

クラシックバレエのトゥシューズ着用時の 筋骨格系力学負荷と足型の関係

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Relationship between Musculoskeletal Mechanical Load and Foot Shape When Wearing Classical Ballet Pointe Shoes

by

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ABSTRACT

Classical ballet dancers can stand on one's toes with toe shoes which are made of hard materials. This posture is called as pointe. Ballet dancers tend to suffer from injuries by a substantial mechanical load on the toe. The purpose of this study was to clarify the mechanical load acting on the foot during pointe for protecting injury. The ground reaction forces acting on a dancer with a Greek foot shape, in which second toe

length was the longest of the toes, were measured while holding pointe with both legs supported. Images of the bones and deformation of the cartilages in the foot were taken using a nuclear magnetic resonance system when the dancer holds a pointe-simulated posture. The stresses in the bone and cartilage were determined with a finite element model constructed from the images. During pointe, ground reaction force acted from between the first and second toes and pushed both feet toward the instep. The load along the longitudinal axis of the foot was the largest and followed by towards the first toe. With the foot finite element model, the center of the second metatarsal was the most stressed. These results suggest that holding a pointe posture should induce the second metatarsal fracture, bunion, and lateral ankle sprain.

要 旨

クラシックバレエでは、トゥシューズという爪先部分が硬い靴で爪先立ちすることをポアントという。ポアント時には爪先部に負荷が集中し、足部の怪我に繋がりやすい。本研究はポアント時に足部に作用する力学的負荷を明らかにし、外傷や障害を予防することを目的とした。本研究では第二趾が最も長い足形状（ギリシャ型）のダンサーにおいて、両脚支持でのポアント保持時に作用する床反力を計測した。また核磁気共鳴装置を用いて同ダンサーのポアント模擬姿勢保持時の骨と軟骨の形状変形や配置変化状態を撮影し、画像から構築した有限要素モデルを用いて骨と軟骨の応力を解析した。ポアント時は第二趾に荷重し、両足を甲側に押し出す力が作用して足の長軸方向と第一趾側に負荷を分散させていた。足部有限要素モデルでは主に第二趾に中足骨中央部で大きな応力が生じていた。これらの結果から、ポアント姿勢の保持により第二中足骨骨折、外反母趾、足関節内反捻挫が誘引される危険性が示唆された。