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Original Article

Reliability of the modified Thomas test using a lumbo-plevic stabilization

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Abstract. [Purpose] The purpose of this study was to examine the test-retest reliability of the modified Thomas test using lumbo-pelvic stabilization. [Subjects] Thirteen subjects (male=10, female=3) with hip flexor tightness voluntarily participated in the study. [Methods] The participants underwent the modified Thomas test under three conditions: 1) the general modified Thomas test (GM), 2) active lumbo-pelvic stabilization (ALS), and 3) passive lumbo-pelvic stabilization (PLS). Intra-class correlation coefficients (ICC) were used to determine the test-retest reliability of the knee joint angle measurement under three conditions. The standard error of measurement (SEM) and minimal detectable difference (95% confidence interval) (MDD^{95}) were calculated for each measurement to assess absolute consistency. [Results] The ALS (ICC = 0.99) and PLS (ICC = 0.98) methods for the modified Thomas test were more reliable than GM method (ICC = 0.97). The MDD^{95} score for the ALS method, 2.35 degrees, indicated that a real difference existed between two testing sessions compared with the scores for the PLS (3.70 degrees) and GM methods (4.17 degrees) [Conclusion] Lumbo-pelvic stabilization is one of the considerations for precise measurement and may help to minimize measurement error when evaluating hip flexor tightness using the modified Thomas test.

Key words: Lumbo-pelvic stabilization, Modified Thomas test

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INTRODUCTION

The tightness of the hip flexor muscles limits hip hyperextension in gait and may correlate with lumbar curvature, back pain, and knee dysfunction. The modified Thomas test is used to assess the flexibility of four different types of hip flexor muscle: the iliacus, psoas major, rectus femoris, and tensor fasciae latae (TFL)[1, 2)]. Though the modified Thomas test has been commonly used, it is still unclear which test can be used most reliably. The test may be affected by variations in the assessment skill of the examiners, the scoring method, the consistency of the assessment procedure, or the accuracy of the measurement equipment[3, 4)]. To improve the clinical reliability of the modified Thomas test, various alternative methodological approaches have been proposed, for example, utilization of an inclinometer instead of a goniometer, the use of digital photography, comparison by goniometer, and a pass/fail scoring system[3, 5–7)].

Lower limb movements result in forces on the vertebrae and can affect the lumbo-pelvic area[8, 9)]. When the hip flexor muscles are short, the lumbar vertebrae are put directly into more extended positions, and the degree of the anterior pelvic tilt is increased during the modified Thomas test. As a result, the reliability of the test outcome is limited[10)]. Therefore, lumbo-pelvic stabilization is one of the imperative considerations for test-retest reliability. Although several studies have investigated the reliability of the modified Thomas test, whether lumbo-pelvic stabilization can influence the test-retest reliability has not yet been reported. The aim of our study was to examine the test-retest reliability of alternative methods of the modified Thomas test. Specifically, we investigated the effects of lumbar stabilization on the reliability of the modified Thomas test.

SUBJECTS AND METHODS

Thirteen subjects (male=10, female=3) with hip flexor tightness participated in the study. Subjects who met the inclusion criteria including no history of surgery or trauma to the hip, knee, or lower extremities voluntarily participated in this study. Prior to the study, the principal investigator explained all procedures in detail to the subjects. All subjects signed an informed consent form. A physical therapist with five years of orthopedic physical therapy experience measured the flexibility of the rectus femoris muscle of the dominant leg using the modified Thomas test. Examiner training sessions were conducted by the principal investigator to ensure familiarization and standardization of the pho-

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Table 1. Mean and standard deviation for the knee joint angle according to the measurement methods (N = 13)

	Session 1		Session 2	
	Mean	SD	Mean	SD
General measurement	59.0°	9.2°	59.0°	8.7°
Active stabilization measurement	50.8°	8.3°	51.0°	8.7°
Passive stabilization measurement	50.6°	9.9°	50.6°	9.3°

Table 2. Inter-rater reliability of knee joint angle according to measurement methods (N = 13)

	ICC_a	SEM_b	$MDD^{95}{}_c$
General measurement	0.97 (0.91–0.99)	1.51	4.17
Active stabilization measurement	0.99 (0.98–0.99)	0.85	2.35
Passive stabilization measurement	0.98 (0.95–0.99)	1.34	3.70

ICC_a: intraclass correlation coefficient (95% confidence interval); SEM_b: standard error of measurement; $MDD^{95}{}_c$: minimal detectable differences (95% confidence interval)

tographic measurements, including the precise location of the landmarks and measurement, in order to reduce measurement error. Each assessment was made according to previously described methodologies[11, 12]. The lower extremity of each subject was photographed by the principal investigator using a digital camera (DCR-SR68/S; Sony Corp., Tokyo, Japan). Prior to taking a photograph, the examiner used three adhesive circular red stickers (5 mm in diameter) to mark the fibula (most proximal aspect located 3–4 inches laterally to the tibial tuberosity), the greater trochanter of the femur (most superficial aspect located 4–6 inches inferiorly to the midpoint of the iliac crest), and the lateral malleolus (most distal aspect) of the fibula. After attaching the three stickers, the examiners took photographs with the still image function. Examiners used the modified Thomas test to assess rectus femoris tightness in each subject under three measurement conditions. First, the general modified-Thomas test (GM) was performed. Second, active lumbo-pelvic stabilization (ALS) by internal fixation was accomplished using a biofeedback pressure of 40 mmHg during the modified Thomas test. Third, passive lumbo-pelvic stabilization (PLS) by external fixation was accomplished with the examiner's hand on the right side of the pelvis (dominant leg) during the modified Thomas test. The order of measurement was randomized using the random number generator in Excel. The subjects were asked to rest for 10 minutes to minimize the effect of the previous measurement. After the first measurement session, the second session (after an interval of 2–5 days) was performed following the identical protocol. The knee joint angle under the three conditions was determined using the Simi motion analysis software (Simi Motion 5.0; Simi Reality Motion Systems, Unterschleissheim, Germany). Examiners placed the computer marker over the predetermined point (adhesive red sticker) on the photograph. Two red lines (from the greater trochanter to fibula and from the fibula to the lateral malleolus) were drawn by the Simi software, which automatically calculated the angle between the two lines. The study was approved by the Yonsei University Wonju Campus Human Studies Committees.

The mean and standard deviation (SD) of each subject's characteristics and knee joint angle were calculated under the three conditions. Intra-class correlation coefficients (ICC; 3, 1) were used to determine the test-retest reliability of the knee joint angle measurement under the three conditions. For the purpose of interpretation, an ICC >0.75 was considered "excellent," 0.40–0.75 was "fair to good," and 0.00–0.40 was "poor"[13]. The standard error of measurement (SEM) was calculated for each measurement in order to assess absolute consistency [$SEM=SD\sqrt{1-ICC}$]. Minimal detectable difference (95% confidence interval) (MDD^{95}) scores were calculated [$MDD^{95}=SEM \times \sqrt{2} \times 1.96$][14]. Statistical analyses were performed using the Statistical Package for the Social Sciences version 12 for Windows (SPSS, Inc., Chicago, IL, USA).

RESULTS

The mean age, weight, and height (mean ± standard deviation [SD]) of the subjects was 24.0 ± 3.9 year, weight was 63.3 ± 4.2 kg, and height was 171.2 ± 5.6 cm. The mean and standard deviation are shown for the knee joint angle according to measurement methods in Table 1. The ICC, SEM, and MDD^{95} are shown in Table 2.

DISCUSSION

The purpose of this study was to examine the test-retest reliability of lumbo-pelvic stabilization as an alternative methods for the modified Thomas test. Previous studies have indicated that many variables confound the clinical reliability of the modified Thomas test. For example, the results were influenced by examiner experience[15], patient variation both within and between assessment sessions, variation in patient positioning, and landmark identification and scoring procedures[16]. To improve the precision of the measurement, the modified Thomas test using digital photography is cur-

rently being suggested[17].

Our results show that use of ALS (ICC = 0.99) or PLS (ICC = 0.98) for the modified Thomas test was more reliable than use of GM (ICC = 0.97). Even when compared with data from the previous research of Gabbe et al.[4] (ICC=0.69), Harvey[17] (ICC=0.91–0.94) and Peeler and Leiter[8] (ICC = 0.98), our results are more reliable. But, differences in testing procedure, scoring method, and sample size may explain the difference in the research results.

The MDD[95] score for the ALS method, 2.35 degrees, indicated that a real difference existed between the two testing sessions compared with the PLS score (3.70) and GM score (4.17). Because the ALS method can be achieved by co-contraction of the local and global muscles and an increased amount of abdominal muscles activity, lumbo-pelvic motion was minimized, and this provided more stability[17, 18]. This result has important implications for clinical and research measurement. Lumbo-pelvic stabilization is one of the considerations for precise measurement and may help to minimize measurement error when evaluating hip flexor tightness using the modified Thomas test.

This study has several limitations. First, because of the small sample size of young and healthy subjects in this study, the generalizability of our results is limited. Thus, additional research is needed to examine the reliability for different age and pathology groups. Second, not all measurement procedures were standardized. For example, PLS was accomplished by the examiner's hand in this study. Despite these limitations, the results of our study suggest that lumbo-pelvic stabilization was effective for increasing the reliability and for minimization of measurement errors in the modified Thomas test. Further study is required for standardization of the lumbo-pelvic stabilization measurement procedure of the modified Thomas test.

REFERENCES

1) Clapis PA, Davis SM, Davis RO: Reliability of inclinometer and goniometric measurements of hip extension flexibility using the modified Thomas test. Physiother Theory Pract, 2008, 24: 135–141. [Medline] [CrossRef]
2) Glard Y, Launay F, Viehweger E, et al.: Hip flexion contracture and lumbar spine lordosis in myelomeningocele. J Pediatr Orthop, 2005, 25: 476–478. [Medline] [CrossRef]
3) Peeler JD, Anderson JE: Reliability of the Thomas test for assessing range of motion about the hip. Phys Ther Sport, 2007, 8: 14–21. [CrossRef]
4) Gabbe BJ, Bennell KL, Wajswelner H, et al.: Reliability of common lower extremity musculoskeletal screening tests. Phys Ther Sport, 2004, 5: 90–97. [CrossRef]
5) Magee DJ: Orthopedic physical assessment, 3rd ed. Philadelphia: Saunders, 2002, pp 607–660.
6) Shaheen AA, Basuodan RM: Quantitative assessment of head posture of young adults based on lateral view photographs. J Phys Ther Sci, 2012, 24: 391–394. [CrossRef]
7) Yoshida A, Fukushima T, Sunagawa T, et al.: Development of a clinical model for upper extremity motion analysis—comparison with manual measurement. J Phys Ther Sci, 2012, 24: 1149–1152. [CrossRef]
8) Park KN, Yi CH, Jeon HS, et al.: Effects of lumbopelvic neutralization on the electromyographic activity, lumbopelvic and knee motion during seated knee extension in subjects with hamstring shortness. J Phys Ther Sci, 2012, 24: 17–22. [CrossRef]
9) Oh JS: Effects of pelvic belt on hip extensor muscle EMG activity during prone hip extension in females with chronic low back pain. J Phys Ther Sci, 2014, 26: 1023–1024. [Medline] [CrossRef]
10) Kendall FP, McCreary EK, Provance PG, et al.: Muscles Testing and Function, 5th ed. Baltimore: Williams and Wilkins, 2005, pp 271, 280–285.
11) Peeler JD, Anderson JE: Reliability limits of the modified Thomas test for assessing rectus femoris muscle flexibility about the knee joint. J Athl Train, 2008, 43: 470–476. [Medline] [CrossRef]
12) Peeler J, Leiter J: Using digital photography to document rectus femoris flexibility: a reliability study of the modified Thomas test. Physiother Theory Pract, 2013, 29: 319–327. [Medline] [CrossRef]
13) Crossley KM, Bennell KL, Cowan SM, et al.: Analysis of outcome measures for persons with patellofemoral pain: which are reliable and valid? Arch Phys Med Rehabil, 2004, 85: 815–822. [Medline] [CrossRef]
14) Ries JD, Echternach JL, Nof L, et al.: Test-retest reliability and minimal detectable change scores for the timed "up & go" test, the six-minute walk test, and gait speed in people with Alzheimer disease. Phys Ther, 2009, 89: 569–579. [Medline] [CrossRef]
15) Somers DL, Hanson JA, Kedzierski CM, et al.: The influence of experience on the reliability of goniometric and visual measurement of forefoot position. J Orthop Sports Phys Ther, 1997, 25: 192–202. [Medline] [CrossRef]
16) Harvey D: Assessment of the flexibility of elite athletes using the modified Thomas test. Br J Sports Med, 1998, 32: 68–70. [Medline] [CrossRef]
17) Park KH, Ha SM, Kim SJ, et al.: Effects of the pelvic rotatory control method on abdominal muscle activity and the pelvic rotation during active straight leg raising. Man Ther, 2013, 18: 220–224. [Medline] [CrossRef]
18) Noh KH, Kim JW, Kim GM, et al.: The influence of dual pressure biofeedback units on pelvic rotation and abdominal muscle activity during the active straight leg raise in women with chronic lower back pain. J Phys Ther Sci, 2014, 26: 717–719. [Medline] [CrossRef]