Can the pedaling task detect unilateral knee extensor strength deficit?

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Résumé

Introduction

Returning to sport after an anterior cruciate ligament reconstruction (ACLR) is challenging as patients are exposed to a high risk of reinjury and face difficulty in returning to their pre-injury level of performance (*Kotsifaki et al, 2023*). When the rehabilitation process includes objective criteria, the knee extensors (KE) strength of the injured leg is typically assessed (*Rambaud et al, 2018*), and compared to the non-injured leg using limb symmetry index (LSI). Though it is the most common task to assess KE strength, knee extension is an open kinetic chain exercise, and so cannot be safely tested in the early stage of the rehabilitation (

Method

Seventeen healthy participants performed i) maximal unilateral knee extensions of both legs on an isotonic leg extension ergometer (power at 50% of pre-determined maximal resistance) and ii) a single maximal sprint on a cycle ergometer to assess power-torque-cadence relationships of each leg before (PRE) and 15s after (POST) a unilateral fatigue protocol of the KE of the non-dominant limb (only maximal power values are presented here). The fatigue protocol, designed to induce artificial between-limb asymmetry in force production capacities of KE (simulating typical strength deficits after ACLR), consisted in isotonic contractions at maximal velocity every 1.5seconds (at 50% of pre-determined maximal resistance) during two consecutive sets of 3minutes and 45s, separated by 15s rest.

Individual LSI were computed on power values for both knee extension (LSIKE) and pedaling (LSIpedaling) using the dominant leg as the reference. Responsiveness of pedaling task to unilateral KE alteration was evaluated using paired t-test for LSIpedaling PRE and POST. Paired t-tests and correlation analyses were conducted between LSIpedaling and LSIKE values for both PRE and POST conditions.

Results

LSIpedaling POST (88.3+/-6.3%) was lower ($p< 0.001$) than PRE(98.3+/-3.9%). Nor difference ($p=0.215$) and correlation ($r=-0.158$,$p=0.559$) were observed between LSIKE (93.4+/-13.8%) and LSIpedaling (98.3+/-3.9%) for PRE. For POST, LSIKE (35.9+/-16.6%) was lower ($p< 0.001$) than LSIpedaling (88.4+/-6.3%) and both were positively correlated ($r=0.505$,$p=0.046$). POST, 17 and 9 participants presented an asymmetry (LSI< 90%) in KE and pedaling, respectively.

*Intervenant

Discussion

The lack of difference or correlation in asymmetry between KE and pedaling in non-fatigue condition can be explained by the fact that healthy participants did not present high enough natural asymmetries. When an artificial KE strength asymmetry is induced using a fatigue protocol, strength asymmetries in pedaling increased, with magnitudes partly related to asymmetries in KE. However, pedaling task enable to detect asymmetries (LSI< 90%) only for half of the participants. This may be partly due to the specificity KE alteration induced here by a fatigue protocol, potentially different from an ACLR-induced deficit.

Conclusion

These results emphasize the interest of using the pedaling test (safe and quick) to evaluate unilateral lower limb capacities and detect asymmetries in knee extensor strength, yet asymmetry was not detected for some participants. Further analyses are required to better understand these individual behaviors, especially among ACLR patients.

Bibliography

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