# THE KNEE AND HIP JOINT ANGLE WHEN ILIOTIBIAL BAND SLIDE OVER THE LATERAL FEMORAL EPICONDYLE

**Shinji Tomiyama, Yukio Urabe and Noriaki Maeda**

**Graduate School of Biomedical and Health Sciences, Hiroshima University, Hiroshima, Japan**

According to a previous study, the knee flexion angle, is approximately 30° when the iliotibial band (ITB) slides over the lateral femoral epicondyle. However, the corresponding hip joint flexion angle has not yet been determined. The purpose of this study was to examine whether hip joint flexion angle affects the location of the ITB. The study included 16 uninjured male subjects. The subjects had their knee flexion angle measured when the ITB slides over the lateral femoral epicondyle at five different hip joint angles: 10° of extension and 0°, 20°, 40°, 60° of flexion. As the hip joint flexion angle increased, the knee flexion angle also increased. It should be considered that the position of the ITB affects the knee joint angle, as well as the hip joint angle. The findings of this study may help improve the treatment and prevention of ITB friction syndrome.

**KEY WORDS:** iliotibial band, hip joint flexion angle, lateral femoral epicondyle.

**INTRODUCTION:** The iliotibial band (ITB) originates from the tensor fasciae latae, gluteus maximus and the iliac crest. The ITB attaches to Gerdy's tubercle located in the lateral tibia. As the knee is flexed, the ITB moves posteriorly and slides over the lateral femoral epicondyle. According to a previous study (Noble, 1979), the knee flexion angle is approximately 30° when the ITB slides over the lateral femoral epicondyle. However, the corresponding hip joint flexion angle has not yet been determined. Orava (1978) reported that friction and compression associated with the knee flexion angle lead to ITB friction syndrome (ITBFS).

ITBFS often occurs because of running or cycling, which involved the same repeated movements (Holmes, Andrew, & Nina, 1993; Tounton, Ryan, Clement, McKenzie, LloydSmith, & Zumbo, 2002; Maruyama, 2004). During these movements, the movement of the hip and knee joint are synchronized. Therefore, we should consider that ITB movement occurs not only during knee joint flexion/extension but also during hip joint flexion/extension.

In this study, the authors examined various hip joint angles and measured the knee joint angle when the ITB slides over lateral femoral epicondyle. This is because, we consider that the primary pain in ITBFS caused by knee joint flexion angles is not fixed but is affected by the hip joint angle. We hypothesized that the knee flexion angle also increases when the hip joint flexion angle is increased.

**METHODS:** The subjects included 16 uninjured males. Anthropometric data of the 16 subjects were recorded (20.0 ±1.2 y; 171.7 ±2.9 cm; 59.5 ±5.5 kg). The purpose of the study was explained to the subjects, who participated after providing informed consent.

Subjects lay on their side and maintained their hip joint internal/external rotation angle at 0° and their abduction/adduction angle at 0°. The subjects' hip flexion angle was then changed to the following 5 conditions: 10° extension, 0° flexion, 20° flexion, 40° flexion and 60° flexion. The subjects flexed their knee joint while the authors palpated the lateral femoral epicondyle. We measured the knee flexion angle by using a goniometer as the ITB slides over the lateral femoral epicondyle.

Data were expressed as mean ±SD. Statistical analysis was performed for the 5 hip joint angles by using paired t-tests, with a P value of $<0.05$ considered significant. Considering the multiplicity of the test, we adjusted the significance level by using Bonferroni correction. To confirm the reliability of the measurements, triplicate measurements under each condition and the intraclass correlation coefficient - ICC (1,1) was calculated

**RESULTS:** The knee flexion angle during hip extension at 10° was 23.6° ±3.0°, during hip flexion at 0° was 28.6°±3.0°, during hip flexion at 20° was 35.4°±2.0°, during hip flexion at 40° was 43.6° ±3.2°, and during hip flexion at 60° was 51.5° ±5.0°. In all the 5 conditions, the knee joint flexion angle increased in accordance an increase in the hip joint flexion angle, with a significant increase when the ITB slide over the lateral femoral epicondyle ($p<0.005$).
Figure 1 shows the change in the knee joint flexion angle in relation to the change in the hip joint flexion angle, when the ITB slides over the lateral femoral epicondyle. When the hip joint flexion angle increased, the knee flexion angle also increased relative to the hip joint angle. When the hip joint was flexed from hip extension at 10° to hip flexion at 60° the knee joint angle increased by 27.9°.
The reliability of the measurements by ICC(1,1) was 0.97, 0.92, 0.96, and 0.94 for hip extension at 10°, flexion at 0°, flexion at 20°, flexion at 40°, and flexion at 60 respectively.

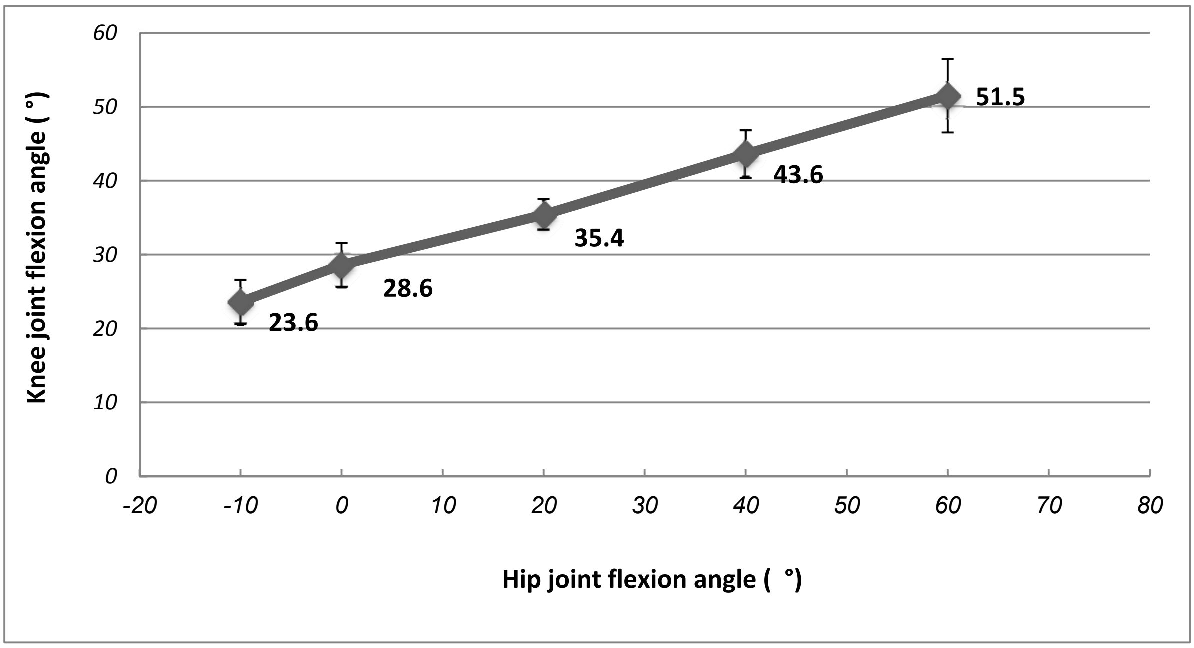


**Figure 1: The transition of knee joint angle and hip joint angle.**

**DISCUSSION:** In this study, we performed triplicate measurements under each condition in assessing the reliability of measurements. The repeatability of hip flexion angle according to the ICC(1,1) criterion was "great" because, in this study, this repeatability was over 0.90 for all 5 conditions (Ituki & Taizo, 2004). A previous study, showed that the knee flexion angle is 30° when the ITB slides over the lateral femoral epicondyle. If hip joint flexion angle is 0° in Noble's study (Noble, 1979), this result is almost same as our result (28.6°). Therefore, we believe that the reliability of the measurement of this is much better.
When the hip joint flexion angle was great, the knee joint flexion angle increased when the ITB slide over the lateral femoral epicondyle. ITB crosses the knee joint and hip joint. Likewise, the rectus femoris muscle crosses these 2 joints. Thus, the muscle tone is decreased and the flexion range of motion in the knee joint is increased when the hip joint is flexed passively. Similarly, it way be considered that the tension of the ITB and tensor fasciae latae, the muscle involved in hip flexion, is decreased by passive hip joint flexion. Therefore, a greater force is required to draw the ITB to a posterior position even when the knee is flexed. Thus, the ITB slides over the lateral femoral epicondyle when the knee joint is in a deep flexion angle.
Furthermore, as shown in Figure.1, as the hip joint flexion angle increases by 1°, the knee joint flexion angle increases by 0.4°. Thus when the ITB slides over the lateral femoral epicondyle, we can guess the knee joint flexion angle for other hip joint angle that have not been measured.
The friction force between the ITB and lateral femoral epicondyle plays an important role in the development of ITBFS (Orava, 1978; Noble, 1979). In this study, we have shown that the

knee flexion angle changes when friction occurs between the ITB and lateral femoral epicondyle. This study has some limitations. ITBFS occurs when the knee joint is loaded, which may occur during running or cycling however, in our study, subjects were assessed by asking them to lie on their side. This condition differs from that experienced when participating in sports. However, we performed this measurement to remove any strain on the ITB before loading in a side-lying position. Future studies should measure the knee joint flexion angle when the ITB slides over the lateral femoral epicondyle in different loading positions.

**CONCLUSION:** We have shown that the location of the sagittal plane of the ITB is affected by the change in the hip joint flexion angle when the ITB slides over the lateral femoral epicondyle. The knee joint flexion angle increases with an increase in the hip flexion angle. Thus, we were able to clarify the knee joint flexion angle when friction occurred between the ITB and lateral femoral epicondyle.

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