ANALYSIS OF THE APPROACH RUN IN THE JAPANESE JUNIOR TRIPLE JUMPERS

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INTRODUCTION

In the horizontal jump events like long jump and triple jump, it has been pointed out the importance of the approach run to achieve superior performance. Therefore, many studies on the approach run in the triple jump and long jump had been done mainly focusing on the change of the stride length and approach velocity during the approach run. Recently, some scientific studies investigated characteristics of the approach run for the long jumpers focused on the step frequency, supporting time and non-supporting time. By analyzing these parameters, interesting findings on the approach run of the elite long jumpers were reported. For example, Omura et al. (2001) investigated the approach run of the Women’s long jumpers at 2000 Sydney Olympic game, and reported that Drechsler (GER, 6.99m) had won the gold medal when she showed the smoothest change of step frequency and the supporting time during the approach run in her six trials. Also, the step frequency of the approach run was the highest in Jones (USA, 3rd place with 6.92m) who had many fouls, and the lowest in May (Italy, 2nd place with 6.92m) who had no foul. Furthermore, Omura et al. (2002) investigated Japanese men and women’s junior long jumpers at 2001 Japan High School Track & Field Championships, and reported that Japanese men’s junior long jumpers tended to show shorter supporting time at the last part of run-up compare to the Japanese elite long jumpers. Also, Japanese junior women’s long jumpers tended to show large variance of step frequency during the approach run. These results suggested that analyzing the parameters such as step frequency and supporting time may be useful to clarify a desirable run-up pattern and the problem of a run-up for each jumper. However, there are few data of these parameters concerning the junior triple jumpers.

The purpose of this study was to investigate the approach run of Japanese junior triple jumpers to obtain the fundamental findings on effective approach run for the junior triple jumper

METHODS

Eight junior men’s triple jumpers, with personal best records ranging from 14.72m to 15.50m, were filmed at the final of 2001 Japan High School Track & Field Championships (August 2nd to 8th) by the Biomechanical Project team of the Japan Amateur Athletic Federation. The whole of the steps of the approaches were recorded using a panning digital video camera (60f/s) placed on the stadium beside the runway. The best trials of each jumper were analyzed using FRAME DIAS system (DKH Co., Japan), and calculated following parameters: step length, step frequency, supporting time, non-supporting time. Air Ratio, dividing the non-supporting time by the supporting time (Hayashi et al., 2000), was also calculated. Step frequency was defined as one cycle from the right (left) foot-off to the left (right) foot-off in the next step. Approach velocities were measured by Laveg Sport (Henley Japan Co., Japan) placed on the stadium behind the jumper.

RESULTS AND DISCUSSION

Table 1 showed the results of the eight triple jumpers at the final of the Championship. Most of the jumpers (six of eight jumpers) achieved their best record in the competition during the first half of the trials: three jumpers achieved the best record in their first trial and another three jumpers achieved the best record in their second trial. Similar trend was observed in the final of the men’s long jump event at the same Championship, and also in the final of the men’s long jump and the triple jump at the 2002 Japan High School Track & Field Championships. These results might be due to a climate with high temperature and high humidity in August of Japan. In fact, the maximum temperature is normally more than 30 degrees during this Championship every year, and the temperature at the beginning of the triple jump final of the 2001 Championship was 35.0 degrees. These results may suggest that performing a good record during the first half of the competition is the key point for junior jumper to win the competition held under the difficult environmental condition with high temperature and high humidity.

Table 1 Results of the Meet

<table>
<thead>
<tr>
<th>Order</th>
<th>Name</th>
<th>record</th>
<th>-1-</th>
<th>-2-</th>
<th>-3-</th>
<th>-4-</th>
<th>-5-</th>
<th>-6-</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>S</td>
<td>M</td>
<td>15m50×</td>
<td>15m50</td>
<td>14m58</td>
<td>14m94</td>
<td>15m39</td>
<td>15m38</td>
</tr>
<tr>
<td>2</td>
<td>Y</td>
<td>K</td>
<td>15m41×</td>
<td>14m92</td>
<td>15m41</td>
<td>14m94</td>
<td>15m16</td>
<td>×</td>
</tr>
<tr>
<td>3</td>
<td>H</td>
<td>S</td>
<td>15m16×</td>
<td>14m74</td>
<td>14m73</td>
<td>15m03</td>
<td>15m16</td>
<td>14m85</td>
</tr>
<tr>
<td>4</td>
<td>H</td>
<td>G</td>
<td>15m05×</td>
<td>15m05</td>
<td>13m97</td>
<td>14m68</td>
<td>14m51</td>
<td>×</td>
</tr>
<tr>
<td>5</td>
<td>N</td>
<td>W</td>
<td>14m92×</td>
<td>14m74</td>
<td>14m78</td>
<td>14m75</td>
<td>14m92</td>
<td>14m90</td>
</tr>
<tr>
<td>6</td>
<td>S</td>
<td>O</td>
<td>14m81×</td>
<td>14m81</td>
<td>14m61</td>
<td>14m79</td>
<td>×</td>
<td>14m59</td>
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<td>I</td>
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</tr>
<tr>
<td>8</td>
<td>M</td>
<td>K</td>
<td>14m72×</td>
<td>14m65</td>
<td>14m72</td>
<td>14m21</td>
<td>14m43</td>
<td>14m70</td>
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Figure 1 showed the change in the approach velocities of the top three jumpers during the approach run. The X-axis represents the distance of the approach, and zero means the takeoff. The maximum approach velocities of the top three jumpers were ranging from 9.6m/s to 10.1m/s for the best records ranging from 15m50 to 15m16. These values were
lower than those of the Japanese elite triple jumper (10.44m/s of Sugibayashi for 16m78) and the World’s elite triple jumper (10.75m/s of Conly for 17m86). And also, these values were lower than those of Japanese junior long jumpers (ranging from 10.1m/s to 10.7m/s for the best records ranging from 7m56 to 7m43). Since the winner of this Championship showed the lowest approach velocity (9.6m/s) among top three jumpers, improving run-up velocity will be his major task to achieve better performance in the future. Another two jumpers in the top three decreased their approach velocities during the last part of the approach run. On the contrary, World top jumpers, such as Edwards (England, personal best of 18.29m) and Conly (USA, personal best of 17.87m), tended to increase or maintain their velocities during the last part of the approach run (Portnoy, 1997). Since triple jump involved multi jumps, i.e. hop, step and jump, taking off under the condition with decreasing run-up velocity might result in shorter distance of jump compared to the long jump involving just a single jump. Therefore, these two jumpers are at least asked to maintain their approach velocities during the last part of approach run. From the results mentioned above, two major subjects concerning the approach velocity of the Japanese top junior triple jumpers are asked to solve in order to improve their performance: making the run-up velocity increase, and minimizing the loss of the velocity during the last part of the run-up.

Hay (1978) mentioned that the approach run of the triple jump serves the same function and is performed in essentially the same manner as in the long jump. It may suggest that comparing the approach run of the junior triple jumpers with junior long jumpers might be useful to clarify the problem on the approach run for the junior triple jumper. Therefore, parameters such as the step frequency, supporting time of the junior triple jumpers were compared to those of Japanese junior long jumpers reported by Omura et al. (2002). World class men’s long jumpers in the 6th World Championship reported by Ito et al. (2000), and world class women’s long jumpers at the Sydney Olympic reported by Omura et al. (2001). However, the first and third place of the jumpers in this Championship tended to increase rapidly their step frequency during the last part of the approach. In addition, some of other jumpers tended to decrease rapidly their step frequency during the last part of the approach. These results might be due to arrangement of the step length during the last part of the approach run done by jumpers in order to take off on the takeoff board correctly. In other words, most of Japanese junior triple jumpers might be lack of the practice in approach run to takeoff on the board correctly. Changing the step frequency rapidly during the last part of the approach may have a negative effect upon approach velocity shown in figure 1 as well as preparatory motion of the takeoff. Muraki (1981) suggested that the motion like sprinting is a desirable in the takeoff of the triple jump. Therefore, junior triple jumpers completed in the Championship should spend much time on practice of the run-up in order to achieve the optimal velocity and the desirable preparatory motion, and take off the board accurately.

Figure 2-a showed the average step frequency of the junior top eight triple jumpers and junior top eight long jumpers reported by Omura et al. (2002). X-axis represents the number of steps same as figure 1. Junior triple jumpers tended to show lower step frequency during the first half and the middle part of the approach run. Since approach velocity is almost the same as the product of the step frequency and the stride length, lower approach velocity observed in the junior triple jumpers may be due to lower step frequency. Concerning the relationship between step frequency and the velocity during the approach run of the long jump, World’s elite women’s long jumpers showed higher approach velocity in spite of lower step frequency compared to those of the Japanese elite women’s long
jumpers (Omura et al., 2003). These results were completely different from those of the junior triple jumpers who tended to show lower approach velocity with lower step frequency. Since there is few data of these parameters of the triple jumpers, further studies are needed to examine the relationship between the step frequency and the approach velocity of the triple jumpers including world elite jumpers.

compared the average supporting time of the junior triple jumpers and junior long jumpers reported by Omura et al. (2002). Average supporting time during the approach for the junior triple jumpers tended to become longer compare to the junior long jumpers except the last two steps. Figure 4-a showed the non-supporting time of the junior triple jumpers during the approach run. Non-supporting time tended to gradually increase from the beginning of the approach run and reach the peak value near the middle of run-up, then decrease during the last part of approach run. These results were similar to those of the junior long jumpers (Omura et al., 2002), but somewhat different from those of the world’s class women’s long jumpers, especially during the last part of run-up. The world’s class women’s long jumpers tended to show longer non-supporting time at the third last and second last step. (Omura et al., 2001). Figure 4-b showed the average non-supporting time of the junior top triple jumpers and junior top long jumpers reported by Omura et al. (2002). X-axis represents the number of step. Average non-supporting times during the approach run for the junior triple jumpers were similar to that of the junior long jumpers. From these results on the supporting time and non-supporting time, lower step frequencies shown by the junior triple jumpers were mainly related to the longer supporting time. Step frequency is calculated from the time required for each step. In other words, step frequency is calculated from the sum of the supporting time and non-supporting time for each step. Since a jumper is in the air during the non-supporting time, it is difficult for the jumper to control the velocity of the approach run during the non-support phase. Therefore, the jumper may try to control the velocity of the approach during the supporting phase. This might be the reason why the junior triple jumpers showed the longer supporting time during the approach run to control their approach velocity. It is not clear whether longer supporting time in the approach run is common to the world elite triple jumpers or not. Therefore, further investigations on the step frequency, supporting time or non-supporting time on the approach run for the various level of triple jumpers are asked to clarify the characteristics of the approach run for the triple jump. Figure 5-a showed the Air Ratio, dividing the non-supporting time by the supporting time, of the junior triple jumpers during the approach run. A large value of the Air Ratio means that a jumper spends more time in the air in each step. Air Ratio tended to gradually increase from the beginning of approach run and reach the peak value near the middle of run-up, then decrease during the last part of approach run again. These results were similar to those of the junior long jumpers (Omura et al. (2002)), but somewhat different from those of the world’s class long jumpers who tended to show larger Air Ratio during the last part of approach run (Omura et al. (2001)). Figure 5-b showed the average Air Ratio of the junior top triple jumpers and junior top long jumpers reported by Omura et al. (2002). Average Air Ratio for the junior triple jumpers tended to be smaller than that of the junior long jumpers during the first half and the middle parts of the approach run. Since the average non-supporting time of the triple jumpers were almost the same as those of the junior
long jumpers, such a difference observed in the Air Ratio might be due to longer supporting time of the triple jumpers. The Air Ratios for the junior triple jumpers during the last part of the approach were 1.20 at the third last step and 1.26 at the second last step. These values were similar to those of the Japanese women’s elite long jumpers (1.22 and 1.30, respectively), but lower than those of the World’s class women’s long jumpers (1.41 and 1.54, respectively) reported by Omura et al. (2003). It is not clear that the relationship between the Air Ratio and preparatory motion for the jump, but the takeoff of the triple jump (hop) should be performed with less takeoff angle than that of the long jump. It means that the takeoff of the triple jump (hop) is desirable to perform with the motion like sprinting. If a triple jumper could do the motion like sprinting during the last part of the approach, the Air Ratio would be maintain the same values of the middle part of the approach run like a World’s class women’s long jumpers did. Triple jump is more complicated event compared to the long jump. Therefore, Japanese junior triple jumpers may be needed to spend more time on run-up or preparatory motion techniques as well as developing their muscle strength, and power.

Figure 4-b Average non-supporting time for the Jr. triple jumpers and Jr. long jumpers

Figure 5-a Air Ratio for the Jr. triple jumpers during the approach run

CONCLUSION

In this study, Japanese top junior triple jumpers were investigated to obtain the fundamental findings on effective approach run for the junior triple jumpers, by analyzing the step frequency, supporting time, non-supporting time and Air Ratio. Following results were obtained:
1) Junior triple jumpers tended to show lower approach velocity compare to those of the junior long jumpers.
2) Junior triple jumpers tended to show lower step frequency during the first half and the middle part of the approach run compare to the junior long jumpers.
3) Some triple jumpers tended to increase or decrease rapidly their step frequency during the last part of the approach.
4) Supporting time during the approach for the junior triple jumpers tended to become longer except the last two steps compare to the junior long jumpers.

From these results, it is clear that the approach run of the Japanese junior triple jumpers were deferent from those of the junior long jumpers. Since the approach run of the triple jump serves the same function and is performed in essentially the same manner as in the long jump (Hay, 1978), Japanese junior triple jumpers are asked to improve their approach run. However, further studies on approach run, including step length and the preparatory motion, may be needed to clarify a desirable approach run for the junior triple jumpers.

This study was done by the Biomechanical Project team of the Japan Amateur Athletic Federation.

References
Muraki (1982) Track & Field (Field) 52, 326-323