

A Case Report on the Immediate Effects of Cytoskeletal Manual Therapy on Pain, Muscle Thickness, and Pressure Pain Threshold in a Patient with Scoliosis

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Objective: Patients with scoliosis complain of various symptoms such as muscle imbalance, dysfunction, back pain, abnormal posture and gait abnormality. The most basic treatment for scoliosis is to observe the progress based on conservative treatment. Therefore, in this case report, the effect of cytoskeletal manual therapy (CMT), a soft tissue mobilization technique, on pain intensity, muscle thickness, and pressure pain threshold (PPT) in a patient with scoliosis was investigated.

Design: A case report

Methods: A 25-year-old male diagnosed with scoliosis visited the Neuromusculoskeletal Science Laboratory with chronic back pain. In the laboratory, scoliosis was confirmed through the X-ray image used for his diagnosis, and it was confirmed again through Adam's forward bending test. Pain, pressure pain threshold and muscle thickness were measured to compare the immediate effects of CMT applied in the laboratory for 40 minutes. Treatments were visited two weeks after the first visit and outcome measures were assessed after a total of two visits.

Results: After receiving CMT up to the second session, the pain intensity decreased by 4 points and the screening angle decreased by 15 degrees. Muscle thickness decreased in all but 10 mm on the dominant side of the thoracic spine. All of the PPTs increased, and the greatest increase was 3.1 lb on the dominant side of the thoracic spine.

Conclusions: CMT showed positive improvement in pain during trunk flexion, spinal curvature, muscle imbalance, and pressure pain, which is considered as an ancillary treatment option for scoliosis management.

Key Words: Scoliosis, Pain, Diagnostic imaging, Manual therapy

Introduction

Scoliosis is defined as a deviation from the normal angle of the spine by lateral curvature and rotation [1, 2]. To confirm this, it is primarily performed through X-ray images, and it is determined that the Cobb angle is 10° or more [3, 4]. Idiopathic scoliosis, which accounts for 85% of scoliosis cases, has been reported with a prevalence of 0.9% to 12% worldwide [5]. The exact cause has not been identified, and it is classified into infancy (0-3 years), juvenile (3-10 years), and adolescence (10

years or older) according to the time of expression. Causes of expression are proposed as structural, hormonal, growth, genetic, and metabolic abnormalities [6].

Patients with scoliosis complain of various symptoms such as muscle imbalance, dysfunction, low back pain, and abnormal posture and gait abnormality, and above all, the visually distorted body causes a decrease in quality of life [7]. Treatment of scoliosis is approached differently depending on the angle. Observation and conservative treatment are required when the angle is less than 25°, and active orthosis

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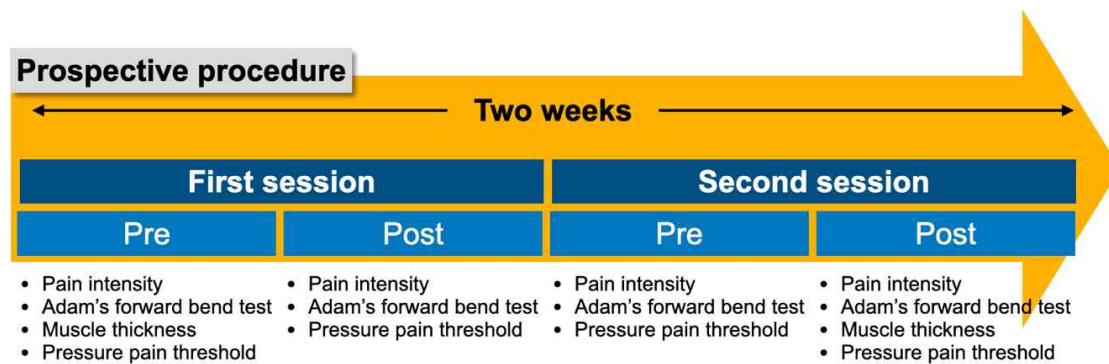


Figure 1. Prospective procedure of case report.

treatment is recommended when the angle is between 25° and less than 50° . Surgical operation is considered when the angle is greater than 45° [4, 8]. Therefore, scoliosis treatment is the most basic treatment approach based on conservative treatment and observation of progress, and scoliosis-specific treatments mainly include various techniques of physical therapy, manual therapy, and exercise therapy [9].

This case report aims to investigate the effect of cytoskeletal manual therapy (CMT), a soft tissue mobilization technique based on the nobel theory, on pain intensity, muscle thickness, and pressure pain threshold (PPT) in a patient with scoliosis in the conservative management of scoliosis.

Methods

In accordance with the Declaration of Helsinki, this case report was conducted after sufficient explanation of the study was given to the patient and consent was obtained. The progress and procedure of the study are shown in Figure 1.

Patient history and systems review

A 25-year-old male who was receiving outpatient treatment for back pain was diagnosed with scoliosis (Figure 2). A man who went to several hospitals and physical therapy centers came to the NeuromusculoskeletalScienceLaboratory because his back pain could not be controlled. His height was 183 cm, his weight was 76 kg, and no other neurological or cardiorespiratory problems were found. He had no major problems functionally, but he said that it was most uncomfortable when he bent his back.

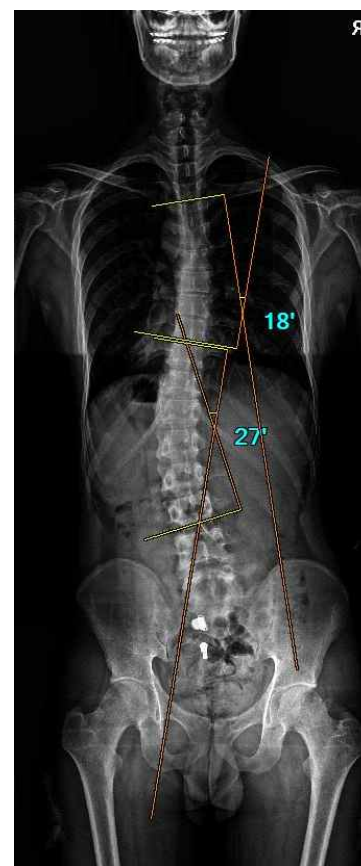


Figure 2. Spinal Scoliosis.

Examination

The patient's pain intensity, scoliosis screening angle, muscle thickness, and pressure pain threshold were measured (Figure 1).

For pain intensity, a numeric pain rating scale (NPRS) consisting of 0 to 10 points was used. The pain felt when bending the back was numerically confirmed. The more severe the pain, the higher the

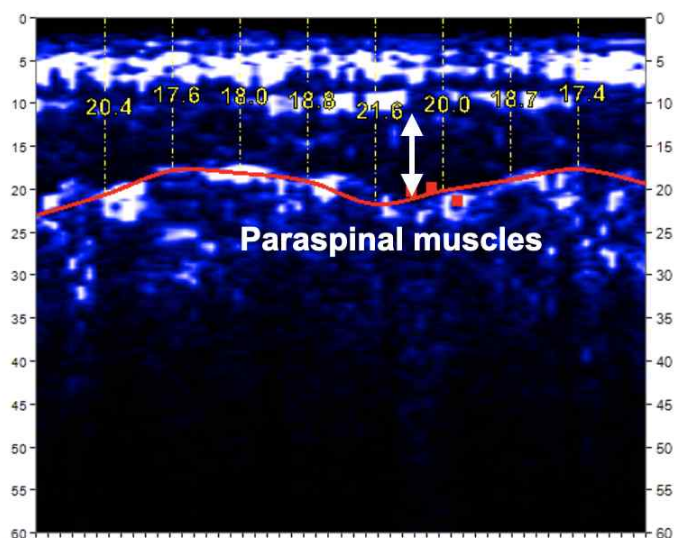


Figure 3. Measurement of muscle thickness using Bodymetrix

score, and the reported minimal clinically important difference (MCID) is 2 points [10].

The scoliosis screening angle used Adam's forward bend test. It is the most commonly used test when screening for scoliosis, and the angle was measured with a scoliosis goniometer app (Scolicheck, Scolicare, Korea). It was reported that the inter- and intra-rater reliability was high at $r=0.86\sim 0.97$ [11].

Muscle thickness was measured using an ultrasound imaging unit (Bodymetrix Pro System, Intelamatrix, Livermore)(Figure 3). The reported test-retest reliability was reported to be 0.99 [12]. The areas measured were the erector spinae of the thoracic and lumbar spine and the semitendinosus of the lower extremities.

Finally, the measurement of the PPT was measured using an algometer (Baseline®, India). A 1.52cm^2 rubber plate is subjected to pressure through a probe and the value is checked on a gauge [13]. Intraclass correlation coefficients reported inter-rater reliability ranging from 0.82 to 0.90 [14].

Cytoskeletal manual therapy

CMT is a novel soft tissue mobilization technique that emerged from touch science based on neuroscientific insights and cell biological evidence [15]. As for the technical characteristics, the compression force would

be increased due to the counter force of the stimulus pressed on the tissue, and the ischemic pain would be increased [16]. Although there are various cell biological grounds [17, 18], the principle is to stimulate transverse tissue as a local stretching effect.

The patient received CMT in the prone position. In the CMT procedure, an imbalanced pattern of all muscles (called a Cascade Connection System [CCS] in the CMT concept) is applied for 40 minutes. However, in the study, it was applied to the thoracic spine, lumbar erector spinae muscle, and semitendinosus muscle (15 minutes) during CMT to find out the immediate effect and then measured. The techniques of CMT used are transverse local stretching, transverse vibration, hold and move [15].

Results

Table 1 shows pain, screening angle, muscle thickness, and PPT for patients who received CMT twice over two weeks.

Pain intensity decreased by four points from six points to two points in the first session and by two points from four points to two points in the second session. Adam's forward bend test was conducted as the screening angle, and in the first session, it decreased from 20° to 12° , and in the second session,

Table 1. Post-intervention changes in pain, screening angle, muscle thickness, and pressure pain threshold.

	First session		Second session			Δ^*	
	Pre	Post	Post-Pre	Pre	Post		Post-Pre
NPRS (point)	6	2	4	4	2	2	4
Adam's forward bend test (angle)	20	8	12	6	5	1	15
Thoracic spine							
Non-dominant side							
Muscle thickness (mm)	61				49		12
Pressure pain (lb)	3.8	4.5	-0.7	5.8	5.7	0.1	-1.9
Dominant side							
Muscle thickness (mm)	44				54		-10
Pressure pain (lb)	3.1	4.6	-1.5	6.1	6.2	-0.1	-3.1
Lumbar spine							
Non-dominant side							
Muscle thickness (mm)	19				17		2
Pressure pain (lb)	3.6	6	-2.4	5.1	6.2	-1.1	-2.6
Dominant side							
Muscle thickness (mm)	20				15		5
Pressure pain (lb)	3.7	4.4	-0.7	4.7	6.6	-1.9	-2.9
Semitendinosus							
Non-dominant side							
Muscle thickness (mm)	170				159		11
Pressure pain (lb)	3.2	4.6	-1.4	5.4	5.7	-0.3	-2.5
Dominant side							
Muscle thickness (mm)	150				144		6
Pressure pain (lb)	4	4.4	-0.4	5.2	5.9	-0.7	-1.9

*Change from the first session to the second session.

it decreased from 6° to 1°.

Muscle thickness decreased by 12 mm on the non-dominant side(left) and increased by 10 mm on the dominant side (right) in the thoracic spine. In the lumbar spine, the non-dominant side decreased by 2 mm and the dominant side by 5 mm. In the hamstring, the non-dominant side decreased by 11 mm and the dominant side decreased by 6 mm (Figure 4).

PPT increased by 1.9 lb on the non-dominant side and 3.1 lb on the dominant side in the thoracic spine. In the lumbar spine, the non-dominant side increased by 2.6 lb and the dominant side by 2.9 lb. In the hamstring, the non-dominant side increased by 2.5 lb, and the dominant side by 1.9 lb.

Discussion

This study is a case report to investigate the effect of CMT, a new concept of soft tissue mobilization in the conservative treatment of scoliosis. In a single case

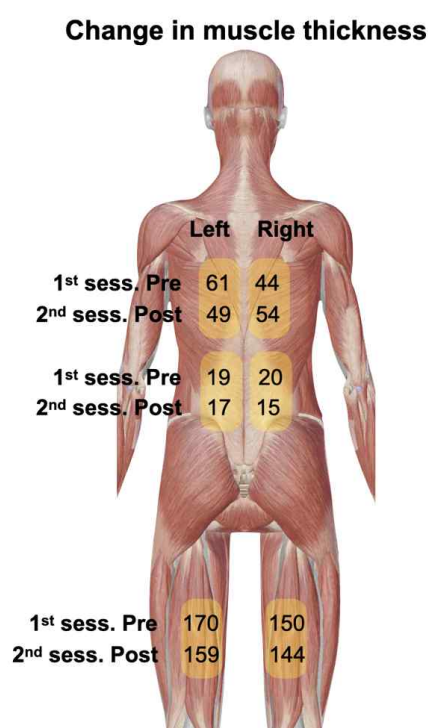


Figure 4. Changes in muscle thickness.

of scoliosis, the immediate effects on pain intensity, screening angle, muscle thickness, and PPT were confirmed.

After CMT, NPRS decreased by four points in the first session, which confirmed immediate pain reduction considering the previously reported MCID was two points. Also, two points decreased after two weeks, and two points decreased after the second session. These results showed a greater positive improvement compared to a decrease of three points in a case report in which myofascial release [19], one of the soft tissue mobilization procedures, was performed for six weeks twice a week.

The results of Adam's forward bend test showed a significant decrease from 20° to 5°. A change in the screening angle means that the asymmetry is reduced, which means that the curvature is reduced [20]. As proof of this, the muscle thickness of the erector spinae of the thoracic spine increased on the dominant side (right) and decreased on the non-dominant side (left)(Figure 4). It was erector spinae of the thoracic spine that showed the greatest increase in PPT, indicating that the reduction in asymmetry in muscle thickness is a positive effect on muscle properties.

The single case in this case report is typical of thoracolumbar scoliosis [21]. In scoliosis, the muscles on the concave surface shorten and the muscles on the convex surface lengthen [22]. Consistent with these characteristics of scoliosis, the results of this case report suggest that the muscle thickness of the thoracic spine increased, reducing asymmetry and increasing flexibility in the relationship between muscle length and tension. Likewise, the increase in PPT is the basis for supporting this. As a result, the decrease in back pain can be partially explained based on the decrease in asymmetry in the results of Adam's forward bend test. In addition, the muscle thickness of both semitendinosus was reduced, especially on the non-dominant side, which is consistent with the fact that back pain is related to stiffness of the hamstring on the non-dominant side, as reported by Radwan, et al. [23].

The difference between CMT and other manual therapies is that there is a difference in the direction of touch and pressure on the muscles, and rhythmic stimulation is given in connection with voluntary movement and breathing pattern. First of all, the

mechanism of differentiation from other manual therapies and effects by different stimuli is as follows. Upon muscle injury, fibro-adipogenic progenitors (FAPs) are activated and proliferate and expand [24-26]. Although it is a normal response for FAPs to be removed from the niche by apoptosis as regeneration continues [27], pathological accumulation and infiltration are closely related to muscle dysfunctions. In this regard, it is considered that it contributed to the reduction of the pathological accumulation of FAP, focusing on the basis of cytoskeleton migration and differentiation according to touch stimulation [28, 29].

As a result of this case report, positive improvement in pain, curvature, and muscle properties was confirmed through CMT in a single case of scoliosis. Due to the limitations of the case report, it is difficult to say that the results were improved through the effect of CMT, so only the immediate effect was confirmed, but there are other limitations. First, the change in curvature is insufficient to interpret as the result of Adam's forward bend test. Therefore, it is necessary to check the Cobb angle through X-ray images. Second, because it was intended to confirm the improvement trend of CMT only, the intervention was provided only twice, and it is difficult to expect a carryover effect. Similarly, randomized controlled trials with a control group and a follow-up period are needed.

Conclusion

Conflicts of interest

The authors declare no conflict of interest.

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