INTRODUCTION:
Evidence shows a carefully designed anterior cruciate ligament (ACL) injury prevention program can reduce the incidence [1-4]. As Dr. Ireland noted, injury prevention programs may be received more warmly if the program is presented with the emphasis on performance improvement [5].

We invented a training device (Realine BalanceShoes (RBS), GLAB Co., Hiroshima, Japan), which is a sandal-like balancing device attached to athletes’ feet with shoes (Fig 1). Since the balancing axis is located underneath the 4th lay of the foot, a knee-over-the-toe position is involuntarily reproduced in various weightbearing exercises by aiming at maintaining the sole of the RBS horizontal. Effects of RBS training programs are being studied in variety of spots and age groups.

The purpose of this study was to examine the effect of a 15-minute warm-up program using the RBS (GLAB program) on measures of athletic performance in young athletes. The hypothesis was that significant improvements in measures of performance would be demonstrated in young volleyball players.

METHODS:
A single-blind randomized controlled trial was performed to evaluate changes in athletic performance. Enrolled in this IRB-approved study were forty-one young volleyball players (23 males, age: 20.0 ± 1.0 yo, weight: 74.9 ± 9.1 kg, height: 181.0 ± 7.6 cm; 18 females, age: 17.0 ± 1.0 yo, weight: 57.8 ± 4.6 kg, height: 163.1 ± 3.9 cm) from 2 teams. All athletes and their parents read and signed an informed consent form prior to the enrollment. All athletes were free from any injury or illness that limited regular volleyball activities at the time of initial testing, and were randomly allocated to either the intervention (n=21) or control (n=20) group.

The both groups underwent blinded performance measurement sessions before and after the 4-week intervention period and the vertical jump height and single-leg hop distance were measured. The vertical jump was measured using the JUMP MD jump meter (Takei Scientific Instruments Co., Ltd., Nigata Japan). The athletes were instructed to stand with their feet shoulder width apart, followed by performing 2 maximal vertical jumps. An arm swing was allowed, but approach steps were not. The highest jump of 2 trials was recorded. The single-leg hop distance was measured using a tape measure. The athletes stood on one leg and hopped forward as far as possible, landing on the same leg. The trial was accepted only if the landing step was securely stable for 3 seconds. The farthest distance (heel-to-toe) of 2 trials was recorded for each leg.

The intervention group performed the GLAB program as a part of their warm-ups. The GLAB program is consisted with a 4-staged progressive exercise program wearing the RBS, involving slow weightbearing exercises, explosive plyometric activities and single-legged exercises. The control group performed same exercises without wearing RBS. Each session lasted less than 15 minutes, and was executed 3 times a week for 4 weeks. A physical therapist supervised all sessions and corrected inappropriate techniques if necessary.

Student’s t-tests were used to compare values for the intervention and control groups to determine statistical significance. Paired t-tests were used for within-group comparisons. Bonferroni corrections were used for a multiple-comparison correction. The level of significance was set at P < .05.

RESULTS:
Twenty-one and 20 athletes were allocated to the intervention and control groups, respectively, and there were no significant differences in participants’ age, height and weight between the groups (Table 1).

Average increase in vertical jump height and single-leg hop distance (right and left) for the intervention group were 6.5 ± 4.8 cm (P < .001), 9.6 ± 11.3 cm (P < .001), and 9.8 ± 12.1 cm (P < .001), respectively. Corresponding values for the control group were 2.3 ± 3.1 cm (P = .003), 6.4 ± 9.8 cm (P < .008), 0.5 ± 12.6 cm (P = .87). Between-group comparisons indicated the GLAB program resulted in greater improvements in vertical jump height and left single-hop leg distance as compared with the control program (P = .002, .019, respectively) (Table 2).

DISCUSSION:
The result of this study showed that the GLAB program using the RBS improved athletic performance after a total of only 180 minutes. A noteworthy is an increase of the vertical jump height by 6.5 cm, which is, to our knowledge, most efficient improvement of athletic performance after an ACL injury prevention program [6, 7]. The findings in this study would be helpful in promoting injury prevention program to athletes and coaches.

The RBS provides multiple modes of effects on athletes including strengthening and plyometric trainings, feedback (proprioception) and feed-forward neuromuscular controls, and realigning effect on joints in the lower quarter with the optimized muscle coordination. A laboratory study is undergoing to reveal biomechanical and neuromuscular adaptations. Future study should include the effects of the RBS training on correcting dynamic valgus during sports. Further work is needed to determine if this program is effective in preventing ACL injury.

To conclude, the GLAB program is effective on improving athletic performance in 4 weeks in young volleyball players.

Table 1. Subject demographics

<table>
<thead>
<tr>
<th></th>
<th>RBS</th>
<th>Control</th>
<th>P</th>
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<tbody>
<tr>
<td>Age (yr)</td>
<td>18 ± 2</td>
<td>19 ± 2</td>
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</tr>
<tr>
<td>Height (cm)</td>
<td>172.7 ± 9.3</td>
<td>173.7 ± 12.6</td>
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<tr>
<td>Weight (kg)</td>
<td>66.5 ± 9.5</td>
<td>68.4 ± 13.2</td>
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Table 2. Average increase of vertical jump and single-leg hop

<table>
<thead>
<tr>
<th></th>
<th>RBS</th>
<th>Control</th>
<th>P</th>
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</thead>
<tbody>
<tr>
<td>Vertical Jump (cm)</td>
<td>6.5 ± 4.8</td>
<td>2.3 ± 3.1</td>
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<tr>
<td>Single-Leg Hop (cm) Right</td>
<td>9.6 ± 11.3</td>
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<tr>
<td>Single-Leg Hop (cm) Left</td>
<td>9.8 ± 12.1</td>
<td>0.5 ± 12.6</td>
<td>.019</td>
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REFERENCES: