

TEAM PULLING TECHNIQUE OF ELITE FEMALE INDOOR-TOW ATHLETES FROM A DRONE'S POINT OF VIEW

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The purpose of this study was to clarify the team pulling technique on Drive phase for Japanese female elite tug of war team from drone's point of view. In order to examine the pulling movement, digital video camera was set at the ceiling of gymnasium, the game performed by 2 elite teams (finalists) in 2006 All Japan Tug of War Championship tournament were videotaped from right above and analyzed displacement of X, Y-axis for all puller and foot position by using two-dimensional motion analysis system. All puller moved from side-to-side at regular intervals, rightward movement and backward movement got into synchronization. While at leftward movement back a right foot step, while rightward movement, left foot set back to right foot position. These movement make it likely 7 pullers and anchor synchronized the pulling timing and direction as far as possible, which culminated in lower the loss of the force.

KEY WORDS: tug of war, pulling technique, Indoor & Outdoor Grip, drive phase, drone's point of view

INTRODUCTION: Tug of war is one of the team sports where it is important to utilize the maximum force of all players. The team pulling force is about 20% smaller than sum of force exerted by 8 players; with the loss of force due to a lack of coordination between players (Liou et al. 2005). Pulling movement in tug of war can be divided into three phases: "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). Also, Liou et al. (2005) investigated relationships of pulling direction and the loss of team pulling force at the sagittal plane. Tug-of-war from a bird's-eye-view is shown in "Rakuchu rakugai zu (Uesugi Version)" which captures the early capital of Kyoto (Photo 1). At previous studies, bird's-eye-view analysis of pulling movement in Tug-of-war only focused "Drop phase" (Nagahama et al. 2007, Mukwaya et al. 2007). Thus, the purpose of this study was to clarify the team pulling technique on "Drive phase" for Japanese female elite tug-of-war team from drone's point of view.

METHODS: Video camera (30FPS) was fixed at roof of gymnasium and 2 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 2 elite teams (champion and second place). All teams videotaped

won these games. All puller adapted Japanese-sword holding (Photo 2). 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 10 second of drive phase. The horizontal direction defined as X-axis, front-back direction defined as Y-axis (Photo3), analyzed displacement of X, Y-axis for all puller, average and foot position.



Photo 1 Street TOW in feudal Japan capital city, Kyoto, cited from Rakuchu rakugai zu (1574) of Japan National Treasure in Yonezawa City Uesugi Museum



Photo 2-a(left) Outdoor TOW grip like a machine-gun holding
Photo 2-b (right) Indoor TOW grip like a Japanese (Samurai)-sword holding
Photo 2-a & b by courtesy of Mr. Hiroshi Hata,
representative legend of Kanazawa FD RESCUE Team

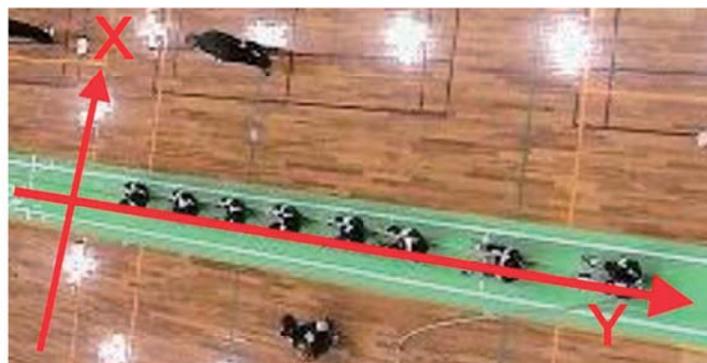


Photo 3 videotaped image and setting of X ,Y-axis

RESULTS: All data are shown in Figure 1.2. All puller moved from side-to-side at regular intervals, rightward movement and backward movement got into synchronization. While at leftward movement back a right foot step, while rightward movement, left foot set back to right foot position.

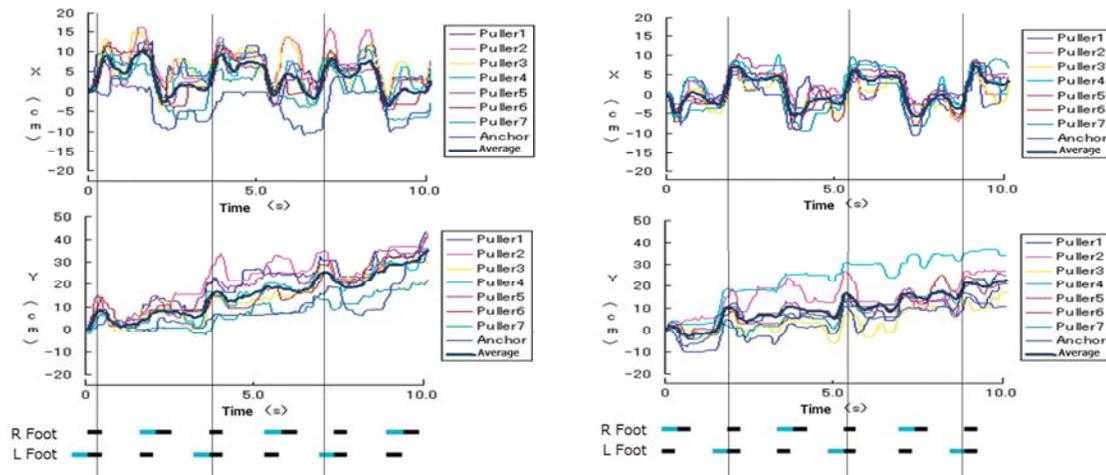


Figure 1 displacement of X, Y-axis for all puller, average and foot position (Left: team A, Right: team B)

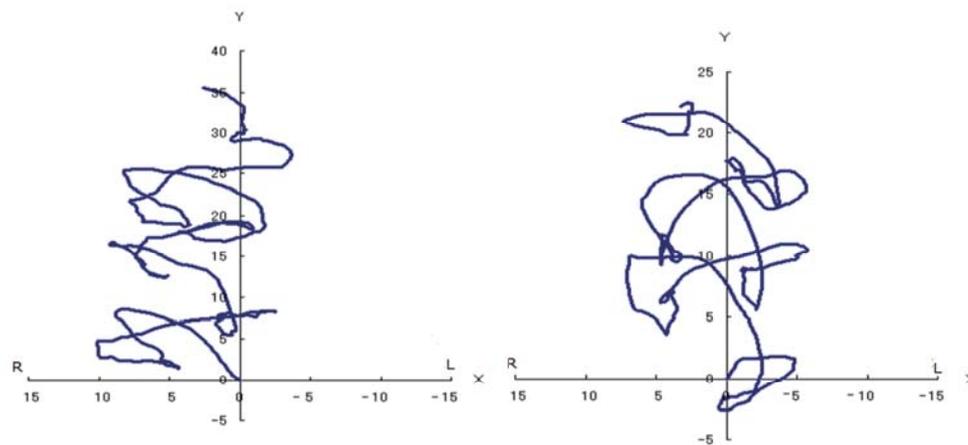


Figure 2 integrated displacement of average X-Y axis (Left: team A, Right: team B)

DISCUSSION: Rightward movement and backward movement got into synchronization, was thought to be due to pullers while at rightward movement pull the rope, while at leftward movement keep their position. All puller hold rope under their arm, while center of gravity at right side, use themselves body weight pulling the rope. Leftward movement must be previously movement. The timing skill, as described above, affects the loss of the team pulling force (Tanaka et al. 2006). These movement make it likely 7 pullers and anchor synchronized the pulling timing and direction as far as possible, which culminated in lower the loss of the force.

CONCLUSION: The purpose of this study was to clarify the team pulling technique on drive phase for Japanese female elite tug of war team. All puller synchronized rightward and backward movement, caused synchronize pulling timing and direction, which culminated in lower the loss of the force.

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