A BIOMECHANICAL STUDY ON "MASTER'S RACE WALKING": FOCUSING ON BENT KNEE REGULATION

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The master's sport became popular including race walking. In master's athletes, especially elderly of more than 70 or 80 years of age, feels difficulty to keep the rule of "Bent Knee". The present study demonstrated the difficulty of keeping the rule of "Bent Knee" using the elderly race walker of 82 years of age and younger one. The experiment in laboratory test showed that the race walking course should be carefully checked the flatness because it is hard to walk the slope course more than 5 degrees even in case of normal walk both in young and elderly walk racer. It should be paid more care for elderly race walker for their safety and the more developing the number of elderly race walker. The rule of race walking relating the Bent Knee should be considered independently from the present rule for the benefit of the master's race walker.

KEY WORDS: Race walking, Master's race walk, Bent knee, Safety, Sport rule

INTRODUCTION:

The Master's Sport Game became popular and so many middle and elderly people enjoy different kind of sport items. The "walking" is one of the most popular sport within middle and elderly people in Japan nevertheless the race walking is relatively not so popular. The reason why the race walking is unpopular will be understood as the regulation of the "Bent Knee" is sometimes very difficult to clear in an actual race and also training especially for the elderly people. The rule of the Bent Knee was regulated as follows: *the knee should be kept strait position from heel contact phase to the vertical position of the leg.*

The present study has tested the possibility of performing race walking by keeping the bent knee regulation using treadmill in laboratory and also tested as a field study, using flat, slope and stair conditions.

METHOD:

The subjects were 3 race walkers (2 male subjects:82 and 24 yrs of age, one female subject of 22yrs of age). The treadmill (POWER JOG GXC 200) was used for simulation of the race walk in laboratory. The experimental conditions were as follows: In case of normal walk test, the slopes were changed as 0, 5, 10, 15, 20, 25 degrees and the treadmill speed was fixed at the speed of 4km/h. The treadmill angle was 0 degree (flat) and the speed was changed as 4km/h, 6km/h and 8km/h in normal walk condition and 8km/h, 10km/h, 12km/h 14km/h and 15km/h in race walking condition.

The motion was filmed from side view by using video camera. The video camera (Sony DCR-VX 1000) was set 5m away from the subject and film speed was 60f/s.

The motion analysis system was used DART FISH soft ware.

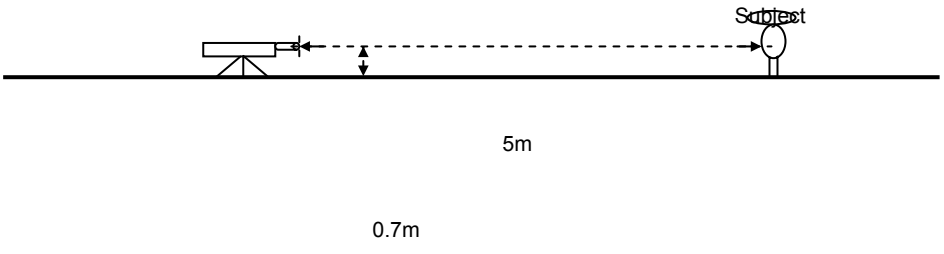

Figure 1: Experimental setup: the video camera was set 5m away from the subject.

RESULTS:

The knee joint angle during the one cycle of normal walk: Fig 2.shows one of the typical data from young female race walker of normal walk on the treadmill in case of 4km/h with flat condition. The Fig 2 shows one cycle of walk from the moment of heel contact phase (①) to the toe off from the ground(⑥). The knee angle was 175.5 degree at heel contact phase, and knee joint angle decreased to 165.1 degree at the next phase. The knee joint angle showed as 172.2 degree at the vertical position of the leg. It seems that the knee joint flex easily after the heel contact in normal walk.

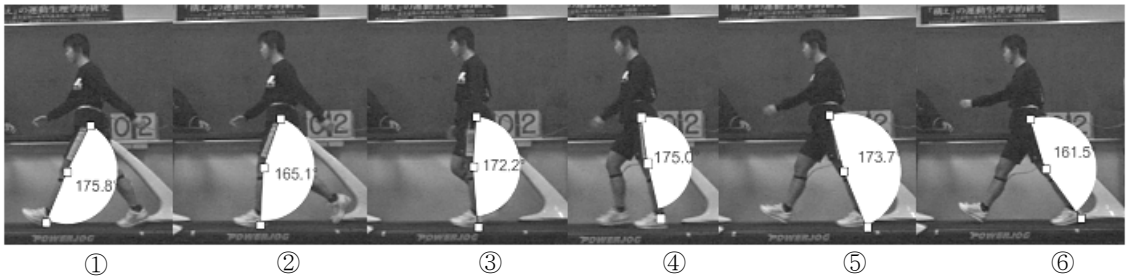

Figure 2: Motion analysis of normal walking: analysis of knee joint angle during walk

The relationship between knee joint angle and treadmill slope angle: The result of the treadmill test was shown in Fig. 3. The subject in Fig 3 was used male masters race walker of 82 yrs of age. In case of normal walk, the knee joint angle during the normal walk on the treadmill was compared. The knee joint was 173.9 degrees in 0 degree (flat condition) of the treadmill and 165.0 degrees in 5 degrees of the treadmill. 146.0 for 10degree, 140.3 for 15 degree, 133.9 for 20 degree and 125.3 for 25 degree of the treadmill slope.

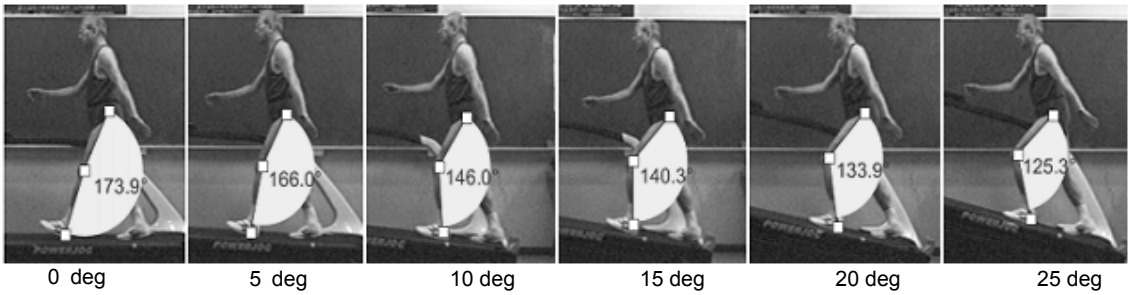

Figure 3: Motion analysis of normal walking: knee joint angle in different slope on treadmill

DISCUSSION:

Knee joint angle during normal walk: In case of young and elderly race walker, the knee angle joint during normal walk produced “natural motion” of walking which demonstrated slightly flex knee joint just after the heel contact for control the shock of the ground reaction force to the body.

It will be difficult for both young and elderly athlete to keep his/her knee strait position from heel contact phase to vertical leg position during the race walk. The rule of the master’s race walk is now basically follows and adopt the rule of International Federation of Track and Field but, there is a big difficulty for master’s race walker because of the Bent Knee rule. The World Championship of Master’s Race Walking has been opened every two years and many athletes joining from all over the world. For male athlete who are able to join to the master’s competition from 40 years to more than 100 years of age. The each ages were divided into every 5 years. The female athlete able to join to the masters competition from 35 years of age. In the elderly people, especially more than 70 or 80 years of age, sometimes express these athletes complains the rule of the Bent Knee because of difficult to keep the knee joint strait position during the walking in the race. It looks like unusual motion, keeping the knee strait position during the walk especially elderly masters athletes.

The relationship between knee joint and slope: The present study explained the difficulty of keep straight position of the knee during the walk on a slope course more than 5 degrees even a normal walk. In an actual race walk, it will be more difficult to walk for keeping the rule of the Bent Knee. Moreover, in the case of walking stair is need not to say, more difficult walking condition was demonstrated.
From a view point of the safety of master's race walking athletes, especially for the elderly, environmental condition of the race walking course should be very carefully checked and also controlled by the management staff of the game.

The developing plan for master's race walking: For the master's race walking, it should be discussed and should be paid attention independently from the present rule of the International Federation of Track and Field. The master's athletes of race walking, especially elderly people has physically different level and characteristics from the general race walker. We mentioned about the safety of the course which should be carefully keep flat condition. We also would like to make a point of equipment which including shoes for elderly athletes, wear for elderly athletes etc.
The more study from biomechanics for elderly race walker should be encouraged. The race walking for elderly people will be more popular if the race will be performed under the rule of not so strictly controlled by the rule of Bent Knee.

CONCLUSION:
From the experimental results of race walking, the following points will be concluded:
1. The present study demonstrated the difficulty of keeping the rule of "Bent Knee" in elderly race walker and also in young race walker when he /her walking the course of the slope even a case of less than 5 degrees.
2. It should be paid more care of elderly racer for their safety and make more popular the master's race walker.
3. The rule of the race walking relating the "Bent Knee" should be considered to change for benefit to the master's race walker.

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