

controversy discussion of the application of OKC and CKC exercises in rehabilitation led to considerable changes in strategies. While so-called OKC exercises were initially propagated, an increasing preference for CKC exercises made its way into everyday clinical practice. Many physicians believe that CKC exercises are safer/more functional compared to OKC exercises (8). Often differentiation is limited to the knee joint or lower extremities. A majority of scientific work thus addressed the anterior tibial shift in ACL-sufficiency or postoperative course after ACL reconstruction and a possible increase in anteroposterior pressure. Frequently, CKC exercises have been preferred due to the reduced ventral-oriented translation of the tibia by co-contractions and an increased anteroposterior pressure only in the last third of flexion. However, it was and remains questionable:

whether this leads to increased ACL tension or to increased cartilage stress and whether the result is a reduced outcome for the patient.

In addition evaluation of discussion by including other joints and intra-articular pressure under consideration also remains unclear. Almost no clinical literature can be found discussing the effects of OKC vs CKC in upper extremities. It is rarely discussed in hip, ankle and shoulder joint (4,15).

## Terms and Definitions

Looking at Steindler's original definition in 1955, OKC is taken to describe **movements with a movable distal segment** and CKC describes **movements with a fixed distal segment** (17). During rehabilitation, this is frequently not applied, but rather, CKC is taken to refer to the application of resistance from plantar to the foot. According to Steindler, for example, ergometer exercise in rehabilitation would not be considered CKC, but rather OKC (9). Misunderstandings coupled with the impact of misused definitions have led to controversial discussions with subsequent correct transfer to exercises in rehabilitation of injuries.

Currently it is correctly recommended to redefine OKC and CKC within clinical rehabilitation. Differentiation might be done between **exercises involving several joints** and those **involving only a single joint** (1). Beynnon differentiates between **weight bearing and non-weight bearing exercises** (3). Lephart and Henry differentiate between fixed boundary with external axial load, movable boundary with external axial load, movable boundary with rotatory external load and movable boundary with no load (11). Blackard postulates that external load is more important than boundary condition describing human activity (4).

OKC exercises might be defined as mainly single-joint exercises with a movable distal segment whereas CKC exercises mainly involve multiple joints with a fixed distal segment performed in loaded or unloaded conditions

## Conclusions

It is not imperative that so-called OKC exercises have more negative effects than CKC exercises. Rather, therapists must be required to work conscientiously in the application of various forms of training and testing. Recent literature confirms necessity of a differentiated point of view with respect to clinical queries (8,9). Depending on stage of rehabilitation, application of OKC and CKC exercises have special importance which supports a combination of the two forms (9). **Both exercise modes are necessary in rehabilitation** to improve both proprioception and function (15). It appears reasonable to redefine terms OKC and CKC exercises in future. For the clinician/therapist it might be helpful to define either by the **site of resistance application** or, better still, by the **muscle groups or joints involved**. In case of OKC exercises, isolated arthron exercise would be assumed, whereas the term CKC would represent more multi-joint exercises.

In summary, medically-oriented therapy and documentation should be required to apply single and multi-joint exercises within the framework of a differentiated indication both alone and also in combination.

## Literature

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## ACL strain and knee exercises

Various scientific methods have been applied in evaluation of clinical relevance of CKC vs. OKC: In simulations, **mathematical calculation models** showed that, due to reduced anterior-directed force, squatting exercises are preferable to isolated, isometric flex/ex exercises (12).

**Cadaver models** proved that increased tibiofemoral compression exercise leads to reduction of the resultant ACL force (13).

**EMG-studies** gave rise to the assumption that the extent of quad/ham co-contractions is higher in squats than in flex/ex exercises (6). It was postulated that OKC exercises lead to increased tibial displacement (10). However, in squats greater EMG activity cannot basically be assumed (7).

In an **in-vivo study** with transducers implanted in patients ACL, Beynnon found no difference in maximum ACL strain values in squats compared to flex/ex movements (3).



Clinical relevance of cadaver models and simulations must be discussed critically with respect to the lack of impact of in-vivo neuro-muscular control mechanisms. Also, it is questionable, if co-contractions are always desirable.

## Metabolism and Osteoarthritis

Velocities of 60°/s lead to a reduction of **intra-articular pO2** below the resting value; 180°/s result in a very small decrease. Reduction of intra-articular partial pO2 has deleterious consequences for metabolism of chondrocytes. Most dangerous mechanisms for cartilage integrity occur when hypoxia is followed by tissue reoxygenation. Due to exercise-induced rise of intra-articular pressure above synovial capillary perfusion pressure causing intra-articular hypoxia, reperfusion of synovial membrane occurs creating an ishaemia-reperfusion process and production of reactive oxygen species (5). Persistence of synovial inflammation can be due to **exercise-induced hypoxia and reperfusion**, injury mediated by reactive oxygen species. Measurement of lipid peroxidation products in synovial fluid might give further information (16).



Nevertheless, differentiated results on intra-articular pressure in using OKC and CKC exercises are not known, yet.

Baratta postulated to privilege CKC exercise in **Osteoarthritis** since qualitative geometrical analysis indicate that antagonists provide regulated stabilizing functions to distraction forces. Equalizing articular surface pressure distribution might preserve and prolong cartilage integrity (2).

In summary, limiting exercise-induced intra-articular stress is an important challenge managing patients with joint inflammation

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