Postural Control in Table Tennis Players on Multiaxial Support Surface

Kuang-Tsan Hung, Jia-Hong Chu, Yi-Jia Lin, and Chung-Hsieh Wu

1 General Education Center, De-Ling Institute of Technology, Taiwan, R.O.C.
2 Department of Computer Science, Thompson Rivers University, Canada
3 Graduate Institute of Physical Education and Health, Taipei Physical Education College, Taiwan, R.O.C.
4 School of Chinese Medicine, Chinese Medical University, Taiwan, R.O.C.

SUMMARY
Biodex balance system (BBS) is an objective and quantitative method for evaluating postural stability revealed by total stability, stability in the anterior-posterior direction, and stability in the medial-lateral (ML) direction. Besides many well known physical characteristic in table tennis player such as reaction ability, eye-hand coordination, a good table tennis player also have general balance and good footwork to move from one side of the table to the other with small steps and subtle shifts in balance and weight, especially in the ML direction. To the best of our knowledge, a study depicting the postural control in table tennis players does not exist in the literature. We aimed to determine dynamic postural stability in the table tennis athletes. Ten young table-tennis players and young controls participated in the present study. BBS was used to assess balance and neuromuscular control with a movable balance platform. Postural balance in table tennis athletes using the BSS showed that the postural stability of table tennis players were better than that of the normal control in the ML stabilities might reflect the nature of table tennis playing that requires mostly ML directional movement of players.

INTRODUCTION
Stabilometry is an objective and quantitative method for evaluating postural stability [1]. Stabilometry studies were performed on a static force plate while, recently, dynamic mobile platforms have been developed to evaluate postural and directional control response to different levels of perturbation. These measures of stability can be reported as total stability, stability in the anterior-posterior (AP) direction, and stability in the medial-lateral (ML) direction. Arnold et al studied an uninjured population of male and female athletes and determined that there is a close relationship between total stability and AP stability, but not between total stability and ML stability. The authors concluded that there is a need for individual evaluation of each component of postural stability to determine deficits in each plane [2]. Unlike high impact sports, table tennis is a low impact sport that appeals to a lot of people. Despite it’s relatively lower physical requirements however, table tennis does place certain demands on players to be able to intercept a small, high speed ball and hit it properly so that it can be sent back at good position and angle. Besides many well know physical characteristic in table tennis player such as reaction ability, eye-hand coordination, a good table tennis player also have general balance and good footwork to move from one side of the table to the other with small steps and subtle shifts in balance and weight. These movements are much smaller than the wider general gross movements made in other sports like running or basket ball, especially in the medial-lateral direction [3]. To the best of our knowledge, a study depicting the postural control in table tennis players does not exist in the literature. We report herein the results of our investigation to determine dynamic postural stability in the table tennis athletes. Considering the frequently side-to-side movement during table tennis playing, we hypothesized that table tennis athlete would display superior postural and directional control in the frontal plane postural stability.

METHODS
Ten young table-tennis players (age: 21.13 ± 1.17 years, height: 169.40 ± 5.35 cm, weight: 64.53 ± 10.03 kg) and age-matched healthy young controls participated in the present study with written informed consents.

To assess balance and neuromuscular control, this study used a commercially available balance device, the BSS (Biodex Medical Systems, Shirley, NY, USA), which consists of a movable balance platform that provides up to 20° of surface tilt in a 360° range of motion. The subject was instructed to stand on 1 foot with the knee slightly flexed and with the free-moving stability platform, with the contralateral knee flexed to 90° for 20 seconds. The subjects were instructed to cross their arms at their chest to minimize their use in attaining balance. Total stability index, AP stability index, and ML stability index were obtained by the mean displacement of the platform in degrees, from a level position. A higher stability index from the reference point indicates a greater difficulty of the subject to maintain the platform in a stable position. This indicates less postural stability demonstrated by the subject. Conversely, the lower the stability index, the more stable the platform, representing greater postural stability of the subject.
The differences between athlete group and control group were analyzed using independent t-test with level of significance set at 0.05 using SPSS 15.0.

### RESULTS AND DISCUSSION

Dynamic postural stability results in the groups during static platform are shown in Figure 1. Similar to previous findings, our findings further confirm the need to evaluate total stability, AP and ML stability independently as the results of them were different between each another. It is showed that table tennis athlete may have no superior dynamic postural stability in the AP direction during static supporting surface condition.

**Figure 1:** Mean total stability index, AP stability index, and ML stability index for the right and left lower extremity during static platform condition. The error bars are 1 SD.

During level 8 condition, the results of group comparison were similar to those found during static condition (Table 1). However. During level 4 (more unstable) condition, the total and ML stability indices in the player group were significantly higher than in controls. The lower stability index measurements of the table tennis players reflect their statistically superior single-legged balance ability in the ML direction compared with the normal controls. This superior dynamics balance control can be detect statistically in a more challenging platform movements.

Considering the frequently side-to-side movement during table tennis playing, the quality of sensory information and disrupt the relation between postural responses and sensory information maybe different from normal controls. Muscle imbalance in hip abductors maybe one reason.

### Table 1: Stability index during left limb support at level 4 and level 8.

<table>
<thead>
<tr>
<th>Level</th>
<th>Stability Index During Left Limb Support</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Level 4</td>
</tr>
<tr>
<td>Group</td>
<td>Player</td>
</tr>
<tr>
<td>Total</td>
<td>1.7± 1.2</td>
</tr>
<tr>
<td>AP</td>
<td>2.7± 1.7</td>
</tr>
<tr>
<td>ML</td>
<td>1.5± 0.2*</td>
</tr>
</tbody>
</table>

The fact that in this study there was significant difference in ML stability index and no significant difference in AP stability index between groups may be because of their muscular strength difference in the frontal plane. The fact that only ML indices were different may be attributed to the inadequacy of the training level in improving the stability level. Another reason may be due to the character of the game itself. As it is known, in table tennis, the players try to hit the ball by opponents, by going or sometimes jumping to the sides. In other words, a side movement is always present in the game. The results also raise the question of the role of practice and training in producing skilful performance.

### CONCLUSIONS

In conclusion, we determined postural balance in table tennis athletes using the BSS. Dynamic postural stability is affected by the degree of multiaxial movements. The postural stability of table tennis players was demonstrated to be better than that of the normal control in the ML stabilities might reflect the nature of table tennis playing that requires mostly ML directional movement of players.

### REFERENCES