ATTENUATION OF GROUND REACTION FORCES IN SALTO DISMOUNTS FROM THE BALANCE BEAM

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INTRODUCTION

Epidemiological studies have documented the incidence of injuries in female gymnasts. In comparison to other sports, the incidence of injury in gymnastics is high. One epidemiological study prompted the author to state "women's gymnastics should be recognized as a hazardous sport" (Snook, p. 242). To understand the etiology of injury, researchers (e.g., Caine, Cochrane, Caine & Zemper, 1989; Clark & Buckley, 1980; Garrick & Requa, 1980; Garrick & Requa, 1978; Lindner & Caine, 1990; Lowry & Leveau, 1982; Martin, Yesalis, Foster & Albright, 1987; Pettrone & Ricciadelli, 1987; Sands, 1985; Sands, Newman, Harner, Paulos & Shultz, 1987; Snook, 1979; Splain & Rolnick, 1984; Vergouwen, 1986; Weiker, 1985; Zaricznyj, Shattuck, Mast, Robertson & Delia, 1980) have identified injuries by sites, types, and/or events (floor exercise, uneven bars, vault, and balance beam). Dismounts, considered an element of all events, have drawn attention as an injury mechanism. Studies have shown the dismount, especially when gymnasts attempt to "stick" their landing, to be a major component of the incidence of injury. The purpose of this study was to determine and compare the ground reaction forces (medial-lateral, anterior-posterior, and vertical) in sticking and rolling out of front and back salto dismounts from the balance beam. It was the belief of the authors that, by appropriately using a forward or backward roll out of a salto dismount, ground reaction forces could be attenuated and possibly reduce the incidence of overuse injuries.

METHODS

The recruitment of subjects for this study was in accord with the policies of the University Committee on Research Involving Human Subjects at Michigan State University. Potential subjects were identified through coaches at youth gymnastics clubs. After completing informed consent forms, subjects were invited to campus to receive a medical screening administered by a sports medicine physician. Those passing the medical screening were permitted to participate in the dismount phase of this study. An initial study (Brown, Witten, Espinoza, Witten, Wilson, Wisner, Weise & Learman, in press) of these subjects was conducted on the ground reaction forces associated with sticking and rolling out of roundoff and barani dismounts from the balance beam. Ground reaction forces of salto dismounts from six subjects, ranging in age from 131 to 184 months and in skill level from 7 to 10, provided the data for the current study.

Table 1 Average Maximal Ground Reaction Force

<table>
<thead>
<tr>
<th>Style of Landing</th>
<th>Type of Dismount</th>
<th>(n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>back salto</td>
<td>cartwheel</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>back salto</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>front salto</td>
<td>2</td>
</tr>
</tbody>
</table>

*Absolute value used.

CONCLUSION

The results of the investigation (Brown, Wisner, D. M., Weise, M., & Learman, in press) of ground reaction forces in dismounts from the balance beam indicate that subjects in the back salto, cartwheel back salto. To normalize in units of body mass, vertical ground reaction forces (as magnitude) are substantial for both styles of dismounts. Mixed results indicate that ground reaction forces could be attenuated and possibly reduce the incidence of overuse injuries.

REFERENCES

After warming up, subjects practiced dismounting onto a specially designed gymnastics mat that was adhered via double-sided carpet tape to an AMTI force platform. This mat was surrounded by and isolated from other matting of the same material. Subsequently, subjects were asked to perform two types of salto dismounts (front and back) from the balance beam and to complete each type with two different styles of landing (stick and roll out). If a subject had a force records from both styles of landing for the front and/or back salto, their data was included for further analysis.

RESULTS

Ground reaction forces were recorded for both styles of dismount for four subjects in the back salto, two subjects in the front salto, and two subjects in the cartwheel back salto. Table 1 contains a summary of the ground reaction forces normalized in units of body weight. The results indicate that, by rolling out of the landing, vertical ground reaction forces (force component with the greatest magnitude) are substantially reduced for all types of salto dismounts that were investigated. Mixed results were obtained for medial-lateral and anterior-posterior ground reaction forces.

<table>
<thead>
<tr>
<th>Ground Reaction Force:</th>
<th>medial-lateral*</th>
<th>anterior-posterior*</th>
<th>vertical*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Style of Landing:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>stick</td>
<td>2.33</td>
<td>2.44</td>
<td>9.09</td>
</tr>
<tr>
<td>roll</td>
<td>3.01</td>
<td>2.16</td>
<td>8.40</td>
</tr>
<tr>
<td>back salto (n=4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of Dismount:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cartwheel back salto</td>
<td>0.42</td>
<td>2.99</td>
<td>9.41</td>
</tr>
<tr>
<td>back salto (n=2)</td>
<td>0.73</td>
<td>1.99</td>
<td>7.55</td>
</tr>
<tr>
<td>front salto (n=2)</td>
<td>0.80</td>
<td>1.23</td>
<td>12.83</td>
</tr>
<tr>
<td></td>
<td>0.32</td>
<td>0.74</td>
<td>9.41</td>
</tr>
</tbody>
</table>

*Absolute value used.

CONCLUSION

The results of this study, in combination with the findings of a previous investigation (Brown, Witten, Espinoza, Witten, Wilson, Wisner, Weise & Learman, in press) of ground reaction forces in sticking and rolling out of roundoff and barani dismounts from the balance beam, support the authors' contention that ground reaction forces could be attenuated and possibly reduce the incidence of overuse injuries in female gymnasts.

REFERENCES


Acknowledgment

Support for this project was provided by American Athletic Inc. of Jefferson, Iowa. The authors wish to thank Mr. Larry Fie for the design and fabrication of the mat used to isolate the force platform from the surrounding matting.

INTRODUCTION

Olympic diving

This paper will concentrate on two groups of inward dives: the (103B), forward dive with 2½ piked somersault (403B), inward full somersault.

For purposes of this paper, the approach, contact, take-off, and flight of the diver will not be described in detail. The focus will be on the conditions of an effective take-off, the flight of the diver, and the techniques used to establish the momentum created during the approach and take-off, as well as the flight of the diver.

METHODS

Biomechanical analysis of the subject's body mass center is used in this study. The data collection and recording is done by an electric analyzer and observers. The methods used in this study have been described by Miller (1974).

DATA COLLECTION

The set-up of the equipment, established in other research, is a description of the side of the platform, the plane of the pool, and the height of the pool. The surveying process on the tripod ensured that the plane of the pool was parallel to the plane of the platform. The surveying process on the tripod ensured that the plane of the pool was parallel to the plane of the platform.