

## Use of an Inclinometer to Measure Flexibility of the Iliotibial Band Using the Ober Test and the Modified Ober Test: Differences in Magnitude and Reliability of Measurements

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**Study Design:** Test-retest design to evaluate the reliability of the measurement of iliotibial (IT) band flexibility using an inclinometer to measure the hip adduction angle.

**Objectives:** The primary objective was to determine the intrarater reliability of the Ober test and the modified Ober test for the assessment of IT band flexibility using an inclinometer to measure the hip adduction angle. A secondary objective was to determine if a difference existed between the measurements of IT band flexibility between the Ober and modified Ober test.

**Background:** The Ober test and the modified Ober test are frequently used for the measurement of IT band flexibility. To date, data documenting the objective measurement of flexibility of the IT band is scarce in the literature.

**Methods and Measures:** Sixty-one subjects, with a mean age of 24.2 (SD = 4.3) years, were measured during 2 measurement sessions over 2 consecutive days. During each measurement session, subjects were positioned on their left side and, with an inclinometer at the lateral epicondyle of the femur, hip adduction was measured during the Ober test (knee at 90° of flexion) and the modified Ober test (knee extended). If the limb was horizontal, it was considered to be at 0°, if below horizontal (adducted), it was recorded as a positive number, and if above horizontal (abducted), it was recorded as a negative number.

**Results:** The ICC values calculated for the intrarater reliability of the repeated measurement were 0.90 for the Ober test and 0.91 for the modified Ober test. Results of the dependent *t* test indicated a significantly greater range of motion of the hip in adduction using the modified Ober test as compared to the Ober test.

**Discussion and Conclusion:** The use of an inclinometer to measure hip adduction using both the Ober test and the modified Ober test appears to be a reliable method for the measurement of IT band flexibility, and the technique is quite easy to use. However, given that the modified Ober test allows significantly greater hip adduction range of motion than the Ober test, the 2 examination procedures should not be used interchangeably for the measurement of the flexibility of the IT band. *J Orthop Sports Phys Ther* 2003;33:326-330.

The iliotibial (IT) tract, or band, is a lateral thickening of the fascia lata that is composed of the distal fusion of the muscular fascia of the gluteus maximus and tensor fascia lata muscles. As such, the proximal attachments of the IT band are in common with those of the gluteus maximus and tensor fascia lata muscles, primarily originating from the iliac crest. The IT band is attached to the linea aspera and lateral epicondylar line of the femur via the lateral intermuscular septum. Distally, the IT band extends as far as the oblique line of the lateral condyle of the tibia, blending at that point with fibrous expansions of the biceps femoris and vastus lateralis muscles and with the knee joint capsule.<sup>1,18,27</sup> Along the lateral aspect of the knee, the IT band overlies and blends with the lateral patellar retinaculum, which is an aponeurotic expansion of the vastus lateralis tendon.

A tight IT band has been implicated in several problems related to the knee, including patellofemoral syndrome and iliotibial

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band friction syndrome. Several authors have suggested that tightness in the IT band may contribute to patellofemoral syndrome and knee pain by pulling the patella laterally, thereby causing abnormal tracking of the patella in the trochlear groove.<sup>3,4,16,21</sup> Iliotibial band friction syndrome, in which a tight IT band rubs over the lateral femoral epicondyle prominence with repetitive flexion and extension of the knee, has been reported as a relatively common condition in cyclists, ballet dancers, and runners, and has been attributed to the lack of flexibility of the IT band.<sup>9,10,15,19,23,26</sup> Across all of these reports in the literature related to the tight IT band and the problems that result from this lack of flexibility, the examination for IT band tightness that has consistently been advocated by each of these authors as the examination of choice is the Ober test or a modification of the Ober test.

The original Ober test was described in 1935 as a test to examine the relationship between tightness in the IT band and low back pain and sciatica. As originally described by Ober,<sup>20</sup> the patient is positioned on the side with the extremity to be tested facing upward. The examiner flexes the knee to be tested to 90° and abducts and extends the hip so that the hip is in line with the trunk. At this point, the examiner allows the force of gravity to cause the extremity to adduct as far as possible (Figure 1). Today, this test (known as the Ober test) is used not only to examine length of the IT band for individuals with low back pain, but also to examine flexibility of the IT band in all individuals.

In a modification to the original Ober test, Kendall<sup>13</sup> suggested that the examiner should keep the knee extended in the extremity to be tested (as opposed to flexing the knee to 90° as originally described by Ober) while performing the examination (Figure 2). This was referred to as the “modified Ober test,” and Kendall<sup>13</sup> rationalized that keeping the extremity in extension during the test caused less stress to the medial aspect of the knee, less tension on the patella, and less potential interference by a tight rectus femoris muscle. Melchione and Sullivan<sup>17</sup> suggested that the modified Ober test was a more functional test position. In reviewing the literature, the Ober test and modified Ober test appear to be used with equal frequency; one version of the test has not been shown to be more popular, accurate, or easier to perform than the other version.<sup>7,12,14</sup> Although Puniello<sup>21</sup> states that the IT band is pulled posteriorly with knee flexion, there is no agreement in the literature regarding the position of the knee (flexion versus extension) that creates the greatest tension on the IT band.<sup>7,12,14</sup> Therefore, prior to this study, there was no supposition that one test (the Ober test or the modified Ober test) would result in greater or less hip adduction range of motion than the other.



FIGURE 1. Measurement procedure for the Ober test (knee flexed to 90°) with an inclinometer. Note that the examiner holding the extremity is masked to the values of the inclinometer.



FIGURE 2. Measurement procedure for the modified Ober test (knee fully extended) with an inclinometer. Note that the examiner holding the extremity is masked to the values of the inclinometer.

Several methods have been described in the literature for quantifying the results of the Ober test and modifications of the Ober test ranging from observation<sup>8,11,20</sup> to the use of a goniometer,<sup>23</sup> tape measure,<sup>3</sup> and inclinometer.<sup>17</sup> Ober<sup>20</sup> relied on observation to quantify the results, stating that “if there is no contracture present, the thigh will adduct beyond the median line.” Hoppenfeld<sup>11</sup> suggested that when performing the Ober test, if the IT band is “normal,” the thigh should drop to the adducted position, and if “contracture” is present in the IT band, the thigh should remain abducted. Gose and Schweizer<sup>8</sup> presented a slightly more sophisticated classification system describing the position of the lower extremity relative to the horizontal body plane: “If the leg can be passively stretched to a position horizontal but not completely adducted to the table, it constitutes ‘minimal’ tightness, especially in the

proximal fascia. If the leg can be passively adducted to horizontal at best, it constitutes 'moderate' tightness of the iliotibial band and proximal fascia . . . If the leg cannot passively be adducted to horizontal, this constitutes a maximal contracture of the iliotibial band throughout its expanse."

Reid et al<sup>23</sup> suggested the use of a goniometer to quantify muscle length of the iliotibial band and tensor fascia lata during performance of the Ober test. The axis of the goniometer was placed at the ipsilateral anterior superior iliac spine, with the stationary arm of the goniometer parallel to the support surface (horizontal) and the moving arm aligned along the long axis of the adducting thigh and pointed toward the mid patella. Zero degrees was documented when the thigh was horizontal, a positive value was recorded if the thigh was adducted past horizontal, and a negative value was recorded if the thigh did not adduct to horizontal. Gajdosik et al<sup>7</sup> used similar goniometric procedures to measure IT band flexibility, but used positive values if the limb remained abducted beyond horizontal and negative values if the limb adducted past horizontal.

The use of a tape measure to quantify muscle length was described by Douchette and Goble.<sup>3</sup> Subjects were placed in the Ober test position and the distance between the medial border of the patella and the support surface was measured. Melchione and Sullivan<sup>17</sup> described the use of an inclinometer placed at the distal lateral thigh of the extremity on which the modified Ober test was performed.

Reports on the reliability of any of the measurement techniques (observation, tape measure, goniometer, inclinometer) used to quantify the Ober test or modification of the Ober test are few. Using a goniometer to measure IT band flexibility in men and women using the Ober test and the modified Ober test, Gajdosik et al<sup>7</sup> reported intrarater reliability ranging from 0.82 to 0.92. Using an inclinometer placed at the distal lateral thigh of the extremity in which the modified Ober test was performed, Melchione and Sullivan<sup>17</sup> reported intrarater reliability of 0.94 in their test-retest study design with 10 subjects.

Given that the Ober test and the modified Ober test are the predominant examination tools for the measurement of flexibility of the IT band, and given that data documenting the objective measurement of the IT band are scarce in the literature, information is needed to document if the Ober or the modified Ober test will provide accurate data and reliable information related to the flexibility of the IT band. Therefore, the primary purpose of this study was to determine the intrarater reliability (accuracy of same examiner) of the Ober test and the modified Ober test for the measurement of IT band flexibility using an inclinometer. If appropriate reliability was established during this study, then a secondary purpose of the investigation was to determine if a difference

existed between IT band flexibility (measured as hip adduction) as measured using the Ober test and the modified Ober test.

## METHODS

### Subjects

Sixty-one subjects (17 males, 44 females) with a mean age of 24.2 (SD = 4.3) years were recruited for this study. All subjects underwent an initial screening to ensure that they were pain free and did not have any musculoskeletal or neurologic dysfunction of the lower extremities at the time of data collection. Subjects were informed of the purpose of the study and the procedures to be used, and signed an informed consent form prior to data collection. The protocol for this study was approved by the Institutional Review Board of the University of Central Arkansas.

### Examiners

Three investigators participated in the measurement of IT band flexibility: examiner 1 possessed 20 years of experience in orthopaedic physical therapy and was responsible for performing the Ober and modified Ober test; examiner 2 had 20 years of experience in measuring joint range of motion and was responsible for placing the inclinometer; and the third individual was a graduate student in physical therapy who was involved in reading the inclinometer once it was positioned and recording the data.

### Equipment

An inclinometer is a circular, fluid-filled instrument with a weighted needle that indicates the number of degrees on a scale of a protractor. An inclinometer with markings at 1° increments was used for all measurements. During data collection, the examiners who performed the test and placed the measurement device were not allowed to view the inclinometer.

### Procedures

Data were collected during 2 measurement sessions. The IT band of the left lower extremity was arbitrarily chosen for measurement. Prior to data collection, random procedures were used to determine the order of the measurement technique used to measure IT band flexibility (Ober test versus modified Ober test).

Once the initial technique was randomly chosen, IT band flexibility was measured using the positioning described by Reese and Bandy.<sup>22</sup> The subjects were positioned on their right side with the hip and knee of the right lower extremity (against the support surface) flexed to 45° and 90°, respectively, in order to stabilize the pelvis.

Examiner 1 placed the right hand on the ipsilateral pelvis to stabilize it by pushing in a superior and downward direction. Examiner 1 then used the left hand to, first, passively abduct the hip, and second, to extend the subject's left hip in line with the trunk. Examiner 1 then asked the subject to relax all muscles of the lower extremity while allowing the uppermost limb to drop into adduction toward the table through the available hip adduction range of motion. As the limb dropped toward the table, examiner 1 supported the limb at the medial joint in order to lower the limb with greater control (Figures 1 and 2). In addition, this support hand prevented flexion and internal rotation of the hip. The end position of hip adduction was defined as the point at which lateral tilting of the pelvis was palpated, when the hip adduction movement stopped, or both.

When performing the Ober test, examiner 1 maintained the subject's knee in 90° of flexion (Figure 1). When performing the modified Ober test, examiner 1 maintained the subject's knee in full extension (Figure 2).

In this position, examiner 1 maintained the alignment and ensured that no tilting of the pelvis and no internal rotation and flexion of the hip occurred, while examiner 2 placed the inclinometer over the lateral epicondyle. Examiner 2 positioned the inclinometer so that the measurement scale was facing away from examiners 1 and 2. Examiner 3 then read the scale of the inclinometer (Figures 1 and 2). If the limb was horizontal, it was considered 0°; if below horizontal (adducted), it was recorded as a positive number; and if above horizontal (abducted), it was recorded as a negative number.

Each measurement (Ober test versus modified Ober test) was repeated twice during the measurement session. An average of the 2 measurements was used for later analysis.

One day later, the same procedures used to measure IT band flexibility with the Ober and modified Ober test were repeated. The researchers did not have information about the measurements collected on the first day when performing measurements of the IT band on the second day.

### Data Analysis

Means and standard deviations were calculated for the measurements obtained for both the Ober test and the modified Ober test for the first day and on the second day of data collection. Intrarater reliability of the measurements was assessed with 2 separate intraclass correlation coefficients (ICC<sub>3,2</sub>): 1 to examine the intrarater reliability of the Ober test, and 1 to examine the intrarater reliability of the modified Ober test.

Finally, a dependent *t* test was used to examine if a significant difference existed between the measurement of IT band flexibility performed using the Ober

test or the modified Ober test. Day 1 data were used for this analysis. The level of significance was set at  $P < .05$ .

### RESULTS

Descriptive statistics for measurement of day 1 and day 2 for both the Ober test and the modified Ober test are presented in the Table. The ICC values calculated for the between-days intrarater reliability of the repeated measurement was 0.90 for the Ober test and 0.91 for the modified Ober test.

Results of the dependent *t* test indicated a significant difference ( $P < .001$ ) in the range of motion of the hip between the Ober test (mean  $\pm$  SD = 18.9°  $\pm$  7.6°) and the modified Ober test (mean  $\pm$  SD = 23.4°  $\pm$  7.0°). The actual measurement difference between the Ober test and the modified Ober test was 4.5°.

### DISCUSSION

This study is one of the first investigations to quantify the measurement of IT band flexibility using the Ober test and the modified Ober test with an inclinometer. Several authors suggest that intratester reliability in a test-retest design needs to be above 0.80 to be considered acceptable.<sup>2,5,6</sup> The correlation coefficients for intrarater reliability achieved in this study of greater than 0.90, irrespective of whether the Ober test or modified Ober test was used, indicate that more than acceptable reliability was achieved according to these previously referenced authors.

Although Melchione and Sullivan<sup>17</sup> reported excellent reliability (ICC = 0.94) using an inclinometer, several differences exist between their study and the present one. First, the sample size of 10 was very low, and second, only the reliability of the modified Ober test was evaluated. Additionally, the technique used by Melchione and Sullivan<sup>17</sup> was quite complex, with the authors using a pelvic level and 2 universal goniometers to maintain pelvic position. The present study showed excellent reliability for both the Ober test and the modified Ober test using a technique that was much more simple and easy to use.

The results, which indicate that there is significantly greater hip adduction range of motion with

TABLE Hip adduction position (mean  $\pm$  standard deviation) representative of iliotibial band flexibility, using the Ober test and modified Ober test performed on 2 consecutive days (measured in degrees).

Technique	Day 1	Day 2
Ober test	18.9 $\pm$ 7.6*	18.6 $\pm$ 6.9
Modified Ober test	23.4 $\pm$ 7.0	23.0 $\pm$ 6.8

\*Values obtained for the Ober test on day 1 were significantly different than values for the modified Ober test on that same day.

the modified Ober test (knee extended) than with the Ober test (knee flexed), are consistent with previous results reported by Gajdosik et al,<sup>7</sup> even though these authors used a different measurement tool. The present study indicated that the difference in these 2 tests was nearly 5°, while Gajdosik et al<sup>7</sup> reported a difference of 10° (sample size was 49). However, larger sample sizes would be needed before any “normal” values should be discussed.

One possible explanation for the greater hip adduction range of motion observed when performing the Ober test with the knee extended rather than flexed may be secondary to the blending of fibers of the IT band and vastus lateralis tendon. Increased tension in the vastus lateralis muscle, caused by the flexed knee position, could in turn result in lengthening of the IT band through their common attachments. Gajdosik et al<sup>7</sup> allude to such a phenomenon as an explanation for the increased hip adduction they observed in the knee-extended position. However, anatomical and biomechanical studies fail to substantiate such an argument, asserting instead that the IT band tightens as the knee approaches extension.<sup>24,25</sup>

A second possible explanation for greater hip adduction range of motion with the modified Ober test (knee extended) than the Ober test (knee flexed) might be due to the inability to control the pelvis. The extended knee position may have allowed a greater passive torque to be applied across the IT band and provide a greater pull on the pelvis, thereby resulting in an increased range of hip adduction. However, no difficulty in stabilizing the pelvis was reported by the examiner. By supporting the limb being measured at the medial joint line with 1 hand and stabilizing and palpating pelvic tilting with the other hand, the examiner easily controlled the hip adduction movement and felt when the defined end range of hip adduction occurred.

## CONCLUSION

The use of an inclinometer for the measurement of IT band flexibility using both the Ober test and the modified Ober test appears to be reliable and the technique is quite easy to use. However, given that the modified Ober test demonstrated significantly greater hip range of motion than the Ober test, the 2 examination procedures should not be used interchangeably for the measurement of the flexibility of the IT band.

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