

Leapin Leotards: An Assessment of Biomechanical Responses and Dancer Perception on Differing Floor Surfaces

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Background

Among dancers, musculoskeletal injuries are the most frequently reported medical problems, with 60-80% of dancers being affected (SHAPE, 2004). These injuries include strains and sprains of bones, muscles, tendons, ligaments, and soft tissues injuries. Flooring may be the most overlooked cause of dance injuries (Schoene, 2005). Since most injuries are from overuse, a hard, concrete floor or other solid surface would put the dancer at risk to increased stresses through the lower legs (Clifford, 2000). Stress injuries are commonly caused by impact since the floor may not provide absorption for the dancer and impact vibrations and energy will be directly returned to the body. Professional dance companies often travel with their own floor to use for rehearsals and performances because there are no standards for the perfect dance floor. The current DIN Standards for sport floors include requirements for Aerobic and Dance surfaces, but are highly criticized by American Society of Theatre Consultants because they are based on walking/running movements and do not reflect the complex biomechanics of dance (Revi, 1995).

Purpose

Dancers and teachers must be made aware of injuries, their causes, the need for proper treatment and rehabilitation, and the use of proper equipment, including flooring, to prevent injury and extend a dancers career. The purpose of this project was to compare the perception and the biomechanical responses of a dancer landing a leap on

two different dance floors. The results of this study may provide dancers with the information to advocate to studio owners for better flooring and to advocate for better national standards for dance floors.

Hypothesis

The hypothesis was that the body makes adjustments when landing a leap on different floor surfaces and that a dancer will prefer the flooring that requires making the least adjustments.

Procedure

The dancer with their parents reviewed the study and the parent signed the consent form. Six dancers landed a leap on two different dance floors. Both floors were layered with cement, wood, under pad, and a Marley Vinyl surface, but only one floor included a layer of foam sponge. A force plate could not be obtained and therefore a spring scale was used innovatively to measure weight of landing the leap and ground reaction force was calculated using:

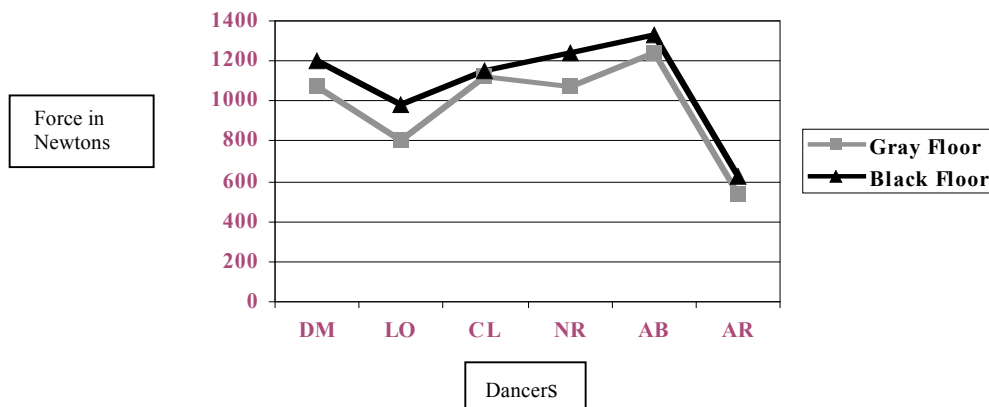
$$\text{Force (Newtons)} = \text{mass (kilograms)} \times \text{acceleration (9.8 m/s}^2\text{)}$$

Permission was also declined to complete the study at a local Human Movement Laboratory and again an innovative approach to looking at the biomechanical changes was used. To measure the angle at the hip, knee and ankle, dancers were video taped performing a demi-plié and grand-jeté. The video images were transferred to a computer and joint angles were measured using a protractor. The dancers also completed a survey about perceived work completing the leap and preference of landing surface. Dance studios were surveyed by phone and asked what type of dance floor surfaces/sub-floors they had.

Results

There was a greater ground reaction force for every dancer landing on the black floor, without the sponge sub-floor as shown in Figure 1. The average ground reaction force of the dancers landing a grand-jeté on the gray (foam) floor was 973.5 Newtons and 1091.1 Newtons landing on the black dance floor.

Figure 1: Ground Reaction Force on Landing



All of the dancers had a change in the angle at the knee landing on both floors when compared to their demi-plié at rest. This is expected as a dancer does absorb some of the landing when countering the ground reaction force of the floor. Fifty percent (3/6) of dancers made adjustments at the knee (Figure 2) landing on the black dance floor and 83% (5/6) of dancers made adjustments at the ankle (Figure 3) landing on the black dance floor. All of the adjustments were the creation of a smaller angle in the joint to absorb more of the landing. The hip adjustments were erratic with a loss of upper body control and compromised technique as the dancers focused more on correcting and absorbing their landing. Fifty percent of dancers increased the angle and 17% decreased the angle on the black dance floor. Thirty-three percent did not change their hip angle when landing on either dance floor.

Figure 2: Angle measured at the knee on landing

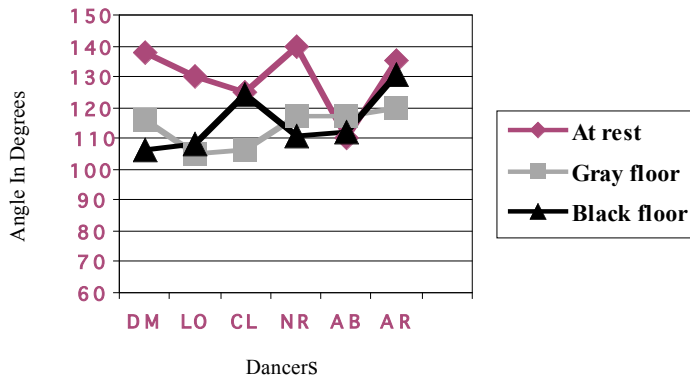
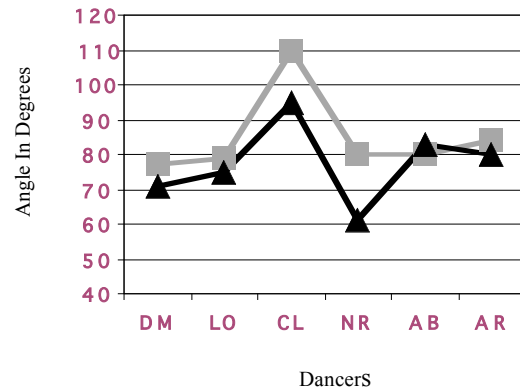


Figure 3: Angle measured at the ankle on landing



Conclusions

All of the dancers experienced a greater ground reaction force on the black dance floor than on the gray dance floor. This can be explained by the sponge foam in the gray dance sub-floor absorbing some of the force on the landing by channeling the impact vibrations through the floor and away from the body. My hypothesis was correct in that fewer joint adjustments were made on the gray sponge dance floor and all of the dancers preferred it. Despite the importance of proper flooring to minimize injuries to dancers, a survey of 13 local dance studios indicated that only 15% had proper flooring.

Good flooring should be resilient, shock absorbing, and have surface friction. The average age of retirement for dancers is the mid-to-late twenties, similar to professional football players (SHAPE, 2004). With better flooring, their careers might be extended. I feel that more research needs to be done to determine the proper type of dance floors/sub-floors that should be used for each style of dance and that standards should

be developed taking into consideration the complex biomechanics of dance.

Professional dancers must advocate to improve their working conditions in order to prevent further injuries. Young dancers are particularly vulnerable to injury and should take classes under the guidance of qualified instructors and in studios with appropriate flooring.

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Proof of Requirements

Any necessary display equipment certifications were obtained and will be part of the display. Approvals for human or animal research and certifications from recognized institutions and/or scientific mentors will be available at the display.

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