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CASE REPORT

Imaging and Clinical Findings after Auto-mobilization in a Cervical Disk Herniation Patient with Prolonged Neck Pain: A 7-year Follow-up Case Report

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Background: Auto-mobilization (AM) is a treatment method that patients can use by themselves for pain relief. We report the case of a patient diagnosed with cervical disk herniation (CDH), with frequent recurrences of upper limb numbness and neck pain. The patient experienced a favorable outcome after cervical spine AM, as evidenced by the immediate and long-term relief of his symptoms as well as changes observed through imaging. **Case:** A 33-year-old-man diagnosed with CDH presented with frequent recurrences of upper limb numbness and neck pain. Radiographic and T2-weighted magnetic resonance imaging scans revealed cervical spine kyphosis and a left paracentral to intraforaminal lesion with disk herniation of protrusion type at C4–5. He was started on AM to elicit physiological lordosis of the cervical spine. This treatment was painless and did not cause withdrawal on discontinuation. AM improved the mobility of his cervical lower facet joints, reduced dysesthesia, and eliminated pain. Improvement in neck pain and cervical kyphosis and reduction of disk herniation were observed 2 years after initiating the intervention. **Discussion:** Appropriate physical therapy evaluation and cervical AM for this patient resulted in symptomatic relief and indirect disk herniation regression. By adding imaging findings to clinical findings, the effect of AM could be visualized, and the reliability of the therapeutic effect was further enhanced.

Key Words: auto-mobilization; cervical disk herniation; magnetic resonance image; neck pain; radiography

INTRODUCTION

Acute cervical disk herniation (CDH) and cervical radiculopathy generally follow a spontaneously curative clinical course and are initially treated by non-surgical methods. The possibility of spontaneous disappearance of CDH is low because the cervical spine frequently prolapses between deep/shallow layers containing a large amount of annulus fibrosus and cartilage endplates.[1–3] Physical therapy (manual therapy: mobilization, manipulation, or traction) combined with medication and fixation with a cervical orthosis has been reported as a conservative treatment option for CDH.[4–9] Although a high level of evidence is not available in support of manual therapy, it can still be considered in selected cases, if appropriately administered. It should also be noted that "manual therapy" has not been consistently defined in research articles and may refer to any technique from soft tissue massage to high-velocity thrusts.[10] Recently, there have been reports of "auto-mobilization (AM) (or self-mobilization)" in which manual therapy was performed by the patients themselves.[11–13] However, there are fewer reports of AM use for CDH than reports of AM use for thoracic or lumbar dysfunction. In addition, previous reports on mobilization by physical therapists utilized the Numeric

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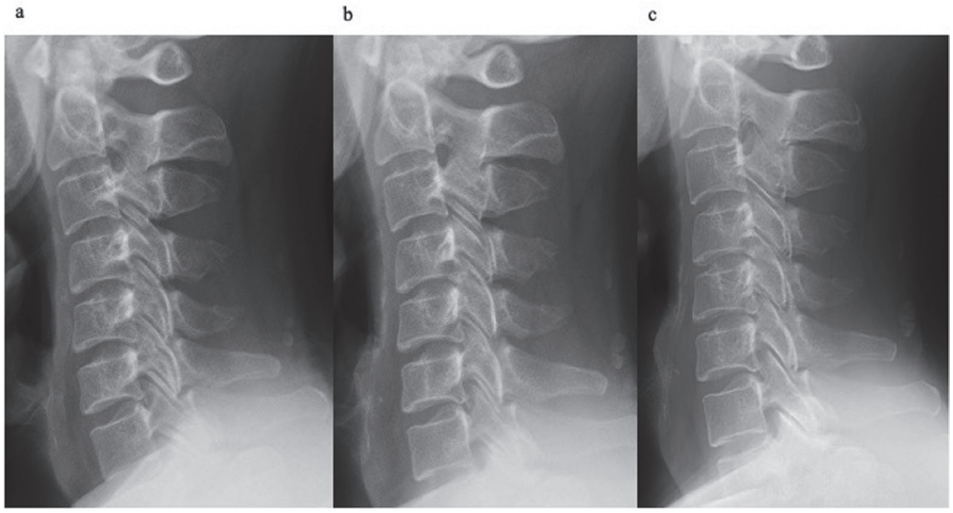

Fig. 1. Radiographic images obtained in the sagittal plane (cervical global angle) showing patient progress. (a) At initial onset (5.3°); (b) 5 years after initial onset (before AM) (0.1°); (c) 7 years after initial onset (2 years after AM) (5.1°).

Rating Scale (NRS) or Visual Analog Scale to determine the effects on neck pain and numbness.[4–8] Therefore, we believe that this case report is the first published report that utilizes imaging findings as outcomes to evaluate the efficacy of AM as a therapy for improving neck pain in patients with CDH.

Herein, we describe the treatment course of a patient diagnosed with CDH who experienced frequent recurrences of upper limb numbness and neck pain. Cervical spine AM was considered to elicit physiological lordosis of the cervical spine. This resulted in a favorable outcome for this patient, as evidenced by the changes in his symptoms and the imaging findings.

CASE

A 33-year-old male with no previous history of trauma experienced sudden neck pain and left upper limb numbness along the C6 dermatome. At the time of initial presentation, radiographic findings did not show any segmental-type ossification of the posterior longitudinal ligament (OPLL) on the posterior walls of the cervical level or narrowing of the canal. However, text neck was observed (**Fig. 1a**). The clinical parameters are listed in **Table 1**. The neck pain at rest was categorized as NRS-4 and motion pain (anteflexion, backbend, and rotation of the neck) as NRS-8. During examination by a physical therapist, winging of the left scapula (frontal plane/dorsal side), forward head (sagittal plane), and flat back of the upper thoracic spine were observed. There were no signs or symptoms of vertebrobasilar insufficiency (dizziness, nystagmus, nausea, or diplopia). A vertebrobasilar insufficiency positional test was also performed (Maigne test and Dix–Hallpike test) but no symptoms were observed. The response to the upper limb neurodynamic test[14] was positive in the median nerve and negative for the other nerves (the radial nerve and the ulnar nerve). There was paresthesia along the C4–8 areas on the left side. The patient's active range of neck motion was restricted and painful on the left side. Flexion and rotation to the left aggravated his arm and shoulder pain. The passive range of motion was 75° for right rotation and 85° for left rotation. The end feel of the final range of motion was "empty" with extension, right lateral flexion, and bilateral rotation. Passive intervertebral movements[15] were hyper-mobile at C4/5 and C5/6 levels and hypo-mobile at C6/7, C7/T1, and T1/2 levels. Coupled movements of left-side flexion (flexion, left lateroflexion, and left rotation) at the lower cervical spine level reproduced pain in that area, and coupled movements of right-side flexion (flexion, right lateroflexion, and right rotation) or extension (extension, right lateroflexion, and right rotation) at the lower cervical spine level increased muscle reactivity in that area. In addition, passive intervertebral extension movements at C4/5 and C5/6 levels reproduced the pain. There was no difference in muscle strength between the left and right sides. However, spasms of the trapezius, levator scapulae, scalenus, and suboccipital muscles on each side were observed. The brachioradialis reflex, biceps reflex, and triceps and plantar reflexes were elicited as normal. The patient was otherwise a healthy man (Barthel Index: 100/100 points). He was

Table 1. Clinical data obtained before and after auto-mobilization

	Initial onset	Before AM (after 5 years)	Two years post AM (after 7 years)
NRS (scores)			
Static pain	4	6	0
Motion pain			
Neck flexion	8	9	0
Neck extension	7	8	0
Rt. neck rotation	7	8	0
Lt. neck rotation	8	9	0
Numbness	+ (Lt. C4–8 area)	+ (Lt. C4–8 area)	+ (Lt. C6)
ULNT			
Lt. median nerve	+	+	–
Lt. radial nerve	–	–	–
Lt. ulnar nerve	–	–	–
PROM (degrees)			
Neck flexion	40	20	45
Neck extension	45	35	50
Rt. neck lateroflexion	30	20	35
Lt. neck lateroflexion	45	30	45
Rt. neck rotation	75	55	75
Lt. neck rotation	85	80	85
End feel			
Neck flexion	Firm	Firm	Firm
Neck extension	Firm	Firm	Firm
Rt. neck lateroflexion	Empty	Empty	Firm
Lt. neck lateroflexion	Empty	Empty	Less elastic
Rt. neck rotation	Empty	Empty	Firm
Lt. neck rotation	Empty	Empty	Firm
Passive intervertebral movement			
C1/2	1 (hypomobility)	1 (hypomobility)	2 (hypomobility)
C4/5	5 (hypermobility)	5 (hypermobility)	4 (hypermobility)
C5/6	5 (hypermobility)	5 (hypermobility)	3 (normal)
C6/7	1 (hypomobility)	1 (hypomobility)	3 (normal)
C7/T1	1 (hypomobility)	1 (hypomobility)	2 (hypomobility)
T1/2	1 (hypomobility)	1 (hypomobility)	3 (normal)
MMT			
Rt. U/E	5	5	5
Lt. U/E	5	5	5
Muscle spasm			
Bil. trapezius	+	+	–
Bil. levator scapulae	+	+	–
Bil. scalenus	+	+	–
Bil. suboccipitales	+	+	–
Muscle shortening			
Lt. trapezius	–	–	+
Bil. levator scapulae	–	–	–
Bil. scalenus	–	–	–
Bil. suboccipitales	–	–	+
Reflex			
Brachioradialis	–	–	–
Biceps	–	–	–
Triceps	–	–	–
Plantar	–	–	–
Barthel index (points)	100	100	100

Rt., right; Lt., left; Bil., bilateral; MMT, manual muscle testing; U/E, upper extremity; ULNT, upper limb neurodynamic test; PROM, passive range of motion.

reviewed twice after the initial presentation and was also administered manual therapy by a physical therapist twice after the initial consultation day. He underwent a physical therapy program comprising relaxation and stretching for the scalenus, trapezius, and levator scapulae muscles, joint mobilization and manipulation of the lower cervical spine and upper thoracic spine, and transcutaneous electrical nerve stimulation on the left side of the neck.[5,7,8] The patient was also prescribed a 2-week supply of 25-mg tramadol hydrochloride and 5-mg pregabalin tablets. His neck pain was alleviated by the medication and physical therapy within the first 2 weeks. However, the patient's symptoms never fully disappeared, and he experienced repeated recurrences. As the patient had stopped receiving treatment, he was still experiencing aggravation of his symptoms with neck movements 5 years after the initial presentation. The patient had used over-the-counter poultices and analgesics irregularly for these 5 years, but had not received massage therapy or acupuncture and had not visited a hospital.

Five years after the initial presentation, the patient underwent radiography and magnetic resonance imaging (MRI) along with examination by a physical therapist. Radiographic findings did not reveal any OPLL or narrowing of the canal. However, cervical spine kyphosis was observed, and the cervical global angle[16] was calculated to be 0.1° (**Fig. 1b**). T2-weighted MRI revealed a left paracentral to intraforaminal lesion with disk herniation of protrusion type at C4–5 (**Fig. 2**a,b). The CDH diameter was measured on T1-weighted MRI scans and was calculated to be 5.5 mm. The patient's neck pain with headache at rest was categorized as NRS-6 and his motion pain (anteflexion, backbend, and rotation of the neck) as NRS-9. Other clinical parameters are listed in **Table 1**. The patient was initiated on conservative treatment, including physical therapy and medication such as lidocaine or neurotropin injections. However, surgical options were also considered by orthopedic surgeons. The patient's pain was so severe that the physical therapist deemed aggressive manual therapy to be difficult to perform. The physical therapist-in-charge devised a mobilization plan that could be performed by the patient himself as it was within his pain threshold. **Figure 3** illustrates how a towel was used by the patient when performing AM. When the patient was in the supine position, he was instructed to: 1) place a rolled towel under the back of his neck, and to adjust the height (arch) to prevent his neck from falling (kyphosis); 2) ensure that the shoulder girdle and occipital region are always in contact with the ground; 3) keep the rolled towel in contact with the lower cervical spine level; 4) perform the above procedure

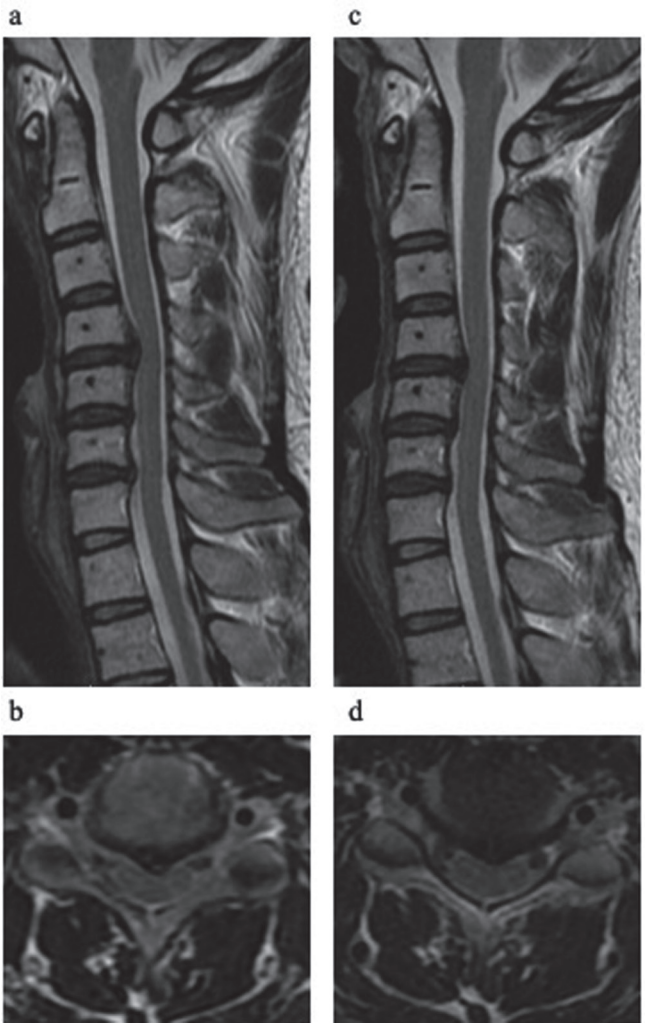

Fig. 2. T2-weighted magnetic resonance imaging scans showing patient progress. (a) Image taken in the sagittal plane 5 years after initial onset (before AM); (b) image taken in the axial plane 5 years after initial onset (before AM) (CDH diameter at C4–5: 5.5 mm); (c) image taken in the sagittal plane 7 years after initial onset (2 years after AM); (d) image taken in the axial plane 7 years after initial onset (2 years after AM) (CDH diameter at C4–5: 4.2 mm).

only when in the supine position not as compulsory training, and; 5) not perform AM when experiencing pain in this posture. No pain was experienced during AM. We also instructed the patient to decrease the diameter of the cylinder when he experienced neck pain and to increase the diameter of the cylinder when his neck pain was less by altering the folding configuration of the towel. The patient discontinued the medications on his own, 1 week after prescription. The patient was able to perform AM each day as part of his sleep routine. The frequency and severity of his pain episodes

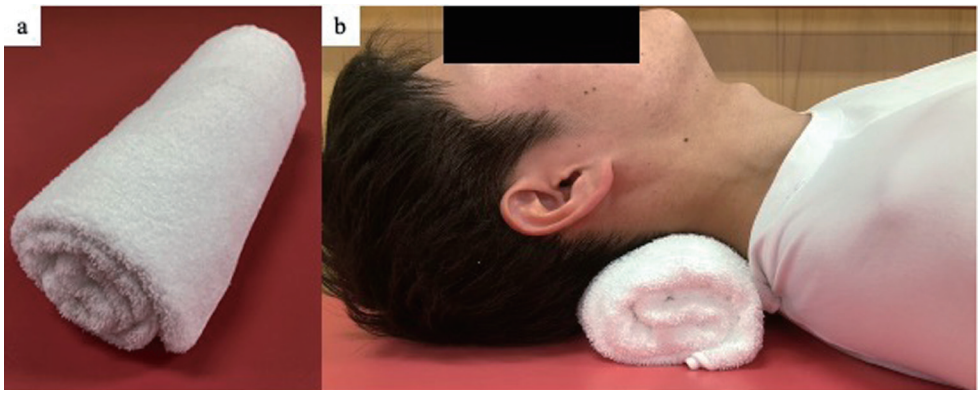

Fig. 3. Photographs of the towel used during AM. (a) The rolled towel (about the size of a bath towel); (b) placement of the rolled towel under the back of the neck (lower cervical spine level) and subsequent height adjustment (arch). The shoulder girdle and occipital region should always be in contact with the ground.

		Initial onset	After 1 w	After 2 w	…	After 5 y (Before AM)	After 5y + 1w	After 5y + 2 w	…	After 7 y (2 y post AM)
Medical doctor	・Clinical examination	•		no-show		•		no-show		•
	・X-ray	•				•				•
	・MRI					•				•
	・Medication (A 2-week supply) → Tramadol hydrochloride (25mg) Pregabalin (5mg)	•	The patient discontinued the medication.			•	The patient discontinued the medication.			
	・Injection → Lidocaine/Neurotropin (The pain area)					•				
	・Physical therapy (The following)	•				•				
Physical therapist	・Evaluation	•	•			•	•			•
	・Relaxation → Periarticular muscles of the neck and shoulder	•	•			•	•			
	・Stretching → Scalenus, Trapezius, Levator scapulae muscles	•	•							
	・Joint mobilization/ Manipulation → The lower cervical spine (C6/7, C7/T1) The upper thoracic spine (T1/2)	•	•							
	・Transcutaneous electrical nerve stimulation → The left side of the neck	•	•							
	・Teaching the auto-mobilization					•	•			
This case	・Auto-mobilization					The patient performed the auto-mobilization during his daily sleep.				
	・Over-the-counter poultices and analgesics	The patient had used over-the-counter poultices and analgesics irregularly.								

Fig. 4. Time course and adherence to treatment. A 2-week supply of tramadol hydrochloride and pregabalin tablets was prescribed to the patient at initial onset. However, the patient discontinued the medicine and physical therapy within the first 2 weeks. He used over-the-counter poultices and analgesics irregularly and did not visit any other hospitals or undergo massage therapy or acupuncture for 5 years. Five years after initial onset, the patient was initiated on AM, which he performed as part of his daily sleep routine.

were gradually reduced, and 2 months after initiating AM, he had no more severe pain, static pain, or motion pain of the neck. The time course and adherence to the treatment plan are shown in **Fig. 4**

At the final follow-up (2 years after initiating AM and 7 years after the initial presentation) (**Table 1**), the patient had numbness in his left thumb tip and forefinger tip. However, there was no recurrence of symptoms (neck pain and decline of range of motion), and the patient did not require any pharmacological interventions. Although the muscle spasms no longer occurred, mild shortening of the trapezius, levator scapulae, scalenus, and suboccipital muscles on the left side were observed. Passive intervertebral movements at the lower cervical spine level had increased and did not

induce any pain in his left neck area. The end feel of the final range of motion improved from "empty" to "firm or less elastic" with neck lateroflexion and rotation. There was no OPLL on radiographic scans. In addition, cervical spine kyphosis showed improvement (cervical global angle: 5.1°) (**Fig. 1c**). T2-weighted MRI scans revealed loss of disk herniation of protrusion type at C4–5 (CDH diameter: 4.2 mm) (**Fig. 2**c,d). Surgical options that were previously offered by orthopedic surgeons were withdrawn because they were no longer required.

Written informed consent was obtained from the patient. Our institution does not require ethical approval for case reports.

DISCUSSION

During the physical therapy evaluation before initiating AM, it was revealed that the patient was experiencing two types of pain. One was neuropathic pain and numbness in the C6 region, and the other was motor pain in the lower cervical spine. We inferred that the neurological symptoms experienced by the patient in the C6 area were probably caused by compression of the intervertebral foramen as a result of shortening of the scalene muscles. We also reasoned that the motion pain experienced by the patient in the lower cervical spine might be caused by hypermobility in C4/5 and C5/6 and hypomobility in the lower cervical spine and upper thoracic spine (C6/7, C7/T1, and T1/2).

Manual therapy is one of the conservative treatment options used for neck pain. A number of reports have described the use of AM in which patients performed the therapy themselves.[6,11–13] Said et al.[13] reasoned that both manual therapy and self-mobilization have a similar effect on the joint position error, Visual Analog Scale score, and Neck Disability Index.[17] Therefore, the traditional method can be favored in patients experiencing chronic mechanical neck pain. In this case, we devised a mobilization tool (AM for the lower cervical spine) for use by the patient himself while staying within his pain threshold. Nakamaru et al.[11] suggested that patients with mechanical neck pain who carried out thoracic spine self-mobilization demonstrated an increase in the active range of motion of cervical flexion and extension. Oh and Hwangbo[12] suggested that self-mobilization of the upper spine was useful in alleviating both pain and dysfunction of the cervical spine. In particular, it improved cervical spine extension. Thoracic spine thrust manipulation should be considered when treating patients with mechanical neck pain, especially if cervical spine thrust manipulation is contraindicated or if the patient is averse to it.[6] In our case, cervical spine manipulation (AM for lower cervical spine below the CDH level) was performed because there were no signs or symptoms of vertebrobasilar insufficiency, and it was not contraindicated by orthopedic surgeons. This AM of the cervical spine improved the mobility of the cervical lower facet joints, reduced dysesthesia, and eliminated pain. Wong et al.[18] suggested that the time required to achieve complete recovery was uncertain for patients with symptomatic CDH with radiculopathy. However, the improvement in symptoms continued for our patient and was even observed at the final follow-up (2 years after initiating AM and 7 years after the initial presentation). We have suggested that it might be necessary to consider pain-free AM for cervical spine levels with hypomobility as well as thoracic spine manipulation. In previous studies on AM, most of the outcome assessments were only based on functional evaluations such as cervical range of motion and pain scale for neck or upper extremities. No previously published study has revealed the effects of cervical spine AM alone, while including imaging findings. This also appears to be the first case report to include the long-term outcomes in the form of imaging findings to evaluate the efficacy of AM therapy for improving neck pain in a patient with CDH.

In our patient, cervical kyphosis and C4/5 disk herniation were observed 5 years after the initial presentation. However, improvement in cervical kyphosis (cervical global angle) and reduction of disk herniation were observed 2 years after the initiation of the intervention (AM of the cervical spine). The possibility of spontaneous disappearance of CDH was considered to be low.[1–3] Pan et al.[3] reported that the following factors could be related to the resorption of a herniated disk: the age of the patient, dehydration of the expanded nucleus pulposus, resorption of hematoma, revascularization, penetration of herniated cervical disk fragments through the posterior longitudinal ligament, size of disk herniations, and existence of cartilage and annulus fibrosus tissue in the herniated material. Based on our findings, we inferred that it is unlikely that the CDH would disappear spontaneously in the 2 years after the intervention because the symptoms recurred multiple times in our patient during the 5 years prior to receiving the intervention. For our patient, AM not only reduced symptoms but also indirectly affected cervical spinal alignment.

The cervical spine AM that we proposed is a treatment performed in a sequential manner, either when performing certain movements or when holding a particular posture (including sleeping). Previous studies on AM have indi-

cated self-mobilization with two tennis balls,[11] a Kaltenborn wedge,[12] or a towel.[13] We envisioned a simple treatment that the patient could easily continue. Therefore, AM may be effective for patients who find outpatient visits difficult or who do not like active exercise. AM should be provided based on the patient's symptoms and condition because appropriate physiotherapy evaluation is essential before providing AM. For our patient, the improved mobility of the lower cervical spine reduced mechanical stress on the cervical spine and led to the disappearance of symptoms, including pain. An indirect effect of cervical spine alignment was also observed. However, there was a residual decrease in mobility of the upper cervical spine (C1/2) above the compression level. Although muscle spasms no longer occurred, shortening of the muscles persisted on the pain side, including the trapezius muscle. Some published reports of home exercises have described symptom-relieving effects, but there are many limitations.[11–13,19] The cervical spine AM that we proposed in this case was intended to improve the mobility of the lower cervical spine and reduce the mechanical stress on the cervical spine. It is not a treatment method that completely improves the functional status. To make up for this limitation, we need to include approaches for the upper cervical spine and upper thoracic spine[6,11–13] as well as stabilization exercises[8] after pain relief.

CONCLUSION

Appropriate physical therapy evaluation and cervical spine AM improved mobility in the hypomobile cervical spine for our patient. The improved mobility of the hypomobile cervical spine might have resulted in distribution of hypermobility at the herniated level, hence resulting in reduced neck pain. Therefore, the reduction in neck pain could have indirectly impacted cervical spine alignment. We were able to visualize the effects of AM by adding imaging findings to clinical findings. The reliability of the therapeutic effect was also further enhanced. However, manual therapy-specific studies are scarce, include few participants, and possess numerous limitations that make it difficult to form clear and conclusive judgments about predisposing factors and predictors of adverse events.[20] Our study also only reports a single case. Therefore, future studies with larger patient populations are warranted to determine the ideal treatment method.

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CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

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