AEROBICTRAINING FOR ATHLETES WITH ILIOTIBIAL BAND FRICTION SYNDROME WITH CONSIDERING OF ITS PATHOGENIC MECHANISM

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Iliotibial band friction syndrome (ITBFS) is caused by friction between iliotibial band (ITB) and lateral femoral epicondyle. Effective aerobic training for athletes with ITBFS has not yet been reported. The purpose of this study was to propose an aerobic exercise that does not apply load on the ITB. The study consisted of 10 uninjured men. We measured hip and knee joint flexion angle during pedaling bicycle ergometer under 3 saddle height conditions. As the saddle height was lowered, the hip and knee joint flexion angles increased. Under the low saddle height condition, the ITB did not slide over. This shows that pedaling exercise in low saddle condition can be special exercise, in which athlete can get enough training effects and yet it would put less burden on the ITB.

KEY WORDS: ilotibial band friction syndrome, cycling, friction.

INTRODUCTION: The iliotibial band (ITB) originates from the tensor fasciae latae, gluteus maximus muscles and iliac crest. The ITB attaches to Gerdy's tubercle in the lateral tibia (Kaplan, 1958). As the knee is flexed, the ITB moves posteriorly and slides over the lateral femoral epicondyle. Orava (1978) reported that friction and compression associated with the knee flexion angle lead to ITB friction syndrome (ITBFS).

ITBFS often occurs during running or cycling ;12% of running-related knee joint injuries and 24% of cycling-related knee joint injuries result in ITBFS (Holmes et al, 1993 ; Tounton et al, 2002). Runners and cyclists require a high aerobic capacity in order to be successful. However, athletic rehabilitation for athletes with ITBFS is not enough. Effective aerobic exercises for athlete with ITBFS who have exercise-related pain during flexion or extension of the injured knee have not been reported.

According to a previous study (Noble, 1979), the knee flexion angle is approximately 30° when the ITB slides over the lateral femoral epicondyle. Additionally,we reported that if the hip joint flexion angle is increased, the knee flexion angle when ITB slides over is increased (Tomiyama et al, 2011). Thus, the lower extremity position when friction occurs in the ITB changes according to the location of the knee and hip joint angles.

The incidence rate of ITBFS in cycling exercises shows that the ITB friction occurs during pedaling. Nevertheless, we considered that if we change the saddle position, the hip and knee joint angles in pedaling are changed and thus friction does not occur. The purpose of this study was to measure the lower extremity angles in cycling according to changes in saddle height, and to propose an aerobic exercise that does not apply load on the ITB.

METHODS: The subjects consisted of 10 uninjured athletes. The measurement data of the 10 subjects were recorded (age, 22.3 ± 1.2 years; height,173.2 ± 8.1 cm; weight, 63.1 ± 11.2 kg). The purpose of the study was explained to the subjects who participated in the study after providing informed consent.

AEROBIKE 75XLⅢ was used in cycling. Nordeen (1977) recommended that the apposite saddle height should be equal to the subject's greater trochanter head height. The saddle height was determined based on 3 conditions as follows: 110% of the greater trochanter head height (high height), 100% of the greater trochanter head height (middle height), 90% of the greater trochanter head height (low height). The saddle heights were differnt in each subjects.

We provided a pedaling load of 150W, and the pedaling cadence was 60RPM. Knee and hip joint kinematics were obtained with a high speed video camera (EXILIM EX-FC160S Casio) at a sampling rate of 120 fps. Reflective markers were placed on the following 4 points at the right side: the acromion, greater trochanter head, lateral side of the knee joint cleft between

the articulations, and lateral malleolus. The knee joint and hip joint flexion angles in pedaling were calculated. We used angle datas over the entire cycle.
Subsequently, the measurer pedaled slowly, while subject was on the saddle. The subjects grasped ergometer's handle that fixed same height in each subject and extended their elbows. Their trunk posture was determined. They flexed their knee joint in pedaling while the measurer palpated the lateral femoral epicondyle. The knee and hip flexion angles were measured by using a goniometer as the ITB slid over the lateral femoral epicondyle.
Data are expressed as mean ± SD values. Statistical analysis was performed for the 3 saddle height conditions by using repeated measure ANOVA, with a P <0.05 considered as statistically Considering the multiplicity of the test, we adjusted the significance level by using Bonferroni correction.

RESULTS: Fig.1 shows the knee joint and hip joint transition in pedaling under the 3 saddle height conditions. If the saddle height was lower, the subject's knee joint and hip joint flexion angles were decreased (P<0.05) .
We confirmed that the ITB slid over the lateral femoral epicondyle twice under the relatively high and middle saddle height conditions. Under the low saddle height condition, the ITB did not slide over. Table 1 shows hip and knee joint angle when ITB slides over lateral femoral epicondyle in pedaling. The hip joint flexion angles when the ITB slides over the lateral femoral epicondyle were 58.2 ± 3.6 and 64.3 ± 3.4 degrees under the relatively high-saddle height condition, and 58.6 ± 3.2 and 61.1 ± 4.1 degrees under the relatively middle-saddle height condition. The knee joint flexion angles when the ITB slid over the lateral femoral epicondyle were 56.3 ± 2.7 and 56.5 ± 2.9 degrees under the relatively high-saddle height condition, and 58.1 ± 4.1 and 50.7 ± 3.9 degrees under the relatively middle-saddle height condition.

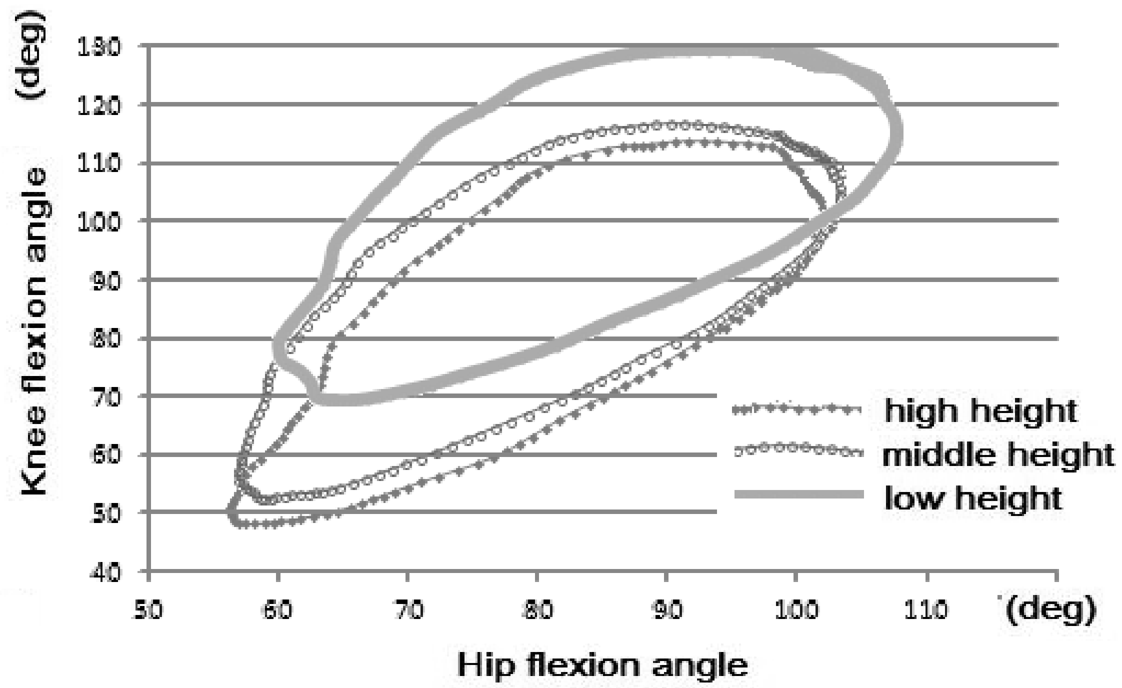

Figure 1: The knee joint and hip joint transition in pedaling under the 3 saddle height conditions.

Table 1
Hip and knee joint angle when the ITB slides over lateral femoral epicondyle in pedaling. Values are means ± standard deviations.

	Hip flexion angle	Knee flexion angle
High-saddle height	58.2±3.6	56.3±2.9
	64.3±3.4	56.5±2.9
middle-saddle height	58.6±3.2	58.1±4.1
	61.1±4.1	50.7±3.9
low-saddle height	Not slide over	

DISCUSSION: In this study, we measured the hip and knee joint flexion angles in athletes during pedaling. In each saddle height condition, the locus of the pedal and the subject's leg length and ergometer's handle height were fixed. Consequently, if the saddle height was lower, the hip and knee flexion angles increased as the subject began pedaling.
Because of the incidence rate of ITBFS in cycling, it is easy to infer that friction would occur between the ITB and lateral femoral epicondyle under the middle-saddle height condition (the established common height) (Holmes et al, 1993). In fact, the sliding of the ITB over the lateral femoral epicondyle was confirmed in this study. When the hip flexion angle increased, the knee flexion angle also increased when the ITB slid over the lateral femoral epicondyle. Thus, it is necessary to confirm the occurrence of friction under the high-saddle height condition and that the hip and knee joint flexion angles are decreased under the middle-saddle height condition and increased under the low-saddle height condition. Consequently, the measurer could not palpate the sliding over of the ITB under the low-saddle height condition in which the knee joint angle ranged from 68 degrees to 130 degrees. As the knee was flexed, the ITB was located posterior to the lateral femoral epicondyle. Therefore, we considered ITB friction to be absent.
Athletes with ITBFS feel a pain during knee joint flexion and extension, making them unable to perform aerobic exercises and decreasing their aerobic capacity. Bicycle ergometer exercise is one of the most common aerobic training. In this study, the low-saddle height condition provided for 90% of the greater trochanter head height. Under this condition, maximal knee joint extension moment and maximal power were not decreased (Ro et al,2006, Ito 1986). In conclusion pedaling exercise in low saddle condition can be special exercise, in which athlete would be able to get enough training effects and yet it would put less burden on the ITB.
The limitation of this study is that the trunk angle was not measured when subjects pedaled. But we provided handle height, saddle height and pedal arm. Because of these, subject's posture is almost determined. We should be measurer trunk angle in next reseach.

CONCLUSION: We have shown that ITB did not slide over the lateral femoral epicondyle under low-saddle height condition that is equal to 90% of greater trochanter head height. If the friction between ITB and lateral femoral epicondyle was not induced, athletes with ITBFS do not feel pain during knee joint flexion and extension. Therefore, athletes with ITBFS may train aerobic capacity if they can not run because of knee pain. We trust that the result of this study is beneficial for athletes.

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