

# 動作の完遂不能時のフィードフォワード制御修正の動態を 抽出する新手法を使って ACL 損傷発生機序を探る

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## Assessment of Neural Mechanism of ACL Injury with Innovative Method by Using Analysis of Alternated Feedforward Control Due to Unaccomplished Locomotion of Athletes

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### ABSTRACT

There is no previous study which have examined how neural control abnormalities due to anterior cruciate ligament (ACL) injury affect muscle feed-forward (FF) control when an unpredictable event occurs in the landing. By using the prolonged vibration stimulation to the infrapatellar tendon, in the present study, the similar neural abnormalities occurred after ACL injury could be induced in healthy subjects. The study design using the neural abnormalities induced by prolonged vibration stimulation in healthy individuals enable to compare the effect before and after the occurrence of neurological abnormalities. It is difficult to extract direct effects of the neural abnormalities in experiments with actual patients with ACL injury since it is impossible to predict when and who would get injured. In the present study, furthermore, all subjects

were imposed unpredictable event which is called Surprised Landing task. The task was designed to impose unexpected landing task under the same conditions to subjects. The EMGs before and after the induction of neural control abnormalities were compared to identify changes in pre-landing muscle activity. The results of present study demonstrated that activation of vastus medialis and rectus femoris were significant increased in muscle activity of the first half part after passage of the false plate by the induction of neural control abnormalities ( $p=0.014, 0.04$ ). There was no significant difference in all muscles in the latter half. Those results might suggest that the enhanced corticospinal pathways excitability induced by the ACL injury complement the declined activity in the spinal reflex pathway of some muscle in FF control of unpredictable events.

## 要 旨

前十字靭帯 (ACL) 損傷による神経制御異常が、着地動作における予測外事象発生時に筋のフィードフォワード (FF) 制御にどのような影響を与えるかは不明である。本研究では膝蓋腱部振動刺激にて ACL 損傷における神経制御異常モデルを健常被験者にて作成した。この異常モデルを用いることにより、実際の患者を用いた実験では実現することができない ACL 損傷による神経異常発生前後の変化を比較することができる。そして、FF 制御の再構築時の実験条件を均一化できる Surprise Landing 課題を被験者に課することにより、神経制御異常の誘発前後での着地前筋活動の変化を調査した。その結果、神経制御異常の誘発にて、偽板通過後における前半部分の筋活動で内側広筋、大腿直筋が有意に大きくなった ( $p=0.014, 0.04$ )。後半部分ではすべての筋で有意差は見られなかった。これらの結果から ACL 損傷で発生する皮質脊髄路興奮性変化によって、予測外事象の FF 制御では一部の筋の脊髄反射経路にて補完的に活動が高まると推測された。