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論　　文　　名　　Single-leg loading test performed after acute lateral ankle sprain in competitive athletes

　　　　　　　　　　競技スポーツ選手の急性足関節外側捻挫後に実施した片脚負荷テスト

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学位論文の要旨

Lateral ankle sprain (LAS) is one of the most common injuries during sports activities. Due to its high incidence rate, LAS tends to be neglected, with more than half of the patients who injured their ankle joints do not take a medical treatment, and a previous study reported that approximately 90% of the patients with (LAS) have returned within 1 week. Another report also showed that many athletes still had symptoms such as pain and joint instability 1 year after the injury, and most of athletes were re-injured as a result of inadequate treatment and premature return to sports.

For early return to sports after a LAS and recurrence prevention, effective rehabilitation and gradual return to sports should be initiated while predicting the return time based on the appropriate severity evaluation immediately after injury. However, since severity evaluations performed in previous studies required large space and stairs and involved high-revel activity, their use as a test and index to evaluate severity after LAS was not appropriate considering convenience and risk of re-injury. Therefore, a quick and simple test was developed to evaluate the severity of acute LAS.

In the experiment 1, we aimed to verify the association between ankle function for severity evaluation and anterior talofibular ligament (ATFL) injury type by ultrasonography and to clarify the usefulness for acute LAS severity evaluation of the single-leg loading (SLL) test. In total, 50 patients (34 men, 16 women) out of 58 patients who visited our sports clinic within 3 days after acute LAS and who conformed to the study criteria were included in this experiment 1. The SLL test and objective/subjective ankle joint evaluation were performed at the first visit to our clinic. This test consists of difficulty standing, standing, heel raising, and hopping step-by-step, and the test was terminated when the patient felt pain or fear. Then patients were classified into four levels from 1 to 4 according to results. In addition, ultrasonographic evaluation was performed within 1 week after the first visit to evaluate the type of ATFL injury. Type I was defined as intact ATFL, Type II as swollen ATFL with an almost intact fibrillar pattern and Type III as ATFL appearing swollen with a disrupted fibrillar pattern. The relationship between the SLL test and each evaluation item was investigated using Spearman's correlation coefficient. Regarding to correlation coefficients of the SLL test, Japanese Society for Surgery of the Foot ankle/hindfoot scale and sports activity were $r_s = 0.71$ ($p < 0.001$) and $r_s = 0.66$ ($p < 0.001$), respectively, showing a significant positive correlation. SLL test and the type of ATFL

injury also showed a significant negative correlation ($r_s = -0.58$, $p < 0.001$). These results suggested that the SLL test was a simple and useful test that can be used as an index to evaluate the severity of acute LAS.

Although we elucidated the usefulness of SLL test in the experiment 1, it is unclear whether the severity level assessed by the SLL test was associated with the time to jog and return to sports (RTS) of competitive athletes. Therefore, we aimed to examine whether the time to jog and RTS differ depending on the severity level of the SLL test in experiment 2. 240 ankles of 234 athletes with a Tegner activity level scale of ≥ 7 who visited our sports clinic within 3 days after an acute LAS were included in this experiment. The SLL test was performed at the first visit, and the patients were classified into four levels. The Steel–Dwass multiple comparison method was performed to verify differences between the levels of the SLL test and time to jog and RTS, and significant differences were found among almost all the levels of the SLL test. Multiple regression analysis performed to verify whether the test affected the time to jog and RTS revealed that only the SLL test was selected as a significant variable for both the time to jog and RTS. These results suggested that the time to jog and RTS can be predicted by the level of the SLL test.

In conclusion, the SLL test which we devised as a screening test for acute LAS was thought to be useful for its evaluation and could predict the time to jog and RTS in competitive athletes.

論文審査結果の要旨

　本研究の目的は，独自に開発した機能テストである片脚負荷テスト（以下 SLL テスト）が足関節外側捻挫後の指標として使用可能かどうか，スポーツ動作開始時期を予測可能かどうか，を示すことである．SLL test は，片脚立位，片脚ヒールレイズ，片脚ホップ，から構成されており，それぞれの課題動作の可不可によって４つのレベルに分類するものである．急性足関節捻挫後の本テストの結果は，主観的・客観的評価、超音波検査による前距腓靭帯の損傷評価と有意な相関を認め，かつ重回帰分析においても本テストが有意な変数として選択されたことから，簡易的なスクリーニングテストとして使用できることが示唆された．更に，本テストとジョギング開始時期およびスポーツ復帰時期の関連性についても検討した結果，それぞれの時期を予測可能であった．

SLL test は場所を選ばず短時間で実施できるため，臨床場面だけでなくスポーツ現場においても使用可能なテストである．本論文は，簡便なテストであっても足関節外側捻挫急性例の有用なスクリーニングテストとなること，さらに受傷後早期であっても本テストの評価結果から復帰時期を予測できること，を証明している点で独創的である．復帰の見通しに関する情報は医療従事者だけでなく，選手やコーチにとっても非常に重要であるため，本論文の結果は臨床的意義が大きい．以上のことから本論文は博士の学位論文に値するものである