# BIOMECHANICAL ISSUES IN SPORTS PHYSIOTHERAPY AND REHABILITATION

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**INTRODUCTION:** In the last decades the number of people participating in sports and leisure time exercise activity has increased tremendously (Westerstahl et al., 2003). Due to this raise in participation the incidence of sports injuries increased, which resulted in a boost for medical interventions. For example, in the Netherlands with a population of about 15 million, there is an allover incidence of 3 injuries per 1000 hours spent on sports. One of these 3 injuries needed medical care (van Mechelen et al., 1992).
Many injured athletes or leisure time sporting persons not only consult their sports physician (team physician), but also rely on the professionalism of the sports physiotherapists to increase the speed of their recovery and reduce time off of their sports and training (either competitive or a lower level of exercising). Sports physiotherapy is a specialty widely recognized as a profession with its own body of knowledge and as such represented in the World Confederation of Physical Therapy (WCPT) by the International Federation of Sports Physiotherapy (IFSP). As members of the sports medical team, sports physiotherapists are active in the prevention and rehabilitation of sports related lesions. Sports physiotherapists work with athletes of all ages and abilities, at individual and group levels, to prevent injury, restore optimal function and contribute to the enhancement of sports performance after injury, using sports-specific knowledge, skills and attitudes to achieve best clinical practice (Bulley &. Donaghy, 2005). Furthermore, sports physiotherapists are pioneers in their field, critically challenging, evaluating practice and developing new knowledge through research. However, for many years, sports physiotherapists have been relying too much on authority and non-scientific methods rather than on hard evidence for their clinical decision-making.
With the risk of oversimplifying, it can be stated that many injuries are the result of a biomechanical “overuse” of the musculoskeletal system, either in an acute (trauma) or a chronic (fatigue) state. The rehabilitation of injured athletes to their functional pre-injury status is confronted with the loading capability of the injured tissue and its interaction with the known training principles (variation, overloading, specificity and recovery). Depending on the progression of the wound healing, the injured tissue may (and must) receive more and more loading in order to heal and regain functionality. Therefore, restoration of function will depend merely on the phases in which the immunological system is restoring the injured tissue (Cabri & Gomes-Pereira in E. Müller et al., 1998).
For example, in muscle injuries, it is known that these phases of repair are linked with the amount of loading the injured tissue can bear (loading capability) and that early mobilization will contribute to increased efficacy of repair (Järvinen et al., 2005). In this context, biomechanical studies contribute much to the knowledge of loading on the musculoskeletal tissues during (rehabilitation) exercises, both quantitatively and qualitatively.

**SPORTS BIOMECHANICS AND THERAPEUTIC INTERVENTIONS:** Biomechanics in sports plays an important role in sports physiotherapy since it provides much of what is known in the field of stress-stresshold and the pathogenesis and recovery of injuries. Furthermore, it contributes to the developing knowledge of the sports physiotherapist with respect to the biomechanical loading of an athlete during the execution of sports movements, not only for intervention (therapy) reasons, but also from a preventive point of view. Additionally, biomechanical data have been proven useful to challenge current treatment concepts in physiotherapy in general and in sports physiotherapy more specifically. For example, in vivo arthrokinematic evaluation of the proximal radio-ulnar joint, using 3D reconstructions of helical computerized tomography data showed a clear inverse behavior with respect to the convex-concave concept used in manual therapy (Baeyens et al., 2006).

The same antagonism with the convex-concave rule was found for the glenohumeral joint where the humeral head translates posteriorly on the glenoid with external rotation in 90º shoulder abduction (Baeyens et al., 2001). In minor anterior unstable shoulders of elite handball players, this posterior translation was lacking. The humeral head remained in a central position on the glenoid, indicating a dysfunction of the anterior part of the inferior glenohumeral ligament.
Another example is the belief, that massage is having biomechanically alterates in muscles and connective tissue. Both sports physiotherapists and their patients still believe that the mechanical pressure during massage will result in less adhesions, more muscle compliance and range of motion, and less passive and active stiffness. However, a recent systematic review (Weerapong et al., 2005) could not confirm these effects either due to the inexistence of significant effects on the outcome variables (range of motion, strength) or because of the low quality level of the studies published.
Although slowly changing, many other interventions (sports) physiotherapists apply to their patients still need more and better proof in order to ensure optimal care. As such, in some areas of application, biomechanics in general and sports biomechanics more specifically, will help the sports physiotherapist to increase quality of care.

**SPORTS BIOMECHANICS AND CLINICAL OUTCOMES:** The fact that sports physiotherapists are nowadays requested to document their interventions in order to evaluate the status of the athlete and appreciate the time of regaining sports specific activities to full loading, measuring clinical outcome is an important aspect within the field of sports physiotherapy.

For example, the use of isokinetic equipment for the evaluation of muscle strength has become quite popular in many sports rehabilitation clinics. Biomechanical parameters like, maximal strength at a given movement speed, agonist/antagonist ratios, time to peak force, amongst others, are used as clinical outcomes to decide whether the athlete has regained the strength necessary to join the sports without the risk of re-injury. These data may then be linked with data from exercise scientists, sport physicians and other health care professionals for research or therapeutic purposes. Apart from the fact that still a lot of research is needed to determine the clinical relevance of these variables, measuring isokinetically is known to lack sports specificity, since it is an unnatural movement not sensitive enough to detect changes in strength, especially in elite athletes (Cabri, 1991, Gleeson & Mercer, 1996). Furthermore, this type of equipment seems to have validity flaws, since at high movement velocities, the isokinetic part of the movement is either reduced in its range of motion or inexistent (De Jonghe et al., 2005). Thus, without this knowledge sports physiotherapists would use test methods that are not sensitive, valid nor reliable.
How new information of clinical outcomes may change traditional sports physiotherapy interventions is shown in the next example. Overhand-throwing athletes have been shown to have increased external rotation and decreased internal rotation of the shoulder when measured at 90° of abduction.(Downar & Sauers, 2005, Crockett et al., 2002). Several theories have been proposed to explain the change in total arc of motion in the overhand thrower. These include posterior capsular contracture, anterior capsular plastic deformation, and increased humeral retroversion. Using 3D electromagnetic tracking, we could demonstrate in female handball players increased external rotation and reduced internal rotation in 90° abduction and reduced internal rotation in 90° of flexion.
Preventive stretching of the shoulder has routinely (and arbitrarily) emphasized external rotation of the shoulder. In contrast, from the point of view of evidence based sports physiotherapy, the arthrokinematic data accentuate to predominantly stretch internal rotation and to avoid stretching of an already enlarged external rotation.
Consequently, a team approach to research including clinicians and biomechanists is essential if performance is to be optimized while keeping athletes free of injury.

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