**Influence of Stance Position when Evaluating Lisfranc Injuries in Radiographs**

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**Introduction:** The Lisfranc ligament is a tough band of tissue joining the metatarsals to the tarsal bones in the midfoot and is vital for proper biomechanical function and strength of the foot. Injuries to this ligamentous structure result in severe discomfort and pain (1). Unfortunately, 20-40% of Lisfranc injuries are overlooked during initial clinical evaluation because opening of the joint (diastasis) is not readily discerned in radiographs (1-2). As high as 50% of patients that show Lisfranc injuries in weight bearing radiographs will display normal diastasis in non-weight bearing radiographs (3). While weight bearing radiographs have been recommended when there is suspicion of a midfoot injury (4-5), patients are often unable to tolerate weight on the afflicted foot because of the pain. We hypothesize that patients may shift their stance position to reduce the pain during weight bearing radiographs and thus potentially obfuscate the injury itself. This study documents the importance of stance positioning on Lisfranc joint diastasis using a previously validated computational foot and ankle model.

**Materials and Methods:** The 3D anatomy of individual bones was generated from computerized tomography scans of a healthy foot. The bones were imported into the 3D design software SolidWorks (Dassault Systemes, Waltham MA) and positioned in a neutral foot position. Tension only force elements with an initial in situ strain represented ligament restraints. All joints other than the tibiofibular joint were defined by 3D articular contacts. Muscle forces were incorporated based on magnitudes from similar foot and ankle models (6). A 343 N compressive force was applied to the proximal tibial plateau to represent bodyweight on the limb segment. Models with and without muscle forces were run for the foot in a neutral position and 10° of inversion (lateral loading) or eversion (medial loading). The diastasis in the medial Lisfranc joint (key indicator in clinical settings) was recorded at three locations: Dorsal, interosseous, and plantar aspects of the joint (Figure A).

**Results and Discussion:** Without muscle forces (Figure B), inverted stance with the injury had less joint diastasis than the other two stances, particularly in the dorsal structure, and behaved more closely with the healthy foot. With muscle forces active (Figure C), the difference in diastasis of the injured foot to healthy was substantially lower than without muscle loading. Here, the neutral stance had the largest separation compared to a healthy foot, but now in the plantar structure. This suggests that the neutral foot position would present with the largest separation to identify the injury if patient muscles are contracting. One potential drawback in model assumptions is that the same muscle forces were used for the different stances which may not accurately reflect how patients adjust muscle loading and body position to alter foot position to reduce pain.

**Translational Impact:** These results show that if patients are introducing alternative loading into their stance when performing weight bearing radiographs in order to alleviate pain in the midfoot, key indicators of injury may be masked. These results may suggest wider use of local anesthesia so that patients are able to perform a neutral stance without pain or having to alter their foot’s orientation. This may help improve the likelihood of spotting signs of Lisfranc injuries.

**Disclosure Statement:** None

**References:**

A) Sagittal view of computational model and anteroposterior view of the mid and forefoot with the highlights of joint space where ligaments were transected/weakened (red line) and the dorsal diastasis distances measured (black bracket); B) Difference in diastasis measurements between the injured simulations and healthy neutral simulation without muscle forces; C) Difference in diastasis like Figure B but with muscle forces included for the healthy and injured simulations.