INFLUENCE OF GENERALIZED JOINT LAXITY ON LANDING GROUND REACTION FORCE IN BALLET AND MODERN DANCERS

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Introduction

Generalized joint laxity (GJL) is a condition in which most joints of the body move beyond the accepted normal range of motion. It allows for greater flexibility, which may be beneficial to athletes in certain sports [1], such as dance. GJL, however, is a common finding associated with musculoskeletal complaints and is a risk factor for injury [1]. Studies have shown that joint laxity is negatively correlated to strength [3]. Further, individuals with stronger muscles about the hip and knee joints have lower peak vertical ground reaction forces than those with weak muscles [4]. The ability to control landings with strength and stability is key to high level dance performance. The purpose of this study was to evaluate differences in peak ground reaction force (GRF; vertical, medial-lateral, and anterior-posterior), during landing, between dancers with and without GJL.

Methods

A convenience sample of twenty healthy female volunteers (age = 21 ± 2 yrs, height = 1.65 ± 0.07 m, weight = 57.0 ± 5.7 kg) were selected for testing, from the Dance Department at Brigham Young University and other local dance studios. Subjects were screened for GJL using the Beighton Scale for joint laxity [5]. 10 subjects with GJL scores of 6 or above and 10 without GJL (scores of 3 or below) were selected for testing.

Subjects performed 3 forward drop landings onto a portable force plate (Bertec Corporation, OH, USA). Participants were unshod, dropped from a height of 40 cm, and landed on one foot. Subjects were instructed to land on their dominant leg as normally as possible, without falling, stepping off the force plate, or touching down with the opposite foot or either hand for the 3 seconds following the landing. Peak GRF for each landing were found. Trials were averaged for each subject and group averages were compared.

Results

A between-subjects multivariate analysis of variance was performed using SPSS (version 25, IBM) to determine differences in peak GRF between the groups ($p<0.05$). No differences were found in peak GRF of landing in any direction between the GJL and control groups ($F_{5, 14} = 0.587$, $p = 0.71$, Wilks' $\lambda = 0.83$).

Discussion

We hypothesized that dancers with GJL would experience increased peak GRF in all directions when landing, but no significant differences were found. However, a visual comparison of the landing force patterns between the groups indicates further investigation may be warranted (Fig 1). Additionally, upon landing, the peak vertical and posterior GRF forces show higher variability in the GJL group than the control group (Table 1), as subjects within the GJL group appeared to utilize a variety of landing techniques.

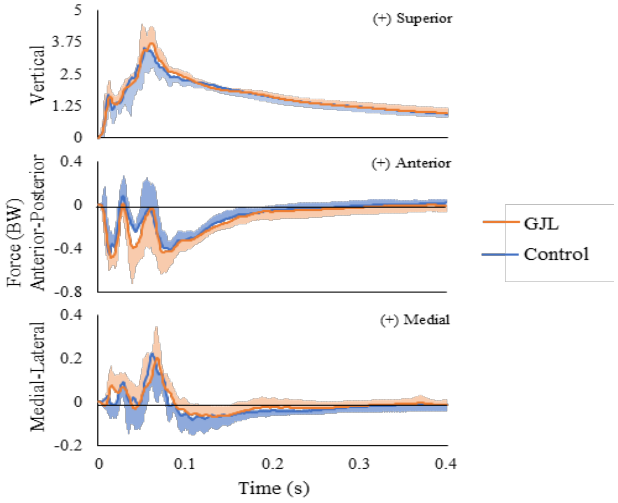

Figure 1: Group averages (±SD) of GRF (reported in body weights) following a drop landing.

Group	Vertical	Anterior	Posterior	Medial	Lateral
GJL	5.60 ± 1.31	-0.70 ± 0.16	0.52 ± 0.23	0.42 ± 0.12	-0.17 ± 0.06
Control	5.17 ± 0.82	-0.74 ± 0.17	0.41 ± 0.18	0.34 ± 0.13	-0.16 ± 0.05

Table 1: Averages (±SD) of peak GRF (reported in body weights) following a drop landing.

We believe the similarity in peak forces between groups is due to dancers' training and technique. Dancers are expected to control and soften their landings. GRF provides information about the load placed on the body, but lacks details related to landing technique. Further research describing 3D landing kinematics, joint moments, and muscle activation is required to determine if different landing techniques exist between dancers with and without GJL. These differences in technique may help attenuate forces similarly, but could also lead to overloading of bone and connective tissues, which may, over time, lead to injuries that affect performance.

References

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