Impact Forces of Jump Landings Between Beginner and Elite Dancers

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Abstract

Introduction: Unlike most athletic activities, dancers complete the vast majority of their training by concentrating solely on dance technique, with very little to no other forms of exercise. This limitation obviously increases probability of excelling in dance, however it can pose some obstacles in regards to the overall health and sustainability of the dancer, in particular to the joints. Jumping is an integral part of dance technique and as they advance in training, dancers are taught many forms of jumps, but may not be aware of the amount of force absorbed by the joints upon landing.

Purpose: The purpose if this study was to compare the impact force upon landing between beginner and elite trained dancers.

Methods: 11 beginner (6 female, 5 male; age 17 ± 1.91 yr; weight 69.745 ± 13.587 kg; height 1.618 ± 0.091 kg; height 1.618 ± 8.211m) dancers participated in this study. The knee angle of each subject’s maximum plie was measured along with their maximum jump height. Each subject performed three trials of 2 different jumps (ballonne and soubresaut) on a force plate at their maximum height where their impact force during landing was recorded and analyzed.

Results: There was a significant difference in impact force between the beginner and elite dancers while executing both jumps (soubresaut beginner 3.288 ± 0.3685 (BW) elite 3.7059 ± 0.4971 (BW); balone beginner 2.3672 ± 0.4249 elite 2.2992 ± 0.7116 (BW)) when controlling for the angle of plie depth. There was no significant difference in impact force for soubresaut, however there was significant difference in impact force between the two groups for ballonne, when controlling for jump height. The elite group had a significantly higher jump height (0.350 ± 0.0766m) than the beginner group (0.296 ± 0.0758m). Beginner dancers had a maximum depth of plie 136 ± 14.6553° and elite dancers had a maximum depth of 122.0833 ± 10.128°.

Conclusions

The elite dancers exerted more force than the beginner dancers when performing both jumps when confounding variables were taken out of the analysis. This could be due to the fact that the elite dancers weighed more and jumped higher than the beginner dancers. The elite dancers also had a more acute angle of plie depth than the beginners, thus allowing for more elastic energy to be stored in the Achilles tendon, which possibly increases the height of the jump.

<table>
<thead>
<tr>
<th>Group</th>
<th>Height</th>
<th>Weight</th>
<th>Jump Height</th>
<th>Knee Angle</th>
<th>Impulse Force</th>
<th>Impact Force</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginner</td>
<td>1.707 ft x 0.004m</td>
<td>69.745 kg</td>
<td>3.288 ft</td>
<td>0.4798°</td>
<td>1.90 ft</td>
<td>3.706 ft</td>
</tr>
<tr>
<td>Advanced</td>
<td>8.211m</td>
<td>0.296 ft</td>
<td>0.0766m</td>
<td>0.350 ft</td>
<td>136°</td>
<td>0.4249 ft</td>
</tr>
</tbody>
</table>

The subjects reported to the biomechanic lab where they familiarized themselves with the force plate and warmed up with their normal routine. The subjects first performed a demi-plie and a goniometer was used to measure the maximum angle of each subject’s right knee joint. The subject performed 2 basic dance movements which were assigned a random order. The movements were ballonne and soubresaut. The ballone and soubresaut were chosen because they are jumps that are taught to dancers early in their training and are jumps that are used in several genres of dance. A ballone is a jump during which the dancer begins in 5th position performing a demi-plie and springs into the air, extending one knee either in front, back or to the side and landing on the foot that was held straight. A soubresaut is a jump where the dancer begins in 5th position with legs and feet together. Then he performs a demi-plie and jumps vertically into the air, keeping the legs and feet together while extending the ankle and lands on both feet back in 5th position. A good trial consisted of a take-off from the maximum demi-plie angle and landing completely on the force plate without movement of the legs after landing. In addition, there had to be a minimum of 200 ms of landing data collected by the force plate. Each subject performed both jumps with 3 trials being recorded landing on the force plate. All acceptable trials were used for statistical analysis.

To assess jump height, a tape measure was mounted to the floor next to the force plate and the tape end attached to waist to the subject. Height of jump was determined to be the difference between the measure of tape before and after the jump.