CHANGES IN THE POSTURAL SWAY IN ELITE SYNCHRONIZED SWIMMERS

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SUMMARY
The purpose of this study is to examine the postural sway in synchronized swimmers. Twenty-three female synchronized swimmers (international level) participated in this study. Postural sway was measured by a piezo-electric force platform (9281E, KISTLER, Swiss). The synchronized swimmers were more superior in the total length (LNG) of COP displacements (elite: Open eyes LNG: 26.15±7.96cm, Closed eyes LNG: 36.32±11.36cm, junior: Open eyes LNG: 30.48±7.43cm, Closed eyes LNG: 36.04±10.35cm). The synchronized swimmer had a short LNG in comparison with the normal student. In addition, the LNG in open eyes standing position was significantly shorter in the elite synchronized swimmer than in the junior synchronized swimmer. On the other hand, there was no significantly difference in the LNG during closed eyes. It is clear that the elite synchronized swimmers had high balance ability during the static standing position. In the present study, we confirmed that the elite synchronized swimmers can be superior in balance maintenance by the optic nerve and vision. From our results, it was shown that well-trained synchronized swimmers improved their balance ability level during the year.

INTRODUCTION
Postural sway has been used as a number of maintenance of stabilization. An athlete must have good ability for balance to move during a competition efficiently. In sports activity, it is important that muscular strength is coordinated as well. In particular, muscle coordination during aquatic sports (swimming, water polo, synchronized swimming) were most important factor to improve human performance. The control of local muscles during sports performance and daily living activity serves to stabilize a body during these maneuvers. Synchronized swimmers must perform the technical and free routines while holding their breath, and these routines contain high-intensity movement, which suggests a high anaerobic energy involvement. The synchronized swimming must perform while keeping balance underwater. No previous studies appear to have been made to compare the postural sway of elite and junior synchronized swimmers. The purpose of this study is to examine the postural sway in synchronized swimmers.

METHODS
Twenty-three female synchronized swimmers (international elite level and junior international level) participated in this study (Table. 1). Postural sway was measured by a piezo-electric force platform (9281E, KISTLER, Swiss). To measure the balance ability, the center of pressure (COP) displacement of the ground reaction force was recorded at a frequency of 20 Hz while the subjects were taking static standing position with opened eyes or closed eyes on the force platform for 30 seconds. The total length of COP displacements (LNG) and total movement area of COP (environmental area: ENV. area, rectangle area: REC. area) were calculated as an indicator of the balance ability. On the physical fitness test, the reaction time, flexibility, standing-broad-jump, side-jump, vertical jump and stepping were analyzed. Postural sway and physical fitness tests were repeated one year after the first ones.

RESULTS AND DISCUSSION
The synchronized swimmers were more superior in the total length of COP displacements (elite: Open eyes LNG: 26.15±7.96cm, Closed eyes LNG: 36.32±11.36cm, junior: Open eyes LNG: 30.48±7.43cm, Closed eyes LNG: 36.04±10.35 cm, Fig. 1). The total area of COP displacements (ENV. area) showed 0.91±0.60 cm² (elite) and 1.39±0.77 cm² (junior) in open eyes static standing position (Fig. 2). The total area of COP displacements (REC. area) showed 2.29±1.48 cm² (elite) and 3.83±2.56 cm² (junior) in open eyes static standing position (Fig. 2). Average values and SD of percentage of center of gravity (anatomical posture) and percentage of center of gravity (both hand-up posture) were 53.3±0.8% and 57.0±0.7%, respectively. The results confirmed that the magnitude of the postural sway in synchronized swimmers depends on their physical fitness level. The total area of COP displacements (ENV. area) in the second test was significantly smaller than in the first test (Fig. 3). On the other hand, the total length of COP displacements was no significantly difference in the first test and second test (Fig. 4). From our results, it was shown that well-trained synchronized swimmers improved their balance ability level during the year.

Table 1: Physical characteristics of the subjects.

<table>
<thead>
<tr>
<th>Group</th>
<th>Elite</th>
<th>Junior</th>
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</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>18.0 (1.7)</td>
<td>15.4 (1.5)</td>
<td></td>
</tr>
<tr>
<td>Height (cm)</td>
<td>162.1 (3.0)</td>
<td>159.4 (5.4)</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>52.8 (2.4)</td>
<td>46.2 (6.2)</td>
</tr>
<tr>
<td>BMI (kg/m2)</td>
<td>20.0 (1.8)</td>
<td>18.2 (2.4)</td>
</tr>
<tr>
<td>%fat (%)</td>
<td>17.3 (3.8)</td>
<td>15.1 (5.2)</td>
</tr>
</tbody>
</table>
CONCLUSIONS
The synchronized swimmer had a short LNG in comparison with the normal student. In addition, the LNG in open eyes standing position was significantly shorter in the elite synchronized swimmer than in the junior synchronized swimmer. On the other hand, there was no significantly difference in the LNG during closed eyes. It is clear that the elite synchronized swimmers had high balance ability during the static standing position. In the present study, we confirmed that the elite synchronized swimmers can be superior in balance maintenance by the optic nerve and vision.

REFERENCES