MUSCLE ACTIVITY IN THE SUBJECTS WITH FUNCTIONAL INSTABILITY OF THE ANKLE DURING A SINGLE-LEG DROP JUMP

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KEYWORDS: ankle sprain, drop jump, muscle activity.

INTRODUCTION: Ankle sprain is one of the most common injuries experienced sporting participation, and Hertel J (2002) reported it's recurrence rate is very high(47-73 %). Presence of residual pain and functional problems (recurrent complaints of "giving way" or repeated sprain) following inversion ankle sprains are often reported. These symptoms of repeated complaints of "giving way" and/or recurrent sprains have been termed functional instability (FI) of the ankle joint with the report of Freeman, Dean and Hanham (1965). Including the report of Konradsen and Ravn (1991) and Hertsell and Spaulding (1999), There are many studies of muscle functions such as muscle strength, muscle activity, muscle response time of ankle joint evertor in the subjects with FI of the ankle joint. However, a few studies have researched muscle activity in the situation actually occurs ankle sprain such as jump landing on the subjects with FI of ankle joint.
The purpose of this study was to identify differences in ankle joint muscle activity in subjects with FI of the ankle joint during a single-leg drop jump landing.

METHOD: Six male subjects (e; mean ± SD age 23.8 ± 2.99 years; height 177.5 ± 2.52 cm; weight 74.0 ± 6.98 kg) with the subjective compliant of FI, and non-subjective compliant of FI 6 control male subjects (mean ± SD age 23.3 ± 2.88 years; height 172.2 ± 8.06cm; weight 67.5 ± 8.04kg) volunteered to participate in this study. This study is conducted with the approval of the ethics committee of department of physical therapy and occupational therapy sciences (authorization number: 0951). Determination of the subjective complaint FI is made by the Scoring scale by Karlsson et.al (1991), and the total score of 100 points, 80 points or less is judged as FI group.
Subjects performed single leg drop jump on stable surface, and unstable surface created by the balance pad (Airex AlcanAirex, Switzerland). Subjects who remained barefoot during testing, were first introduced to the required jumping technique. Subjects standing on a 40 cm high platform in front of the each surface with the test leg relaxed and non-weightbearing. The subjects then used to opposite limb to propel himself from the platform and landing on the each surface with test leg. Subjects permitted a period of practice in the jumping technique prior to testing. Each subject performed 3 single-leg drop jumps onto the surface of the two conditions. A jump was discarded if the subject required any corrections following landing such as touching the floor with the opposite side foot.
A total of five muscles; tibialis anterior (TA), peroneus longus (PL), gastrocnemius (GAS), soleus (SO), tibialis posterior (TP) were recorded in each group by using the surface EMG (Personal-EMG, Oisaka electronic device Co., Japan). Data relating to the period from initial contact (IC) to 200 ms post-IC were extracted 3 EMG records for each muscle, and these were converted into root mean square (RMS). To compare the muscle activity, data were expressed in percentage of isometric maximal voluntary contractions (%MVC) for each muscle. Subjects during single-leg drop jump were captured by using two high-speed camera units from the front and side of them, and made them synchronized with the EMG to determine the moment of IC for each subject.
Statistical analysis was performed by means of excel add-in software (Statcel 2, OMS-publising, Japan). Differences in FI and control group %EMG in each surface in terms of each muscle were tested for statistical significance using Mann-Whitney U test. Differences in stable surface and unstable surface %EMG in each group in terms of each muscle were

tested for statistical significance using Wilcoxon signed rank test. The level of significance for all analyses was set at $P<0.05$.

RESULTS: The mean ± SD of %MVC activity in each group, each surface, each muscle during the period from IC to 200 ms post-IC are shown in Table 1. FI subjects showed a significant decrease in unstable surface PL %MVC from stable surface ($P<0.05$). No significant differences were noted between the groups each surface in terms of TA, PL, GAS, SO, TP. There were no significant differences between the surfaces each group in terms of TA, GAS, SO, TP.

Table 1. %MVC activity during the period from Initial Contact to 200-ms post-Initial Contact

	FI Group(%)		Control Group(%)	
Variable	Stable surface	Unstable surface	Stable surface	Unstable surface
TA	57.5±26.2	47.1±25.9	55.8±16.8	43.7±11.3
PL	76.2±20.5	59.2±9.50*	62.2±25.9	56.3±30.7
GAS	56.5±28.3	65.6±32.0	51.1±31.9	55.2±32.7
SO	89.4±33.8	80.7±19.7	83.9±43.9	83.5±25.0
TP	97.5±22.0	87.3±24.5	86.4±26.6	86.4±21.3

Values are means ± SD.
*Significant difference from stable surface in FI group (P<0.05).
FI, functional instability.

DISCUSSION: Reimann, Myers and Lephart (2003) reported the importance of ankle joint for shingle-leg stabilization on the unstable multiaxial surface (5). In this study, PL muscle activity was significantly decreased on the unstable surface compared to the muscle activity on the stable surface in FI group ($p<0.05$). The main function of PL muscle is to control the amount of inversion occurring at the ankle joint. The deficit of muscle activity of eversion ankle joint would increase the risk of occurrence of ankle inversion sprain, or of recurrence. Based on the result of this study, it is necessary to intervene to improve the PL muscle activity, using the proper exercise.

CONCLUSION: We have studied that muscle activity in subjects with FI of the ankle joint during a single-leg drop jump. This study has shown that subjects with FI have significantly deficit PL muscle activity on the unstable surface compared to the stable surface.

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