

Clinical Functional Assessment of Knee Joint Movement

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Received: September 18, 2017; **Accepted:** September 19, 2017; **Published:** September 30, 2017

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The essence of knee joint function is a set of motor tasks best evaluated during movement. However, clinical traditional assessment is limited to static tests, giving at the most, insight on standing ability and laxity. In addition, the current clinical tests (Lachman, KT2000) are used purely on primary grounds, with no information on sensibility or specificity [1].

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Subjective evaluations, such as that published by Lysholm, are of importance to patients during rehabilitation of the knee with no direct link to surgical results. Despite its limitations, Lysholm Score and Tegner Activity Scale are the most widespread functional self-evaluations at this time for patients with reconstructed Anterior Cruciate Ligament (ACL) [2]. Goniometric studies as well as arthrometer applications lead to static evaluations of the knee joint, with no information derived from a walking patient, for instance.

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ACL reconstruction success should be measured not only considering sports performance but also in terms of pain and lack of stability. For instance, an athlete not operated on for ACL tear will not be evaluated in terms of standing ability but rather measuring quadriceps strengthening and looking into proprioceptive aspects. Functional performance is paramount, according to therapeutic goals. Knee laxity would not be a good interpretation because the clinical objective is not tibial migration reduction, but rather a functional restoration.

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The most common knee lesions include ACL tears, meniscus ruptures, articular cartilage lesions and subcondral bone fractures. There is no local functional evaluation available while patient outcomes are commonly described with specific scores related to gait analysis, weakness or static laxity [3]. To confirm the knee joint stability in the anteroposterior direction, clinicians use the Lachman, the drawer- and the Pivot-shift test [4]. All these are referred to a joint in a special non-functional motor task: the knee in the hand of a clinician, neither walking nor climbing stairs.

Citation: Santos D, Artigas J, Barrios A, Simini F (2017) Clinical Functional Assessment of Knee Joint Movement. J Physiother Res. Vol. 1 No. 1: 3.

CT scans, MRI and X-rays studies are occasionally used to describe knee joint injuries and recovery after surgery. Anatomical structures are very precisely described but no dynamic evaluation is possible since all images are static.

The knee is subject to continuous movements and exercises in everyday life. After a serious lesion such as ACL rupture, the joint kinematics are altered [5], basically the tibio femoral mobility, which is professionally known as “arthro-kinematics” amongst

physiotherapists [6]. Bone mutual movement of femur and tibia (osteokinematics, measured by bone angles) is commonly measured in gait analysis laboratories omitting all phenomena associated to arthro-kinematics (surface interactions). There is no osteo-kinematics without arthro-kinematics, and both are intimately connected. To this day only the former is objectively reported in clinical settings.

Since there was no objective evidence to quantitatively report the rehabilitation of the knee during motor tasks (osteo- and arthro-kinematics), a new instrument and methodology was taken from research labs and adapted to clinically settings, named CINARTRO [7,8]. This methodology was developed based on prior works by Baltzoupoulos, Andriacchi, Pandey, Leardini [9-12] and others. The goal of CINARTRO is to quantify image processing of video fluoroscopic (VFC) during movement. By doing so, CINARTRO obtains the main biomechanics parameters such as the Tibio Femoral Contact Point migration and the Moment Arm variations during a motor task. Step climbing under VFC or hanging leg flexion/extension are some of the tasks under study with CINARTRO.

The quantitative evidence obtained is compared with the contralateral parameters, as a reference, and is helpful during subsequent follow-up instances [8]. Thus, the usually vague professional judgement has a set of numeric parameters to guide further decision making and planning. In addition, for the first time objective information is available with CINARTRO to be included in the Electronic Clinical Record (ECR) of the patient under rehabilitation.

CINARTRO with its functional knee joint arthokinematics analysis is a new tool available to clinicians and physical therapists to help them to confirm diagnostic judgement and prognosis, as well as rehabilitation planning, all based on real movement during standard motor tasks.

In conclusion, CINARTRO may turn clinical knee joint evaluation into an objective figure with reduced discussion associated to subjective test. International comparisons and collaborative research will also be fostered by the availability of standard measurements.

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