
- 3) Lower extremity weakness