

## **BACKWARD PULLING DISTANCE IN DROP PHASE FOR JAPANESE ELITE FEMALE TUG-OF-WAR ATHLETES**

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The purpose of this study was to clarify the backward pulling distance on 1 second of drop phase for Japanese female elite tug of war team. In order to examine the pulling movement, digital video camera was set at the ceiling of gymnasium, the game performed by 5 elite teams (finalists) and 5 normal teams (non finalists) in 2006 All Japan Tug of War Championship tournament were videotaped from right above and analyzed by using two-dimensional motion analysis system. Backward pulling distance was measured and compared between groups. In some pullers, elite team pulled the rope longer significantly. This might be caused by difference of individual or team pulling techniques to synchronize timing and direction.

**KEY WORDS:** tug of war, backward pulling distance, drop phase

### **INTRODUCTION:**

Tug-of-war has three phases in the game: drop, hold and drive phase. Drop phase is the stage that pullers put pulling force rapidly right after start pulling hold phase is the stage that pullers hold against pulling of opponent or pullers are driven by opponent, and drive phase is the stage that exerting pulling force with backward walking and drawing opponent into own side (Nakagawa et al. 2005). Above all, drop phase is important phase because pullers drop their body and exert maximum pulling force by using their body weight. Some studies about drop phase were taken in the past. For example, Tanaka et al. (2006) suggests importance of timing skill of drop phase to avoid the loss of team pulling force in tug of war. There is much kind of skills in this brief moment of phase. However, few studies about pulling technique in tug of war game were done. Especially, the backward pulling distance on drop phase for elite athletes has never clarified. Thus, the purpose of this study was to clarify the backward pulling distance on 1 second of drop phase for Japanese female elite tug of war team.

### **METHODS:**

Video camera (30FPS) was fixed at roof of gymnasium and 10 games were filmed just above the R side of the competition lane. These matches were trial game in All Japan Tug of War Championship women's lightweight division (A total of weight of 8 people must be less than 480 kg) performed by 5 elite teams (finalists) and 5 normal teams (non finalists). All teams videotaped won these games. Video image was edited after captured to PC. 2D motion analysis system was used to digitize crossing point of rope and body. Analysis time was 1 second of drop phase from game start. The backward pulling distance of each player on drop phase was measured. The peak backward pulling distance was named max BPD. All measured data was shown as Mean  $\pm$  SD. These mean was compared between groups. Max BPD on elite teams and normal teams were evaluated using dependent t-tests ( $p=0.05$ ).

### **RESULTS:**

All data are shown in Figure 2. For max BPD, significant differences were found on puller1 ( $0.52\pm 0.10$  vs.  $0.32\pm 0.11$ ), puller2 ( $0.59\pm 0.16$  vs.  $0.36\pm 0.12$ ), puller4 ( $0.52\pm 0.07$  vs.  $0.37\pm 0.1$ ) and puller6 ( $0.51\pm 0.09$  vs.  $0.34\pm 0.09$ ) ( $p<0.05$ ). Significant differences were not found on puller3 ( $0.49\pm 0.10$  vs.  $0.33\pm 0.14$ ), puller 5 ( $0.49\pm 0.10$  vs.  $0.38\pm 0.09$ ), puller7 ( $0.37\pm 0.10$  vs.  $0.34\pm 0.11$ ) and anchor ( $0.20\pm 0.04$  vs.  $0.12\pm 0.07$ ).



Photo 1 An image recorded for real.

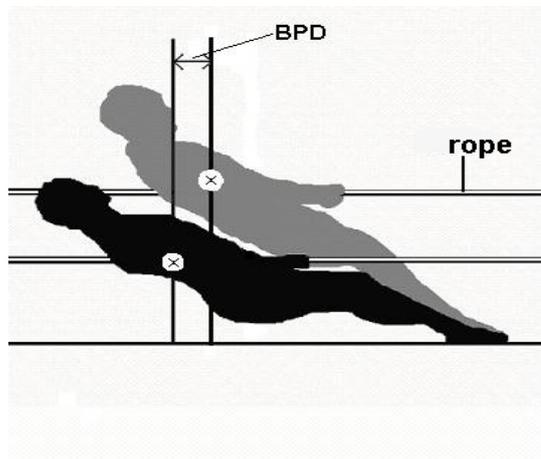


Figure 1 pattern diagram of BPD. The gray shape is the puller right before pull; black shape is the puller when the maximal BPD came out.

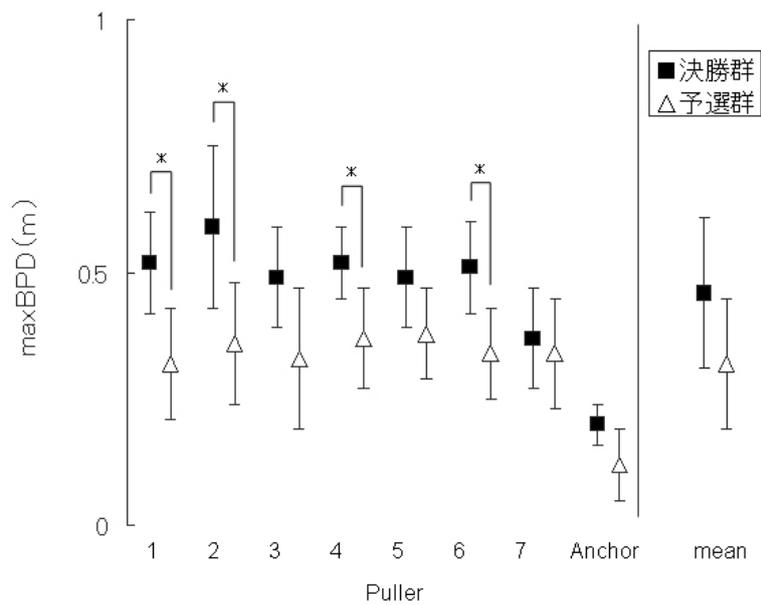


Figure 2 comparisons of two groups of max BPD on each puller.

## **DISCUSSION:**

Elite team pulled the rope longer than normal team in some positions. During first a few seconds, elite team already pulled the rope longer. This might be caused by difference of pulling technique. Needless to say, individual pulling technique of each puller of tug of war team is in it, in addition, team pulling technique linked to the result of this study. For example, the timing skill, as described above, affects the loss of the team pulling force (Tanaka et al. 2006). Also, vertical or lateral slanting of pulling direction affects that. By 7 pullers and anchor synchronize the pulling timing and direction as far as possible, elite team might pull the rope longer.

Anchorman pulled the rope shorter than other positions comparatively. This is because anchorman has a different role. In drop phase, pullers try to lay flat their body and put their own weight into the rope. Anchorman has to back up them not to take down by pulling up the rope and pullers.

## **CONCLUSION:**

The purpose of this study was to clarify the backward pulling distance on 1 second of drop phase for Japanese female elite tug of war team. Elite team pulled the rope longer than normal team. In this study, difference of backward pulling distance on different competitive levels was investigated. This might be caused by difference of individual or team pulling techniques to synchronize timing and direction.

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