

The Squat: An Excellent Final-Phase Knee Rehabilitative Assessment Tool

Bongani T Qumbu*, Terry J Ellapen, Mariëtte Swane-poel and Juandre Williams

Physical Activity Sports Science Recreation, Focus Area: PhASRec, Faculty of Health Science, North-West University, Potchefstroom, South Africa

*Corresponding author

Bongani Timothy Qumbu, Physical Activity Sports Science Recreation, Focus Area: PhASRec, Faculty of Health Science, North-West University, Potchefstroom, South Africa, E-mail: ntatetimo@yahoo.com

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Abstract

During the last 30 years, physiotherapy therapy and biokinetic rehabilitation have moved away from traditional isolated assessments to integrative functional screenings, viewing joint stability from a dynamic multi-planar perspective. An integrative functional final-phase knee rehabilitative assessment is needed to determine the quality of the rehabilitative progress; hence the authors' proposed the squat as this assessment tool. The squat is a popular closed kinetic chain exercise that has been judiciously applied in the double stance closed-kinetic-chain rehabilitation of knee injuries. However, it is postulated that the squat can extend as a final-phase-rehabilitative tool to assess whether the patient is ready to commence with open-kinetic chain-exercises.

Keywords: Final-phase knee assessment, Squatting.

Introduction

The squat is prescribed in many knee rehabilitative programmes as an early closed-kinetic-chain-exercise (CKCE) before open-kinetic-chain-exercises [1]. The benefits of squatting include protection of the anterior cruciate ligament (ACL) and medial collateral ligament (MCL), activation and co-activation of the quadriceps and hamstrings reciprocally, increased muscle strength of the quadriceps-hamstrings force-couple, enhanced neuromuscular facilitation of this force-couple, increased patellar joint reaction force (PJRF) that enhances patellofemoral joint congruency, thereby reducing incidence of patellofemoral pain syndrome (PFPS) and osteoarthritis [2,3]. The squat is a renowned functional movement screen that identifies potential muscle tightness, asymmetry and weakness [4]. It is postulated that it can also serve as an excellent final-phase-knee rehabilitative assessment tool to determine whether the patient is ready to progress to single leg dynamic stabilization. This communication describes the squatting technique, exploring the potential benefits of the squat as a final-phase-functional-knee assessment tool through its kinesiology.

The squatting technique

The patient assumes the starting position by placing his/her feet approximately shoulder width apart. The feet should remain forward, deviation such as toeing-out, rear-foot valgus or varus, and pes planus should be noted. A bar is placed on the trapezius muscle. The person descends slowly into a squat-position, with the heels on the floor, head and chest facing forward. The trunk should be parallel to the tibia or towards vertical (no lumbar

vertebral hyper-extension). Femur should be parallel to the floor and knee-flexion not greater than 90° because it would stress ACL and menisci [5]. The knees should not extend over the feet, in the sagittal or frontal planes (either medially or laterally over the knee). Perform 10 repetitions. Each knee-flexion repetition should be held statically for 20 seconds (Figure 1).

The tibiofemoral joint is a condyloid joint that allows movement in the sagittal and transverse planes [6]. Tibiofemoral joint deviation in the transverse plane during knee-flexion places additional tensile stress on the ACL, MCL and LCL. When a patient squats from 0°-extension-to-90°-knee-flexion, the femoral condyles roll on the tibial plateau in adherence to Joint Arthrokinematics Rule 1 (when a convex surface articulates on a stationary concave surface the roll and the slide is in the opposite direction) [6]. This implies that the femoral condyles roll posteriorly, while there is an anterior slide, placing the tibia anterior to the femur, producing a tensile force onto the ACL. However, this CKCE activates the hamstrings' and popliteus, which limits the amount of anterior tibial translation, preventing ACL damage. Conversely, when the patient moves from 90°-knee-flexion-to- 0°-extension, the femoral condyles roll anteriorly with a posterior slide, placing the tibia behind the femur, stressing the PCL [2]. At maximal knee-extension, the tibia externally rotates controlled by the ACL-screw-home-mechanism.

If the patient cannot attain 90°-knee-flexion, this could be attributed to tight rectus femoris [4]. An abnormal force-couple relationship between vastus medialis obliquus (VMO): vastus lateralis (VL) produces patellar misalignment and pain that often inhibits 90° knee-flexion [6]. The possible contributing factors to patellar misalignment are (i) Tight VL and tensor fascia latae (TFL), (ii) Weak VMO and (iii) Patella-alta (weak ineffective

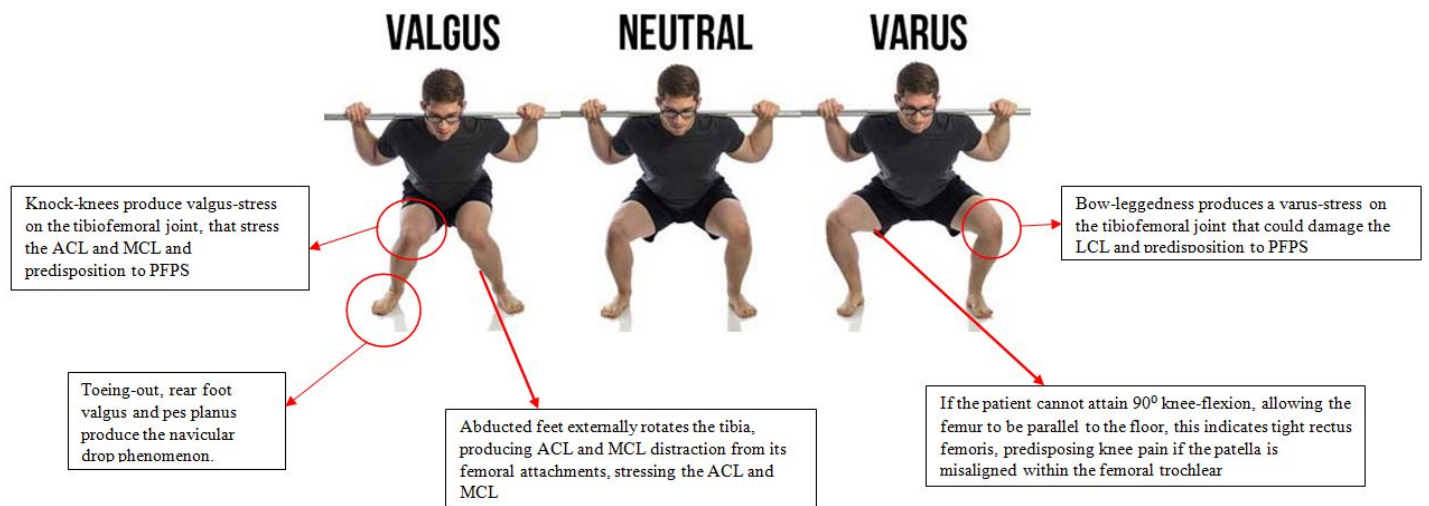


Figure 1: Describes the different knee positions when squatting [9].

dynamic and static restraints of the patellar tendon and ligament holding the patella within the trochlear). The fundamental benefit of squatting is the increased PJRF that ensures patellofemoral joint congruency, decreasing PFPS among arthritic patients, provided the patellar is within the femoral trochlear [7]. During squatting knee-flexion, the flexion moment is increased by the agonistic CKCE concentric hamstring and popliteal contractions, which further augment the eccentric lengthening of the quadriceps and patellar tendon pushing the patella into the trochlear [2,7]. This allows a greater patellar surface area to make contact with femoral trochlear, decreasing internal stress or pain (pressure = force/area) [2,7].

If the patient is able to attain 90°-knee-flexion, but there are valgus and/or varus deviations, then tibiofemoral and patellofemoral joints become destabilized. The genu valgum indicates VMO weakness, compromising the ACL and MCL integrity [6]. Conversely, genu varum indicates VL and TFL weakness, compromising the LCL integrity [6]. Further orthopaedic evaluation should be undertaken to identify ligament laxity and multi-planar asymmetrical force-couple relationships among the tibiofemoral and patellofemoral joint musculature.

Other important kinesiological deviations are toeing-out and rear foot valgus that may occur to accommodate 90°-knee-flexion. This deviated foot movement results in a navicular-drop phenomenon. As the knee flexes, the navicular bone moves inferior/caudally producing pes planus. The navicular descent facilitates an inferior tibial displacement, producing an inferior tensile stress on the MCL, ACL and VMO that could translate into injury [6,8]. It is recommended that further orthopaedic testing be undertaken to determine ligament laxity and abnormal force-couple relationship of VMO: VL.

If the clinical practitioner conducting the test identifies any of the above-mentioned deviations during the final-phase-rehabilitative squat assessment, it is recommended that further closed-kinetic-chain exercises are warranted to increase tibiofemoral and

patellofemoral joint stability.

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