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Original Article

A 3-month Follow-up Study of the Long-term Effects of Direct Stretching of the Tensor Fasciae Latae Muscle in Patients with Acute Lumbago Using a Single-case Design

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Abstract. [Purpose] A 3-month follow-up study was conducted on a patient diagnosed with acute nonspecfic lumbago. Direct stretching (DS) of the tensor fasciae latae muscle (TFLM) was performed, and an immediate effect was confirmed. [Subjects] The case subject was a 60-year-old woman diagnosed with acute nonspecific lumbago. [Methods] We used a single-case study design and an AB-type study structure, in which the leg was placed in positions that relieved the back pain in period A and DS of the TFLM was performed in period B. The evaluation indices were the visual analog scale (VAS), finger-to-floor distance (FFD), and posterior lumbar flexibility (PLF), which were analyzed using the binomial test. [Results] The VAS, FFD, and PLF in period B showed significant improvement when compared with period A. Additionally, complaints of lower back pain ceased after 2 weeks, and the results of the follow-up study showed no recurrence of back pain during the 3 months. [Conclusion] The results of this study suggest that DS of the TFLM has an immediate effect on acute nonspecific lumbago in addition to long-term pain relief effects.

Key words: A 3-month follow-up, Tensor fasciae latae muscle, Acute nonspecific non-specific low back pain

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INTRODUCTION

Approximately 80–85% of the adult population has experienced or suffers from lower back pain, which results in difficulty while walking and turning in bed[1)]. In physical therapy in clinical settings, measures to alleviate pain frequently include manipulative physiotherapy in addition to physiotherapy and guidance for everyday management and exercise[2)]. However, some individuals who experience sudden onset of pain have a good prognosis in which the pain is alleviated without the cause of the pain becoming known. This is known as nonspecific lower back pain, and this pain may originate in the sacroiliac joints, the intervertebral joints, the muscles, or fascia or may arise from acute trauma to the annulus fibrosus of the intervertebral disc[3)]. Of these, pain originating from the intervertebral joints occurs most commonly, and accounts for 70–80% of all cases of lower back pain[4)]. The first-line treatment for nonspecific lower back pain is conservative therapy, with the main component being physical therapy[5)]. Typically, conservative therapy includes rest, drug therapy, nerve blocks, traction therapy and physiotherapy. Williams flexion exercises, exercises that focus on strengthening the abdominal muscles, and stretching are also performed in combination with pain relief[5)]. Since conservative therapy for acute lumbago does not increase the sensation of physical restraint or fear of moving compared with aggressive exercise therapy, some reports state that it is best to continue everyday activities within acceptable pain limits[2)]. On the other hand, conservative therapy for chronic lower back pain involves therapeutic exercises consisting mainly of exercises for the trunk muscles and stretching, which are reported to be more effective than anti-inflammatory analgesics[6–8)]. The purpose of these exercises is the relief of pain[7)]. When a noxious stimulus is applied to the area surrounding the intervertebral joints, referred pain associated with muscle spasms occurrs at a high frequency from the gluteal region to the tensor fasciae latae muscle (including the iliotibial band). If left untreated, this can lead to muscle contraction, which exacerbates lower back pain. Additionally, in the case of patients with chronic lower back pain who have no neurological symptoms in the lower limbs, performing DS of the TFLM and hamstrings can result in an immediate improvement in posture and gait. However, while there are several studies regarding physical therapy for acute lower back pain that have focused on lower back pain exercises and physiotherapy, there are very few studies focusing on interventions targeting specific muscles, and we found no reports of 3-month follow-ups of subjects.

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In this study, we adopted a single patient with acute nonspecific lumbago as a subject. The subject performed DS of only the TFLM, and the immediate effects thereof were analyzed using a single-case study design. We also conducted a 3-month follow-up study in order to investigate the usefulness of this therapy.

SUBJECTS AND METHODS

The subject was a 60-year-old woman (height, 157 cm; weight, 58 kg; body mass index, 23.6; hairdresser) diagnosed with acute lumbago (nonspecific lower back pain) originating in the intervertebral joints. The patient had not experienced any back pain before and reported that the pain had occurred in the muscles near the 4th and 5th lumbar vertebrae due to long periods of standing (as more than 12 hours), and that the pain increased the following day, rendering the patient unable to stand in the same position for longer than 5 minutes without sitting down. The pain was severe enough that she consulted her family doctor. The purpose of this study was fully explained to the patient and her consent to participate was obtained in writing based on the principles of the Helsinki Declaration. The subject voluntarily agreed to participate in the experiment after listening to the purpose and methods of the study.

On examination by the doctor, the patient was found to be negative for Lasègue's sign, and was deemed to have no neurological symptoms such as weakening of the lower limbs or sensory disturbance. Acute lumbago is defined as lower back pain that develops suddenly and that is not associated with neurological symptoms or pain in the lower limbs either during the initial examination or during the course of the illness. Patients complain of pain that develops within a single day and a temporary inability to move the body or corresponding pain, with the patient seeking medical advice within 14 days of onset[9]. Because there are no specific diagnostic criteria for lower back pain originating from the intervertebral joints, diagnosis is made comprehensively using physical findings and imaging findings based on previous research and plain X-rays. Diagnostic criteria[9] included findings of localized tenderness approximately 2 cm from the midline in the area of the intervertebral joints, particularly at the height of the interspinous processes, pain in the multifidus muscle, an absence of trigger points in the affected and painful muscles, and anteflexion of the trunk with notably restricted torsion and retroflexion. Differential diagnoses, which included neurological symptoms, tumors, or general medical conditions, were all excluded. The subject did not exhibit any serious neurological symptoms or clinical symptoms; thus, the need for X-ray imaging was deemed to be low. The subject was prescribed anti-inflammatory analgesics and compresses. But 2 days after the examination, the back pain remained unchanged, and the subject visited our offices.

The single-case study design systematically measures and evaluates patient performance by providing planned treatment and is said to be a case study method with experimental elements that allows new intervention methods to be assessed on a pilot study-basis[10]. We also adopted an AB-type intervention design. The AB-type design involved repeating an A period (primary basic significance level period) and a B period (treatment introduction period), which is the most basic method of verifying a treatment and its effectiveness. Various dependent variables can be assessed by establishing periods in which conventional treatment is performed or not performed (periods A and B) and by establishing a period in which a new treatment is performed. In this study design, a position that alleviated the lower back pain was adopted for 10 minutes during period A, and DS of the left and right TFLM was performed for approximately 10 minutes during period B. During this time, treatment was performed in the first 5 minutes, and the remaining 5 minutes were used for rest. During the treatment, a thumb was applied to the muscle being treated while exerting as little pressure as possible, and the opposite hand was used to press down on the thumb from above, which caused extension. This was based on performing extension in a horizontal direction. The main areas for treatment were the TFLM and the myotendinous junction of the iliotibial band. The amount of pressure applied did not exceed 5 on the VAS. With the subject in the prone position, the hip joint was abducted to 45 degrees with the knee flexed at 90 degrees.

Pain was measured using the visual analog scale (VAS), finger-to-floor distance (FFD), and degree of lumbar kyphosis. After intervention in the A and B periods, the changes in the VAS, FFD, and lumbar kyphosis indices were measured 5 times a minute. The measurement order was random. A 100 mm scale was used for the VAS measurement, with the left end of the scale indicating no pain at 0 mm and the right end of the scale indicating pain at 100 mm. During FFD measurement, the subject was instructed to attempt to reach as far as possible toward the tips of their toes with their fingertips without bending the knees, and to stop bending forward when pain appeared in the lumbar region. At this point, the distance between the fingertips and the floor was measured. The posterior lumbar flexibility (PLF) test was used to assess the range of posterior lumbar mobility. The test starts with both hips at 45 degrees of flexion; the hip joint of the leg placed superiorly is then flexed, and the thigh is brought as close as possible to the chest until resistance is felt. During flexion, the angle at which pain was reported was recorded and was used as an indicator of lumbar flexibility. This physical therapy intervention was performed once a week. We also used the same indicators for the entire 3 months and performed a follow-up study of physical function. No interventions were added, and changes in the VAS, FFD, and PLF indices were measured 5 times in 1 minute.

The patients were advised to stay active and continue ordinary daily activity as tolerated. She was also advised to maintain the pelvic tilt at all times, so that her lower back did not sway forward. When doing any task where she would be standing for a long period of time, such as ironing or doing dishes, shampooing, or, face sled, she was advised to put step stool or to sit on a high stool. This would decrease the sway in her lower back. Her most common sleeping position was on her side, with her legs and hips aligned and flexed. Because this position leaves her upper leg unsupported, the top knee and thigh tend to slide forward and rest on the

Table 1. Effects of direct stretching of the tensor fasciae latae muscle

	First treatment			After 1 week			After 2 weeks			After 3 weeks			After 4 weeks		
Term	VAS	FFD	PLF	VAS	FFD	PLF	VAS	FFD	PLF	VAS	FFD	PLF	VAS	FFD	PLF
	85	15	110	24	10	120	0	10	130	0	5	145	0	5	145
	82	15	110	28	10	120	0	10	135	0	5	145	0	5	145
A	86	15	110	23	10	120	0	10	135	0	5	145	0	5	145
	89	15	110	22	10	120	0	10	130	0	5	145	0	5	145
	84	15	110	24	10	120	0	10	130	0	5	145	0	5	145
	25	10	120	0	5	135	0	5	145	0	5	145	0	5	145
	23	10	120	0	5	135	0	5	145	0	5	145	0	5	145
B	23	10	125	0	5	135	0	5	145	0	5	145	0	5	145
	25	10	125	0	5	135	0	5	145	0	5	145	0	5	145
	21	10	120	0	5	135	0	5	145	0	5	145	0	5	145

A: primary basic significance level period, B: treatment introduction period, VAS (mm): visual analog scale, FFD (cm): finger-to-floor distance, PLF (°): posterior lumbar flexibility

Table 2. Results from the 3-month follow-up

Term	VAS	FFD	PLF	VAS	FFD	PLF	VAS	FFD	PLF
	0	5	145	0	5	145	0	5	145
	0	5	145	0	5	145	0	5	145
A	0	5	145	0	5	145	0	5	145
	0	5	145	0	5	145	0	5	145
	0	5	145	0	5	145	0	5	145

A: primary basic significance level period, VAS (mm): visual analog scale, FFD (cm): finger-to-floor distance, PLF (°): posterior lumbar flexibility

mattress, rotating the lower spine. This slight rotation may contribute to back or hip pain. To prevent that problem, she was advised to place a pillow between her knees and thighs.

To determine the efficacy of the intervention, a statistical analysis of changes in the VAS, FFD and PLF obtained during periods A and B was performed using the probability of binomial distribution. The probability of binomial distribution used in this study involved creating a regression line using the least squares method from a data point in period A, extending this regression line to period B, and statistically testing the number of data points that fell above (or below) the line[11]. The binomial distribution was calculated using the formula $P(r)=n!/r!(n-r)!p^{r}q^{n-r}$. In this formula, n was the total number of data points in period B and p and q were the probability that the data points lay above or below the regression line. A p value of 5% was considered significant.

RESULTS

A total of 5 treatments were conducted. After the first treatment (first day), we noted a significant decrease in the VAS and FFD and a significant increase in the PLF test results.. After the second treatment (first week), we observed a significant decrease in the VAS and FFD and a significant increase in the PLF test results. After the third treatment (second week), we observed a significant decrease in the FFD and a significant increase in the PLF test results. After the fourth treatment (third week) and fifth treatment (fourth week), no significant differences were observed in either the FFD or the PLF test results. The VAS was 0 mm from the third treatment (second week) onwards (Table 1). No recurrence of pain was observed after 3 months. After the fourth week, no significant differences were noted between the FFD and PLF results in the second and third months in period B (Table 2).

DISCUSSION

In order to determine the effect on lower back pain, we used the VAS as the pain scale, FFD for flexibility, and the PLF test for posterior lumbar flexibility. The VAS and FFD are also easy to use in clinical settings and are easily for patients to understand. The PLF test is used to measure the range of motion of the lumbar spine, and negative conversion is only considered to have occurred when sufficient posterior inclination of the pelvis is permitted, at which point at which the flexibility of the lumbar spine first starts to improve. The PLF test is a simple test of contracture to assess mobility of the lumbar spine.

Noxious stimulation of the intervertebral joints is the cause of reflexive spasms of the multifidus muscle, and findings of multifidus muscle tenderness are important for the assessment of lower back pain originating in the intervertebral joints[11].

The sudden onset of lower back pain in our subject was thought to have been caused by mechanical stimulation of

the intervertebral joints due to long periods of standing triggering reflexive spasms of the multifidus muscle. Most cases of acute lumbago recover spontaneously, but when the pain is inappropriately neglected, in addition to persistent spasms of the multifidus muscle, the withdrawal reflex is enhanced due to increased secondary hyperalgesia at the level of the spinal cord, which creates a new movement pattern and ultimately results in a vicious cycle of pain. When this occurs, the lower back pain becomes chronic[12]. Severe pain associated with reflexive spasms in the multifidus muscle due to noxious stimuli leads to immobility of the lumbar region. Furthermore, a new movement pattern associated with enhanced withdrawal reflex is formed, resulting in functional compensation by the hip joints below the lumbar spine, and forcing the hip joints to move excessively. The contraction and muscle spasms of the TFLM increase the tension in the iliotibial band, thereby promoting anterior inclination of the pelvis. Contractions and muscle spasms in the hamstrings act to promote posterior inclination of the pelvis. In other words, simultaneous contraction of both muscle groups reduces the degree of freedom of the pelvis, and this increases the amount of stress placed on the lumbar region during everyday activities. The compensatory TFLM spasms that result from this can be understood as a secondary disorder, which enhances the lower back pain and is assumed to be one cause of chronic lower back pain. The reason the lower back pain not progressing to chronic lower back pain in our subject is likely due to the compensatory TFLM spasms being assessed at an early stage and thus improving.

In the present study, by only applying manipulative extension to the TFLM, the range of motion of the hip joint and pelvis significantly improved, which may have led to decreased pain in the lumbar region. Kippers et al.[13] noted a correlation with anteflexion of the trunk in a standing position when the lower limbs were extended and elevated. However, the correlation with lumbar flexion was weak, and trunk anteflexion in a standing position was found to reflect the extensibility of the hamstrings. In the present study, FFD improved immediately, irrespective of the fact that no extension of the hamstrings was performed. The TFLM is commonly connected to the hamstrings through the fasia[14]. As a result, the hamstrings may have been indirectly extended. The TFLM fibers penetrate the fascia lata, the gluteus maximus muscle, the gluteus medius muscle, and the vastus lateralis muscle[14]. We assume that the degree of tension on the TFLM may indirectly influence the muscle tension of the muscle groups that surround the thigh. A significant increase was also observed in the mean PLF values. In general, in cases of lower back pain originating from the lumbar intervertebral joints, posterior lumbar flexibility is reduced due to persistent muscle spasms of the multifidus muscle and restriction of the intervertebral joints themselves. Accordingly, multifidus muscle relaxation and improvement of the range of motion of the lumbar intervertebral joints have been suggested in order to increase the range of posterior lumbar flexibility.

In this study, DS of the TFLM had an immediate effect on acute lumbago, and results of a 3-month follow-up study showed that no recurrence of pain occurred during the 3 months, the minimum period required to determine efficacy. The above results suggest that DS of the TFLM not only has an immediate effect on acute, non-specific lumbago, but also has a long-term effect.

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