

Clinical Outcome From Mechanical Intermittent Cervical Traction for the Treatment of Cervical Radiculopathy: A Case Series

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Study Design: Case series.

Objective: To describe the clinical outcomes of 15 patients with cervical radiculopathy treated with mechanical intermittent cervical traction.

Background: Effectiveness of traction for the treatment of cervical spinal syndromes is controversial and the outcome of this treatment has not been established in the literature.

Methods and Measures: Fifteen patients (45.5 ± 13 years) completed a course of treatment using mechanical intermittent cervical traction. Eleven patients presented at baseline with radicular symptoms of 12 weeks duration or less, and 4 patients had long-standing radicular symptoms lasting more than 12 weeks. Outcome was measured using the Neck Disability Index (NDI) and the Numeric Pain Rating Scale (NPRS).

Results: Eight of the 15 cases (53%) in this series demonstrated complete pain resolution; these patients had symptom duration of 12 weeks and less. Seven of these 8 cases displayed a final NDI of 10% or less. Three out of 4 of the patients with symptom duration less than 12 weeks showed no reduction in pain or increased pain rating, with minimal change in perceived disability of 12% or less.

Conclusion: In this case series, patients with radicular symptoms lasting for 12 weeks and less demonstrated a reduction in pain and perceived disability. The NDI, when used in conjunction with the NPRS, provides a more comprehensive assessment of the patient with cervical radiculopathy, thus allowing the clinician to make a better judgment about the clinical effects of cervical traction. *J Orthop Sports Phys Ther* 2001;31:207-213.

Key Words: disability, neck pain, traction, treatment outcome

Cervical traction is often used by physical therapists to treat cervical radiculopathy.^{12,19} Opinions vary about the application methods and the clinical results associated with traction.^{12,19,20,25} It is speculated that traction unloads the components of the spine by stretching muscles, ligaments, and functional units,^{2,9,19} which is thought to result in distraction of articular surfaces. Traction might prevent or reduce adhesions within the dural sleeve^{2,9} and relieve nerve root compression within the central foramina.^{5,9,14,17,19,25} Saunders¹⁷ speculated that traction decreases pressure within intervertebral discs, while others have suggested that it relieves tonic muscle contraction^{2,6,9} and improves vascular status within the epidural space and perineural structures.¹⁴ The negative intradiscal pressure that is thought to occur during traction might result in reduction of the herniated nuclear material. Hunterbucher¹⁴ suggested that the effects of traction were mainly mechanical and, therefore, use of traction should be limited to those painful

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conditions where mechanical effects would likely produce improvement.

Effectiveness of traction for treatment of cervical spinal syndromes remains controversial. In a review of the existing literature, Van der Heijden et al²⁰ noted the prevalence of studies with small samples, design flaws, and a lack of clinically relevant outcome measures. They concluded that it was not possible to formulate a strong and valid judgment about the mechanism or the evidence of specific effects of traction from the available literature.

The purpose of this case series is to present the outcomes of 15 patients with cervical radiculopathy who were treated with mechanical intermittent cervical traction. Impairment, examination, and treatment information are described, as well as pain and perceived disability changes from evaluation to discharge. We hope that this case series will add to the pre-existing data on the effectiveness of cervical traction.

METHODS

Subjects

Fifteen consecutive patients who met the following inclusion criteria were admitted for the case series:

1. Complaint of pain radiating to the upper extremity that was provoked or exacerbated by cervical active range of motion.
2. Radicular pain accompanied by at least one of the following symptoms: decreased deep tendon reflexes, myotomal muscle weakness, or paresthesias in a dermatomal pattern. Radicular pain was defined as pain of the cervical nerve root origin (in the upper limb, shoulder, or scapular region) and was distributed in a dermatomal pattern.⁹
3. Clear or unequivocal relief of the radicular pain with the manual cervical distraction test.
4. No history of rheumatoid arthritis, malignancy, hypermobility, upper motor neuronal signs, or infectious disease of the spine. No history of atherosclerotic obstruction of the carotid artery or vertebral arteries, which could be exacerbated by pressure on the neck.

The patients (12 men, 3 women; 45.5 ± 13 years; age range, 32–81) completed a course of treatment for cervical radiculopathy at 2 outpatient clinics in the Pittsburgh, Pennsylvania area.

Physical Examination

All patients underwent a physical therapy examination prior to initial treatment and after the last visit. The examination included a detailed history of patient symptoms, measurements of cervical active range of motion, muscle strength testing, deep ten-

don reflex testing, soft tissue palpation, and performance of the cervical manual distraction test. Active range of motion of the cervical spine was measured with the patient in the seated position using a gravity goniometer that has a magnetic compass needle. Range of motion of forward flexion, sidebending, and extension were measured by force of gravity and rotation by the compass needle. Patterns of restriction that provoked or exacerbated pain were noted and classified as follows:

- Flexion restriction: limited cervical flexion provoking or exacerbating distal symptoms
- Capsular pattern: no limitation of flexion, equal degree of bilateral restriction of sidebending and rotation, with some or greater limitation of extension⁷
- Closing restriction: equal restriction of ipsilateral sidebending and rotation and equal or greater limitation of extension¹⁰

Muscle strength for the myotomal distributions of C5–C8 was tested using methods described by Kendall and McCreary.¹⁵ The manual distraction test was performed as described by Saunders and Saunders.¹⁶ Viikari-Juntura²² found that the manual distraction test and the neck compression test were highly specific for radicular pain, along with neurologic and radiological signs in the diagnosis of root compression in cervical disc disease. The sensitivity of these tests, however, was found to be low.²²

Self-Report Measures

The Neck Disability Index (NDI) scale is used to show changes that occur in pain and functional limitations with treatment. The NDI is a 10-item, scaled questionnaire designed from the modification of the Oswestry low back pain index.²¹ The 10 items addressed in the NDI include effect of pain on personal care activities, lifting, reading, work-related activities, driving, sleeping, and the patient's level of participation in recreational activities. Each section contains 6 statements representing a different level of severity. Each section is scored on a 0 to 5 scale, with 5 designating the greatest disability. The scores of each section are summated for a total score of 50. The total score is then multiplied by 2 to arrive at a percentage score. This value represents the percentage of disability. The items addressed by this scale describe signs and symptoms, or level of disability, that patients commonly present with in physical therapy clinics.

The NDI provides a quantitative means of assessing the self-reported disability of patients presenting with neck pain.²¹ It is associated with levels of severity of patient complaints and is responsive to changes in symptom severity during the course of treatment.^{11,21} The NDI has good test-retest reliability and correlates with other commonly used scales that are known to be responsive to treatment such as the visual analogue scale

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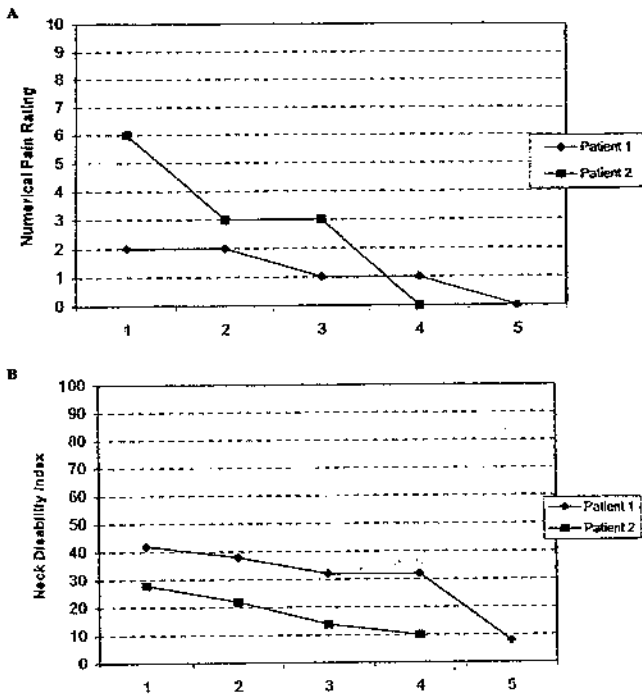


FIGURE 1. (A) Weekly Numerical Pain Rating scores for 2 patients with symptom duration less than 4 weeks. (B) Weekly Neck Disability Index scores for 2 patients with symptom duration less than 4 weeks.

and multiphasic pain questionnaire scores.²¹ Hains et al¹¹ found the NDI to have stable psychometric properties, as supported by high internal consistency.

The Numeric Pain Rating Scale (NPRS) was used to quantify pain. It is an ordinal scale designed to measure the magnitude or intensity of pain. The NPRS is scaled from 0 to 10, with 0 designating no

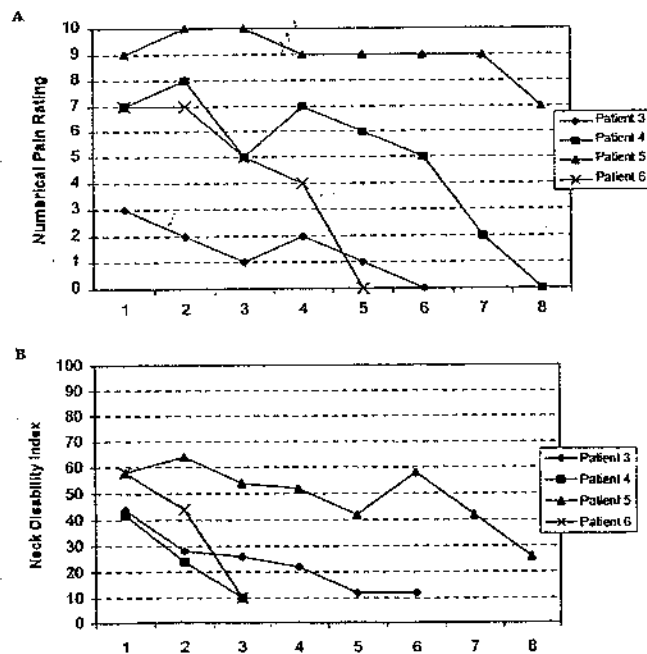


FIGURE 2. (A) Weekly Numerical Pain Rating scores for 4 patients with symptom duration of 4 weeks. (B) Weekly Neck Disability Index scores for 4 patients with symptom duration of 4 weeks.

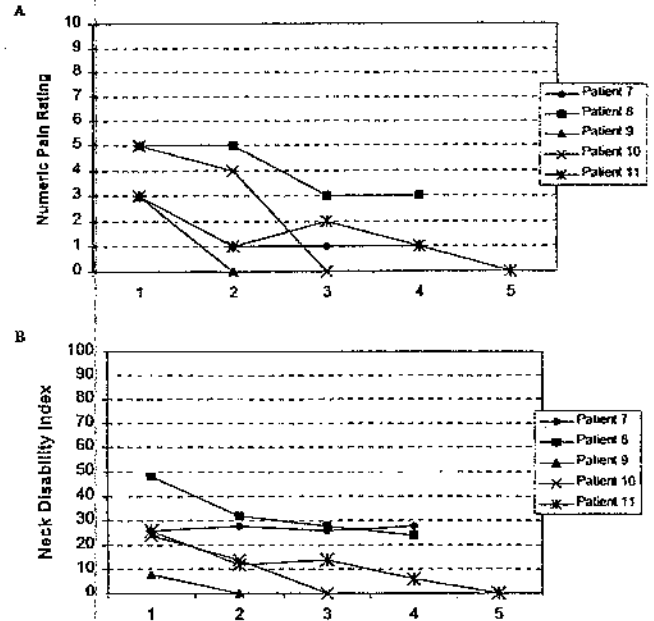


FIGURE 3. (A) Weekly Numerical Pain Rating scores for 5 patients with symptom duration 9-12 weeks. (B) Weekly Neck Disability Index scores for 5 patients with symptom duration 9-12 weeks.

pain and 10 designating the worst pain imaginable.^{4,8} Downie et al⁸ found that the NPRS is more accurate than a 4-point simple descriptive scale or a continuous visual analogue scale at measuring the same underlying pain variable.

The NDI and NPRS scores for each case in this series are summarized in Figures 1 through 4. Patients completed the NPRS at initial evaluation, discharge, and at the beginning of every visit.

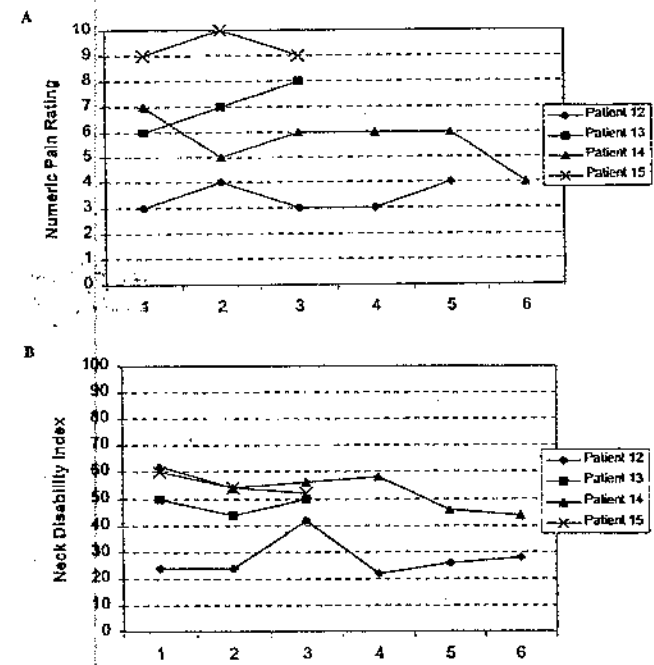


FIGURE 4. (A) Weekly Numerical Pain Rating scores for 4 patients with symptom duration greater than 12 weeks. (B) Weekly Neck Disability Index scores for 4 patients with symptom duration greater than 12 weeks.

TABLE 1. Initial traction characteristics based on movement restriction.

Movement restriction	Cervical position	Type of force	Maximum: Minimum force ratio*
Capsular	Flexion	Gentle, oscillatory	5:1
Flexion restriction	Slight pain-free flexion	Min and max force	2:1
Closing restriction	Flexion	Min and max force	3:1

Min force indicates least poundage set before the reoccurrence of radicular symptoms when traction force is decreasing; Max force, minimum amount of poundage needed to reduce radicular symptoms.

* Ratio of the maximum force to the minimum force used.

Treatment

Intermittent cervical traction was applied to each subject according to treatment guidelines devised by Erhard¹⁰ (Table 1). According to this protocol, a decision algorithm is used to determine indication for traction and treatment parameters (position, duration, and force of pull). Decisions are based upon presence of distal symptoms, symptom response to movement, and type of movement restriction (as described earlier in this study). The initial treatment parameters used in this case series are summarized in Table 2. Treatment characteristics were adjusted according to patient response and tolerance during subsequent treatment sessions.

Patients who displayed muscle guarding upon examination received moist heat to the neck while in the supine position for 20 minutes to promote relaxation before traction was administered. Six patients who had significant limitation in intersegmental mobility underwent manipulation, mobilization techniques, or both (Table 2). All patients were educated on proper positioning of the neck to avoid pain-provoking positions. The patients also participated in an aerobic activity such as cycling on the upper body ergometer, and neck retraction and scapular strength-

ening exercises to promote good postural alignment. Borestein et al³ suggested that exercises are useful to maintain the benefits of traction.

RESULTS

Figures 1 through 4 illustrate changes in NPRS and NDI across treatment sessions for all patients in this case series. The NPRS values that corresponded to weekly NDI scores are plotted, except for Cases 4 and 6, where additional NPRS scores were included to better show the pattern of pain level alteration with treatment. Two patients who presented with symptoms lasting for less than 4 weeks (Cases 1 and 2) demonstrated complete resolution of pain and an NDI reduction of 34% and 18%, respectively. Three of the 4 cases (Cases 3, 4, and 6) with symptom duration of 4 weeks demonstrated complete pain resolution and reduction of self-reported disability to less than 10%. These patients demonstrated an NDI reduction of 32-48%. The subject who had minimal pain reduction in this group (Case 5) demonstrated a 32% NDI reduction (Figure 2A and B).

Three of the 5 cases with symptom duration of 6 to 12 weeks demonstrated complete resolution of pain and self-reported disability. The 2 remaining

TABLE 2. Initial treatment parameters.

Case no.	Duration of symptoms	Pattern of restriction	Force of traction (lbs: max#/min#)	On/off time (s)	Duration of traction (min)	No. of sessions
1*	2 weeks	Closing	18/6	18/6	15	13
2*	3 weeks	Closing	24/8	18/6	15	6
3*	4 weeks	Closing	30/10	18/6	20	9
4*	4 weeks	Closing	30/10	30/10	15	10
5	4 weeks	Nonspecific	25/10	18/6	15	16
6*	4 weeks	Closing	22/5	18/6	15	7
7*	6 weeks	Closing	30/10	30/10	20	12
8	8 weeks	Capsular	24/5	30/10	20	10
9	8 weeks	Capsular	20/5	30/10	15	3
10	12 weeks	Flexion	20/8	10/15	15	7
11	12 weeks	Capsular	30/10	18/6	20	23
12	18 weeks	Closing	24/8	30/10	17	12
13	52 weeks†	Closing	24/8	30/10	15	6
14	260 weeks	Capsular	25/10	30/10	20	18
15	520 weeks	Capsular	35/10	30/10	20	11

Min# indicates least poundage set before the reoccurrence of radicular symptoms when traction force is decreasing; max#, minimum amount of poundage needed to reduce radicular symptoms.

* Patients who received manipulation or mobilization.

† Thirty year total duration with 52 weeks exacerbation.

cases in this duration group reported a 40% and 66% pain reduction and showed an NDI reduction of 24% for Case 8, with Case 7 showing a slight (2%) increase in NDI (Figure 3A and B). Three of the 4 cases with symptom duration greater than 12 weeks showed minimal to no reduction in pain rating or perceived disability. Interestingly, one case in this group demonstrated a 40% reduction in pain rating with no significant NDI change (Figure 4A and B). Overall, 8 of the 15 cases (53%) in this study demonstrated complete pain resolution. Seven of these 8 cases displayed a final NDI score of 10% or less, which were patients with symptom duration of 12 weeks or less.

DISCUSSION

Previous studies have shown mechanical effects of traction, but did not associate the effects with clinically relevant outcome measures.^{5,16,17,19,25} Saal et al¹⁶ reported having "good" to "excellent" outcomes with 20 of 24 patients treated with cervical traction, but did not use quantifiable outcome measures. However, the use of the NDI and NPRS in the present case series allowed us to monitor pain severity and the effect of pain on patient-reported performance of activities of daily living and allowed us to determine whether altering the patient's symptoms has an effect on the patient's disability. This information is an important contribution to the literature because it demonstrates the important role of physical therapy interventions in helping patients return to normal or previous levels of function in activities of daily living.

Patients who had symptoms lasting for more than 12 weeks showed minimal improvement in the NDI and pain rating scale. The chronicity of their symptoms may be a potential explanation for this poor outcome. Waddell²³ has suggested that chronic pain has a tendency to become increasingly dissociated from its original physical basis. It becomes more associated with emotional distress, depression, failed treatment, and adoption of a sick role. We hope that the present case series will provide motivation for a larger study, which will allow for stratification of patients into various levels of chronicity in order to assess these effects on treatment outcomes.

The patients in this case series had patterns of symptom presentation from each of the movement restriction patterns described earlier. It may have been useful to stratify these patients according to the movement restriction patterns since this is what guides the protocol that was used for treatment; however, because of the small number of cases, it was difficult to make conclusions as to whether or not specific groups responded better to cervical traction.

The patients in this case series received various adjunct treatments; therefore, the change in NDI and

NPRS cannot be solely attributed to the effects of traction. Six patients received mobilization and manipulations and that could have influenced outcome. These 6 patients were among those with duration of symptoms 12 weeks or less. According to Erhard, traction manipulation is indicated for patients with muscle weakness, producing an immediate response of demonstrable increase in muscle strength.¹⁰ In a cadaveric study, Yi-kan et al²⁴ found that rotatory manipulations under traction were safest when compared to simultaneous application of traction and rotation or traction imposed on a rotated spine.²⁴ Nevertheless, cervical spine manipulation has been reported to be risky or harmful, but there is little compelling evidence supporting or refuting its use.^{1,13,24}

Another limitation of this study was the lack of a control group. For future studies, it would be useful to have a control group whose patients have similar symptom durations. The clinical effects noted in this study are those noted at discharge of patients and, therefore, no conclusions can be made about long-term effects of traction.

CONCLUSION

Intermittent cervical traction can be used to treat patients with cervical radiculopathy. A reduction in pain level and in level of disability was observed in this case series. In particular, patients with a short duration of symptoms (12 weeks or less) had the best outcome. The NDI, when used in conjunction with the NPRS, provides a comprehensive assessment of the patient, allowing the clinician to make good judgments about the clinical effects of cervical traction.

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APPENDIX. Neck Disability Index

Name: _____ Date: _____

This questionnaire is designed to give the doctor information as to how your neck pain has affected your ability to manage in everyday life. Please answer every section and mark in each section only ONE box, which applies to you. We realize that you may consider that two of the statements in any one section may relate to you, but just mark the box which closely describes your problem.

Section 1—Pain intensity

- I have no pain at the moment.
- The pain is very mild at the moment.
- The pain is moderate at the moment.
- The pain is fairly severe at the moment.
- The pain is very severe at the moment.
- The pain is the worst imaginable at the moment.

Section 2—Personal care

- I can look after myself normally without causing extra pain.
- I can look after myself normally but it causes extra pain.
- It is painful to look after myself and I am slow and careful.
- I need some help but manage most of my personal care.
- I need help everyday in most aspects of self-care.
- I do not get dressed; I wash with difficulty and stay in bed.

Section 3—Lifting (skip if you have not attempted since the onset of your neck pain)

- I can lift heavy weights without extra pain.
- I can lift heavy weights but it gives me extra pain.
- Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently positioned, for example on table.
- Pain prevents me from lifting heavy objects, but manage light to medium weights if they are conveniently placed.
- I can lift very light weights.
- I cannot lift or carry anything at all.

Section 4—Reading

- I can read as much as I want to with no pain in my neck.
- I can read as much as I want to with slight pain in my neck.
- I can read as much as I want with moderate pain in my neck.
- I cannot read as much as I want because of moderate pain in my neck.
- I can hardly read at all because of severe pain in my neck.
- I cannot read at all.

Section 5—Headaches

- I have no headaches at all.
- I have slight headaches, which come infrequently.
- I have moderate headaches, which come frequently.
- I have moderate headaches which come infrequently.
- I have severe headaches, which come frequently.
- I have headaches almost all the time.

Section 6—Concentration

- I can concentrate fully when I want to with no difficulty.
- I can concentrate fully when I want to with slight difficulty.
- I have a fair degree of difficulty concentrating when I want to.
- I have a lot of difficulty concentrating when I want to.
- I have a great amount of difficulty in concentrating when I want to.
- I cannot concentrate at all.

Section 7—Work

- I can do as much work as I want.
- I can only do my usual work, but no more.
- I can do most of my usual work, but no more.
- I cannot do my usual work.
- I can hardly do any work at all.
- I cannot do any work at all.

Section 8—Driving

- I can drive my car without any neck pain.
- I can drive my car as long as I want with slight pain in my neck.
- I can drive my car as long as I want with moderate pain in my neck.
- I cannot drive my car as long as I want because of moderate pain in my neck.
- I can hardly drive at all because of severe pain in my neck.
- I cannot drive my car at all.

Section 9—Sleeping

- I have no trouble sleeping.
- My sleep is slightly disturbed (less than 1 hr sleeplessness).
- My sleep is mildly disturbed (1-2 hrs sleepless).
- My sleep is moderately disturbed (2-3 hrs sleepless).
- My sleep is greatly disturbed (3-5 hrs sleepless).
- My sleep is completely disturbed (5-7 hours sleepless).

Section 10—Recreation

- I am able to engage in all my recreational activities with no neck pain at all.
- I am able to engage in all my recreational activities, with some pain in the neck.
- I am able to engage in most, but not all of my usual recreational activities because of pain in my neck.
- I am able to engage in a few of my usual recreational activities because of pain in my neck.
- I can hardly do any recreational activities because of pain in my neck.
- I cannot do any recreational activities at all.

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