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Postural Alterations after Anterior Cruciate Ligament Surgery: Assessment and Rehabilitation

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Abstract

The visual system controls movement and posture. However, ACL injury can lead to changes in motor control which can then entail risks which compromise the chances of patients having undergone ACL reconstruction to return to competition. Similarly, data from the international literature highlight postural disorders associated with visual dependence after ACL surgery and agree that it is essential to assess this type of deficit. However, there is no consensus today on the evaluation methods. Neuromotor rehabilitation must take into account these disorders which can persist over time in order to optimize the return to the field of patients. Taking into account postural disorders and visual dependence make it possible to limit the factors and risks and a fortiori to reduce the incidence of iterative ACL tears.

Keywords: Neuromotor rehabilitation; Visual dependence; ACL; Postural disorders

Introduction

Vision is one of the main systems for controlling movement and posture, along with the integration of proprioceptive information. Numerous studies have shown that neuromotor control depends on this visual system, so a disturbance of vision automatically results in a change in posture [1]. However, in the case of ACL, the visual system seems to compensate for proprioceptive alterations and therefore disturbs neuromotor control. With a view to returning to the field as optimally as possible, it is necessary to be able to assess the postural disorders associated with the reconstruction of the ACL and to develop a rehabilitation strategy aimed at reducing the risks of iterative rupture linked to sports practice.

Visual System and ACL Injury

In the context of an ACL injury, the proprioceptive system linked to the various local mechanoreceptors finds itself damaged, and also leads to a deficit in neuromotor control of the knee and of the posture as a whole [2,3]. This deficit is partially compensated by the integration of visual information, we can then speak of an increase in visual dependence in this population. This visual dependence is notably noticed on a postural evaluation by comparing the stabilometric parameters on a test with open eyes and closed eyes, with a more significant difference in subjects with an ACL lesion or repair compared to a healthy control population [4,5].

Since ACL damage is mainly linked to sporting practice, it is therefore important to take into account this visual dependence and its impact in return to sport: if vision is disturbed, as is very often the case in a sporting context, neuromotor control of the player then loses the main sensory system to ensure stability and movement, in a situation where these two components are essential (contact with another player, shooting or pivot phase etc.) [6]. Where vision plays a lesser role on knee stability in a healthy population [7], this same situation then becomes a risk of injury for players who have had an ACL, and dependence on vision presents itself as an additional factor which could partly explain the significant number of iterative ACL tears after initial injury [8]. It is therefore essential to take this factor into account in the neuromotor rehabilitation of these patients [9,10].

Postural Alterations and ACL Surgery

Soltani and al [11] studied the impact of an ACL reconstruction on postural balance treated either by surgery or by functional treatment. The study highlighted the effect of the lesion on the static postural balance in bipodal for the two types of treatment compared to a control group, but there would be no difference between the two treatments offered. The effect of the rupture is also found in unipodal but it would seem that the group having undergone a surgical operation has a more important postural imbalance. However, this study does not specify how long after the injury or surgery the patients are.

The reconstruction of the ACL by hamstring graft or Kenneth-Jones leads to muscular, neuromuscular, proprioceptive repercussions. These changes will have an impact in the regulation of bipodal [11-14] and unipodal [11,13-21] posture in

static and dynamic. Because of the importance of measuring and quantifying this imbalance via, for example, force platforms

What Protocols in the Assessment of Postural ACL Disorders?

In their protocols Zouita Ben Moussa and al [15] and Parus and al [12] offer patients a training session on the platform before the different measurements, while the other protocols do not offer it. It should be noted that there are some differences in the protocols for carrying out the measurements. First, the positioning of the patient on the platform may change. Indeed, the patient can perform the knee test in extension [12,15,17] or knee unlocked in flexion at 20° [12,15,18,19,21]. The flexed position at 20° adds an eccentric - isometric contraction of the quadriceps to accentuate the knee's destabilization.

In addition, the exercises can either be done with EO [11-13,16-19,22] or EC [12,13,17,18,20]. Four studies performed the same exercises in both EO and EC. In his study Dauty and al (5) reveals that in bipodal support EC, the values of the displacements of the COM in the sagittal and frontal planes, the size of the ellipse and the total value of the displacement of the COM are greater compared to the EO bipodal support test in patients with ACL but also in healthy patients. Tookuni and al [17] and Pahnabi and al [18] also highlight this point. Visual control would then be important to allow patients with ACL disease or healthy patients to balance.

The time required to maintain the position to acquire the measurements on a stabilometric balance varies according to the study protocols. Generally, the exercises are maintained between twenty and thirty seconds [10-12,16,18,19] but certain articles propose a maintenance of ten seconds [15,17] or a maintenance as long as possible [13]. To allow a satisfactory acquisition of measurements, it is necessary to have a sufficient hold time but not too important so as not to have the impact of fatigue during the measurement. To limit the onset of fatigue, break times are made between each exercise (between 30s and 1 min) [11,13,15].

Long-Term Postural Changes

Different articles deal with postural balance at different stages after ACL reconstruction. Dauty and al [13] studied postural balance two weeks after ACL surgery in unipodal and bipodal. His study evokes an ellipse and a greater variation of the COM in bipodal. However, unipodal tests reveal a higher failure rate and the result must be analyzed with caution. In addition, failure to test highlights the difficulty of performing the exercise after a short period of time following an ACL reconstruction and could mean an altered unipodal balance. Pahnabi and al [18] studied unipodal postural balance in footballers with or without an ACL rupture. His study highlights that after seven months after surgery, there remains a postural imbalance on the operated but also non-operated leg in subjects with ACL surgery. Henriksson and al [21] also studied the static postural equilibrium three years after rupture of the ACL. The study highlights a greater postural imbalance in the sagittal plane than a control group without ACL rupture. These different studies highlight the effects of ACL surgery in the more or less long term on postural balance. Thus, the importance of taking this aspect into account in postoperative rehabilitation therefore seems important to allow recovery of a good balance and therefore return to a sporting activity identical to that before the injury.

Impact on Rehabilitation after ACL Surgery

Studies have been carried out to enable various rehabilitation criteria to be proposed in order to find the most optimal sports recovery possible. Postoperative rehabilitation includes three distinct phases [10] where different conditions will have to be met in order to move from one phase to another. The second phase is often equated with the end of rehabilitation for patients (after five months). As seen above, there remains a postural imbalance several months or even years after the injury. Melick and al [22] and Kruse and al [23] highlight in their writings the main axes of rehabilitation after ACL surgery. The rapid loading and eccentric muscle work from the third week seem to improve the recovery of muscle strength and the improvement of neuromotor parameters. Neuromuscular rehabilitation must be carried out in conjunction with other rehabilitation techniques.

The resumption of sport must be done gradually by combining rehabilitation adapted to the sport practiced. To date, rehabilitation exercises linked to resumption of sport must use the visual system wisely. Neuromotor practice with eyes closed seems archaic given the current data in the international literature. It is necessary to use the gaze without it becoming a means of joint control. Thus, the use of stroboscopic glasses, blackout, or exercises aimed at excluding the articulation of the visual field seems to decrease the visual dependence of patients having undergone an ACL reconstruction.

Gokeler and al [10] proposes in its analysis various criteria including the use of high-performance technological materials such as gait analysis with cameras, electromyography or even the use of force platform. However, the use of its tools is not standardized and would require a large database of healthy patients to better analyze the results of patients with ACL reconstruction.

Conclusion

If the various studies agree on the fact of postural disorders associated with visual dependence after reconstruction of the ACL, it seems difficult for the moment to obtain a standardized evaluation of practices. On the other hand, it seems appropriate to build neuromotor rehabilitation around these disorders and this in an early way in order to reduce the risk of iterative ruptures and allow a resumption of competition in optimal conditions.

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