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Letter to the Editor

Dynamic Postural Stability Characteristic in Functional Ankle Instability

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Dear Editor-in-Chief

Functional Ankle Instability (FAI) is defined as the subjective feeling of ankle instability or recurrent, symptomatic ankle sprains due to proprioceptive and neuromuscular deficits (1). Ankle sprains have the highest incidence rate, with 32% to 47% of these people having history with symptoms including sensations of giving way, subsequent sprains, and instability (2, 3). After initial injury, a high proportion of patients experienced residual symptoms, such as pain, subjective instability, and repetitive ankle sprain (4, 5). Based on these reports, it is clear that FAI in particular are a significant health risk to the physically active population. The primary purpose of this study was to examine stability control in groups during landing. We compared dynamic postural instability for dominant leg between FAI and healthy groups. It also aimed to contribute to the promotion of public health by preventing repetitive re-injury and improving the physical stability of daily life.

This study recruited a case-control design in which participants in the FAI and healthy control groups reported to the laboratory in 2018. The study population included 11 FAI (age 24.14±2.16 year, height 179.41±8.24 cm, weight 79.48±8.72 kg) and 12 healthy (age 21.32±2.36 year, height 173.45±7.39 cm, weight 74.92±10.18 kg).

All participants provided written informed consent, which was approved by the Incheon National University Institutional Review Board.

For function stability measurement of the ankle joint during landing motions, a motion analysis device consisting of eight motion analysis cameras (Eagle and Raptor System, Motion Analysis Corp., USA), and force plates (OR6-5-2000, AMTI Inc., USA) were used. After preparing an environment in which the range of motion could captured, and performed calibration to establish the spatial coordinates. The sampling rate of the camera was set to 120 frames/sec, and the margin of error was 0.3 mm or less. Next, attached 19 reflective markers (Helen Hayes Markers Set), which allowed us to assess landing motions. Participants performed landing motions from a vertical height of 30 cm, and measured these motions using a protocol described in a previous study (5, 6) to assess the mechanism of impact absorption by body segments. The data of ground reaction forces generated upon landing were collected at a sampling rate of 1,200 Hz, synchronized by an analogue converter for measurement (NI USB-6218, National Instruments, Hungary), and analyzed. All data were processed using Cortex 5 (Motion Analysis Corp., USA). The body was assumed a linked rigid body system. The center of mass of the pelvis and each segment were calculated by assigning coordinates to the central point of body joints and were used as parametric data. To remove errors due to noises in data processing, Butterworth low-pass digital filtering was used for smoothing, and the cut-off frequency was set to 10 Hz.

Peak vertical force (PVF) and dynamic postural stability index (DPSI) during a landing motion were analyzed. PVF was calculated by dividing the PVF produced upon landing (N) by the participant's body weight (body weight x acceleration of gravity). DPSI was precisely calculated based on the three components of the ground reaction force (6). The termination point was set as the point at which PVF was generated, which allowed for an accurate calculation (7).

$$\text{MLSI (Medial Lateral Stability Index)} = \sqrt{\Sigma(0 - F_{XPVF})^2/\text{samples}} \quad [1]$$

$$\text{APSI (Anterior Posterior Stability Index)} = \sqrt{\Sigma(0 - F_{YPVF})^2/\text{samples}} \quad [2]$$

$$\text{VSI (Vertical Stability Index)} = \sqrt{\Sigma(0 - F_{ZPVF})^2/\text{samples}} \quad [3]$$

$$\text{DPSI} = \text{MLSI} + \text{APSI} + \text{VSI}$$

The means and standard deviations of all the measured data were derived using SPSS 25.0 (IBM Corp, USA). An independent samples *t*-test was used for comparisons between the groups, and the statistical significance level was set to α=.05 (Table 1).

Table 1: Results of functional ankle instability during landing

Variables	*Function Group (n=11)*	*Healthy Group (n=12)*
Peak Vertical Force	2.18±.42	1.59±.21***
Medial-Lateral Stability Index	1.61±.85	1.18±.43
Anterior-Posterior Stability Index	1.12±.70	1.47±.50
Vertical Stability Index	26.05±7.99	14.63±3.46**
Dynamic Posture Stability Index	29.38±8.41	17.28±3.90**

Values are Mean±SD, $^{**}P<0.01$, $^{***}P<0.001$

The FAI group showed statistical significance in PVF, VSI, and DPSI compared to the healthy group. Vertical stability is a prerequisite to maintain the functional instability of the ankle joint in a more stable posture through this study, which affects the overall dynamic posture stability. Thus, people with FAI need a variety of clinical public health approaches because they can increase the risk of musculoskeletal system further due to failure to control dynamic posture stability.

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Conflict of interest

The author declares that there is no conflict of interest.

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