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Biomechanics of a Tendu Closing: Analyzing Knee Motion in 1st, 3rd and 5th Positions

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Biomechanics of a tendu closing: Analyzing knee motion in 1st, 3rd, and 5th positions

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A dancer will often perform 75 or more tendu closing actions during one technique class (ballet/modern). Ideally, the effectiveness of the tendu movement for strengthening the kinetic chain is achieved through maintaining a straight, well-aligned leg throughout the movement trajectory; however, visual observation indicates dancers often make unhealthy biomechanical adjustments (e.g. "screwing the knee") to accommodate the closing action, particularly in the 5th position front. Given the prevalence of lower body overuse injuries in dance and dance training methods being a risk factor, this study examined dancers' traditional, repetitive tendu training practice. This case study specifically investigated the biomechanics of dancers' knee motions during a tendu to the front in first, third, and fifth position closing traditionally with a flat foot/straight leg.

Thirteen undergraduate dance majors were recruited for this study under an approved IRB. The dancers' tendu movements were tracked using an 8-camera optical motion analysis system and knee angles were calculated in each position: 1st, 3rd, and 5th. To ensure reliability, dancers performed three trials and composite measurements were used. Dancers were also asked to verbally explain their closing strategies in the different positions, and describe associated bodily sensations. Verbal reports were recorded.

Results showed average ROM increases in degrees of knee flexion and rotation from 1st to 3rd to 5th in the traditional closing for both right and left legs (flexion: 6.9°, 10.3°, 12.03° rotation: 5.3°, 5.8°, 6.5°). Abduction angles in 1st, 3rd, and 5th were 2.3°, 1.6° and 1.9°, respectively. Dancers reported more difficulty and physical awkwardness/adjustment in pelvis, hips and knees during the 3rd and, particularly 5th position closing than in the 1st position.

The 1st position exhibited the least amount of knee flexion and rotation indicating that the dancer was able to more effectively perform the tendu movement in this position. This finding coincides with dancers' verbal descriptions and it further coincides with video observations of the dancers performing the 3rd and 5th closings, showing greater biomechanical accommodation throughout. A suggested intervention is to examine alternative 3rd/5th closings (e.g. relevé/plié) to strengthen the kinetic chain and reduce the need for potential injurious torque.