COMPARISON OF THE KNEE JOINT BETWEEN THE SKILLED AND UNSKILLED SUBJECTS DURING THE KIP MANEUVER ON THE HORIZONTAL BAR

[1] Tetsu YAMADA, [2] Michiyoshi AE and [2] Norihisa FUJII
[1] Doctoral program in Health and Sport Sciences, University of Tsukuba, Tsukuba, Japan.
tetsu@lasbim.taiiku.tsukuba.ac.jp,
[2] Institute of Health and Sport Sciences, University of Tsukuba, Tsukuba, Japan.

INTRODUCTION

In general, the knee joint flexion will not be used in executing the kip maneuver on the horizontal bar. However, most of the unskilled subjects bend their knees during the kip maneuver. The knee flexion will be attributed to not only body position, but also poor technique. There is little information of the effect of the knee joint on the execution of the kip maneuver. The purpose of this study was to investigate the effect of the knee joint flexion on the mechanical work, comparing the skilled with unskilled subjects of the kip maneuver on the horizontal bar.

METHODS

Ten varsity gymnasts as skilled subjects performed the kip maneuver on the horizontal bar, and five non-gymnast subjects were selected as unskilled subjects. Their maneuver was videotaped in the sagittal plane with a VTR camera (60Hz) to obtain kinematics and kinetics data by a motion analysis technique. The data were normalized by the time from the instant that the center of mass (CoM) passed under the bar in the forward swing to the same instant in the backward swing, and then averaged. The difference between the skilled and unskilled subjects was tested by Mann-Whitney test ($p < 0.05$).

RESULTS AND DISCUSSION

Figure 1 shows the maximum and minimum knee joint angles during the kip maneuver for the skilled and unskilled subjects. Although there was no difference in the maximum knee joint angle between the skilled and unskilled subjects, the minimum knee joint angle of the unskilled subjects was smaller than that of the skilled subjects ($p < 0.01$). This indicated that the unskilled subjects flexed their knee joint deeper than the skilled subjects. This would help the unskilled subjects raise their leg easier because of smaller moment of inertia about the hip joint.

Figure 2 shows the mechanical works done by the shoulder, hip and knee joint torques for the skilled and unskilled subjects in the kip maneuver. The mechanical work of the shoulder joint for the skilled subjects was larger than that of the unskilled subjects ($p < 0.05$), but there was no difference in the mechanical work of the hip joint. The mechanical work of the knee joint for the skilled subjects was close to zero and smaller than that of the unskilled subjects ($p < 0.05$). Most of the mechanical work for the skilled subjects was developed by the shoulder joint torque. Although the mechanical work of the knee joint for the unskilled subjects was much smaller than those of the shoulder and hip joints, this would compensate for smaller work of the shoulder joint to increase the mechanical energy of the whole body.

Since the knee joint flexion during the execution of the kip maneuver is considered to be undesirable body position and technique, the mechanical work done by the knee joint torque will not be recommended to gymnasts. However, in physical education class, increasing the mechanical work done by the shoulder and hip joint torques should be more focused, correction of the knee joint flexion was less important in succeeding the kip maneuver.

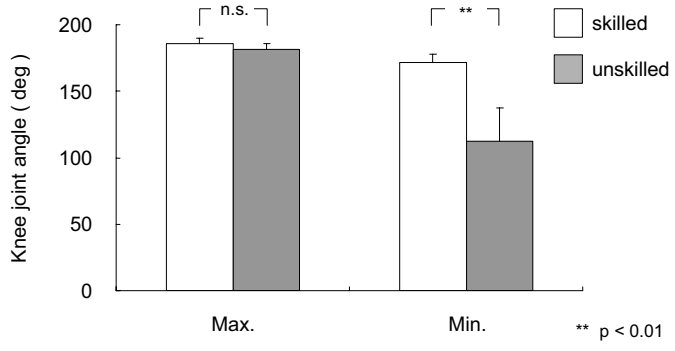

Figure 1: The maximum and minimum knee joint angles during the kip maneuver for the skilled and unskilled subjects.

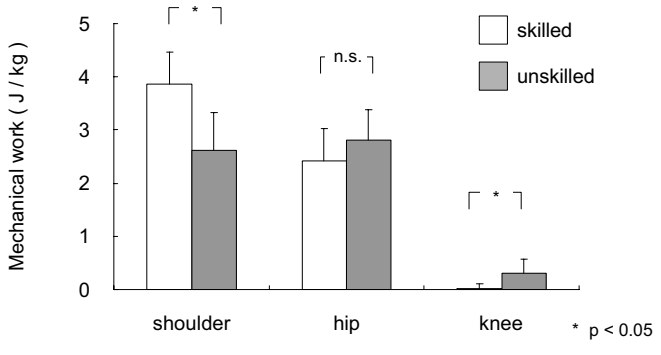

Figure 2: The mechanical works done by the shoulder, hip and knee joint torques in the kip maneuver.