

The contribution of the Anterior Cruciate Ligament to the Knee Proprioception

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Editorial

The anterior cruciate ligament (ACL) is an intra-articular element structure of paramount importance for normal knee movement since it secures simultaneously static and dynamic stability [1].

Dynamic stability is supported by the presence of specific ligament mechanoreceptors which are proved to be an essential element for proprioception as it has been revealed by a few anatomical and histological studies [2-10].

The existence of mechanoreceptors and their potential role in knee function has been discussed for over a century. However only recently in 1984 their existence was proved on the human ACL after the identification in the ligament of type III (according to Freeman and Wyke) and free endings receptors [2].

Afterwards more detailed studies identified three types of mechanoreceptors by different morphologic characteristics: two types of Ruffini end organs, Paccinian corpuscles and a smaller number of free nerve endings. In this study was reported that neural elements comprise about 1% of the area of the ligament [3].

Even though the definition of proprioception has been attempted many years ago, there still is no widely accepted definition. Sherrington introduced this term in the literature who thus described the result of afferent nerve impulses from muscles, tendons, joints and relevant tissues. The processing of the input results in controlling reflexes and muscle control [11].

This description defines proprioceptive sensation primarily as a sensory process. Recently the meaning of the term proprioception has been extended and also includes the interaction of afferent and efferent pathways of the somatosensory system [12].

Most authors refer to two types of proprioceptive sensation for clinical reasons. Static proprioception is defined as joint position sense that is the direction of limbs in space and the perception of their interrelationship. Dynamic proprioception or else [13] includes the sense of limb movement and speed changes, acceleration or deceleration [13].

Those two elements of proprioception should be accompanied by the last but not least important element of proprioceptive sensation of force/tension, occurring during muscle contraction [12,14].

Injury to joint structures such as ACL the menisci and following osteoarthritic changes are combined with mechanoreceptor damage. The following damage of afferent pathways and CNS transmission of information results in disturbing joint position sense and [15]. Reduced proprioceptive sensitivity is recorded apart from ACL damage, with aging [16-20] while impaired joint position sense is recorded as a result of osteoarthritic changes in the knee [19,21,22].

Sensory proprioception following ACL tear has been studied in detail. The reproduction of the predetermined angle (JPS) and the threshold to detection of passive motion (TTDPM) are the most commonly used sensorimotor system measurement techniques [23]

Two other methods of assessment of neuromuscular control is the reflex hamstring contraction latency (RHCL) [24], and the assessment of postural control [25].

Most studies report a reduction in proprioceptive sensation following injury and ACL insufficiency [26-32] while the opposite opinion has gained limited support [33-35]. During the acute phase of ligament injury, it is not clear if joint inflammation and oedema contribute in proprioceptive deficit [36]. Still, those parameters are considered not to be related to static and dynamic proprioception reduction which is evident in chronic ACL insufficiency [37].

As sensory receptors are presented not only in the anterior cruciate ligament but also in the skin, muscles, tendons and the other tissues surrounding the knee [14,38-42], the damage ensued in the sensimotor system by the injured ligament may also represent an afferent pathway damage that results in a decrease of neuromuscular control and dynamic joint stability.

In that case afferent pathway damage or reflex action on muscle spindles results in a decrease in neuromuscular control and dynamic joint instability.

Thus the proprioceptive deficit of a knee with ruptured or non functional ACL is probably not only the result of the loss of ligamentous mechanoreceptors and the subsequent loss of proprioceptive feedback [40] but also the consequence of the abnormal neurologic output from the capsule and the remaining ligaments [43].

Conclusion

The Anterior Cruciate Ligament is not only a primary restraint to anterior tibial translation but is also an important dynamic stabilizer of the knee joint as well.

However ACL contribution to the knee proprioception has not yet been totally clarified. Further laboratory and clinical research is required, so that a better understanding of this complex mechanism can be reached.

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