Traction is a mechanical force applied to the body in a way that separates the joint surfaces and elongates the surrounding soft tissues. Traction can be applied manually by the clinician or mechanically by a machine. Traction can also be applied by the patient using body weight and gravity to apply a force. Traction can be applied to the spinal or peripheral joints. This chapter focuses on the application of mechanical traction to the cervical and lumbar spine and briefly discusses the application of traction to the spine by other means. Information on the application of traction to the peripheral joints is not provided in this book because such traction is generally provided manually by the therapist and is therefore considered to be manual therapy rather than a physical agent. For further information on the application of traction to the peripheral joints, the reader should consult a manual therapy text.

Spinal traction gained popularity in the 1950s and 1960s in response to James Cyriax’s recommendations regarding the efficacy of this technique for the treatment of back and leg pain caused by disc protrusions. A range of studies suggest that spinal traction is more effective for reducing back pain and returning patients to activity than infrared radiation, corset and bed rest, hot packs and rest, hot packs, massage and mobilization, and bed rest. A number of studies, however, have failed to demonstrate that traction is more effective than other treatments, such as isometric exercises, or that high-force traction is any more effective than low-force traction. A systematic review of 24 randomized controlled trials with 2,177 patients looked at traction for mixed groups of patients with low back pain with and without sciatica. They found (1) strong evidence that there is no significant difference in short- or long-term outcomes between traction (continuous or intermittent) as a single treatment and placebo, sham, or no treatment; (2) moderate evidence that traction as a single treatment is no more effective than other treatments; and (3) limited evidence that adding traction to a standard physiotherapy program does not result in significantly different outcomes. There was moderate evidence that autotraction was more effective than mechanical traction for global improvement. However, many of the trials on traction are of poor quality, so the effectiveness of traction is still not known, and traction continues to be used and recommended for patients with symptoms attributable to spinal disorders with reports of good success. This chapter presents what is known about the efficacy of traction and makes recommendations for interventions that are most likely to be effective.

EFFECTS OF SPINAL TRACTION

Spinal traction can distract joint surfaces, reduce protrusions of nuclear discal material, stretch soft tissue, relax muscles, and mobilize joints. Low-force traction, of 10 to 20 lb, applied for a long duration, ranging from hours to a few days, can also be used to temporarily immobilize a patient. All of these effects may reduce the pain
associated with spinal dysfunction. The stimulation of sensory mechanoreceptors by traction may also gate the transmission of pain along afferent neural pain pathways.

A basic understanding of spinal anatomy is helpful when thinking about how traction works and its effects on the joints of the spine. The spine consists of 24 vertebrae stacked on top of each other and connected by ligaments. Between the bodies of each vertebra is a disc that connects one vertebra to another and that serves as a shock absorber (Fig. 10-1, A). The disc has a soft center called the nucleus pulposus surrounded by the tough, fibrous anulus fibrosus (Fig. 10-1, B). The spinal cord is posterior to the discs and the spinal bodies and runs through the spinal canal. The primary joints of the spine are the facet joints, also known as spinal apophyseal or zygapophyseal joints, which connect the posterior elements of the vertebrae. There are foramina, or holes, between the posterior elements of each of the vertebrae that serve as exit points for spinal nerve roots coming off the spinal cord. Spinal traction pulls longitudinally on the spine, potentially reducing pressure on the discs and facet joints, enlarging the intervertebral foramina, and stretching the ligaments, tendons, and muscles running along the spine.

**JOINT DISTRACTION**

**Joint distraction** is defined as “the separation of two articular surfaces perpendicular to the plane of the articulation.” Distraction of the spinal apophyseal joints help the patient who has signs and symptoms related to loading of these joints or compression of the spinal nerve roots as they pass through the intervertebral foramina. Joint distraction reduces compression on the joint surfaces and widens the intervertebral foramina, potentially reducing pressure on articular surfaces, intraarticular structures, or the spinal nerve roots. Thus joint distraction may reduce pain originating from joint injury or inflammation or from nerve root compression.

It has been proposed that the application of a traction force to the spine can cause distraction of the spinal apophyseal joints. One study showed approximately 3 mm joint distraction of the L2 to S1 intervertebral joints with gravitational traction in both healthy subjects and patients with low back pain. For distraction to occur, the force applied must be great enough to cause sufficient elongation of the soft tissues surrounding the joint to allow the joint surfaces to separate. Smaller amounts of force will increase the tension on, or elongate, the soft tissues of the spine without separating the joint surfaces. For example, a force equal to 25% of the patient’s body weight has been shown to be sufficient to increase the length of the lumbar spine; however, a force equal to 50% of the patient’s body weight has been found to be necessary to distract the lumbar apophyseal joints. The amount of force required to distract the spinal joints also varies with the location and health of the joints. In general, the larger lumbar joints, which have more and tougher surrounding soft tissues, require more force to achieve
JOINT MOBILIZATION

Traction

CHAPTER 10

reduced when self-traction was applied by the patient pulling on an overhead bar while lying down, wearing a pelvic harness attached to a spring force scale, or when manual traction was applied by one therapist pulling on the subject’s pelvis while another pulled under the arms.22 Also, Lundgren and Eldevik found that autotraction, in which the traction force is limited by the patient’s ability to pull with the arms, caused no change in the appearance of herniated lumbar discs on CT scan.26

Although the evidence for the effects of traction on discal protrusions is not conclusive, it appears that with sufficient traction force, of at least 27 kg (60 lb) to the lumbar spine, some disc protrusions are reduced by spinal traction and that traction can reduce symptoms in patients with local back or neck pain or radicular spinal symptoms caused by a disc protrusion, if the protrusion is reduced. These symptomatic improvements may be the result of reducing the discal protrusion or may be caused by concurrent changes in other associated structures such as increased size of the neural foramina, changes in the tension on soft tissues or nerves, or modification of the tone of the low back muscles.

JOINT MOBILIZATION

Traction has been recommended as a means to mobilize joints in order to increase joint mobility or decrease joint distraction than do the smaller cervical joints. As mentioned, distraction of the lumbar apophyseal joints has been demonstrated with a force equal to 50% of total body weight; in contrast, a force equal to approximately 7% of total body weight has been reported to be sufficient to distract the cervical vertebrae.15 It has also been shown that the same magnitude of force produces greater vertebral separation in healthy spines than in spines with signs of disc degeneration.16

REDUCTION OF DISC PROTRUSION

According to Cyriax, “traction is the treatment of choice for small nuclear protrusions.”1 The proposed mechanisms for disc realignment include clicking back of a disc fragment, suction caused by decreased intradiscal pressure pulling displaced parts of the disc back toward the center, or tensing of the posterior longitudinal ligament at the posterior aspect of the disc, thereby pushing any posteriorly displaced discal material anteriorly toward its original position1,17 (Fig. 10-2).

A number of studies have shown that spinal traction can reduce spinal discal protrusions, and a number of authors have proposed that the relief of back pain and related symptoms that occurs with the application of traction is the result of a reduction in protrusions of nuclear discal material.18,19 Studies using a variety of diagnostic imaging techniques, including discography, epidurography, and computed tomography (CT), have demonstrated that lumbar traction, using a force of 27 to 55 kg (60 to 120 lb), can reduce a disc prolapse, cause retraction of herniated discal material, reduce the size of a disc herniation, increase space within the spinal canal, widen the neural foramina, and result in clinical improvement in those patients in whom the discal defects are reduced.17,20-23 One small study also showed an increase in straight leg raise (SLR) immediately after traction using 30% and 60% of body weight and little effect on SLR after traction using 10% of body weight.24 It has been reported that symptoms generally do not improve when traction is applied to patients with large discal herniations that fill the spinal canal or when it is applied to those with calcification of the disc protrusion.17

Although studies support the belief that high-force traction can reduce nuclear discal protrusions, some reports indicate that lower forces may not produce this effect.19 Andersson et al reported that intradiscal pressure was not
joint-related pain.\textsuperscript{36,37} Joint mobility is thought to be increased by high-force traction because of stretching of the surrounding soft tissue structures. When lower levels of force are applied, the repetitive oscillatory motion of intermittent spinal traction may also move the joints sufficiently to stimulate the mechanoreceptors and thus decrease joint-related pain by gating the afferent transmission of pain stimuli. In this manner, the effects of spinal traction may be similar to those produced by manual joint mobilization techniques, except that with most traction techniques a number of joints are mobilized at one time, whereas with manual techniques the mobilizing force can be more localized.

**CLINICAL INDICATIONS FOR THE USE OF SPINAL TRACTION**

The clinical indications for the use of spinal traction include back or neck pain, with or without radiating symptoms when caused by a disc bulge or herniation, nerve root impingement, joint hypomobility, subacute joint inflammation, or paraspinal muscle spasm. Although substantial evidence demonstrates the mechanical effects of spinal traction, limitations in the data from clinical studies concerning its use for the treatment of back and neck pain have caused its use for these problems to be controversial.\textsuperscript{8,38}

Because treatment with traction has frequently been associated with a reduction or elimination of spinal pain, with or without radiating symptoms, and because spinal traction has been shown to reduce mechanical dysfunctions associated with such symptoms, the use of spinal traction is recommended for consideration as an intervention for such problems. The indications and recommendations for the selection of traction as a treatment modality, which are provided in the following section, and the guidelines for selection of treatment parameters, are based on the available data and an understanding of the spinal pathologies that can cause signs and symptoms in patients. If a patient’s signs and symptoms are known to be caused by a disc bulge or herniation, nerve root impingement, subacute joint inflammation, or paraspinal muscle spasm and if these are aggravated by joint loading and eased by distraction or reduction of joint loading, then traction may be effective in reducing or controlling the symptoms. Traction is less likely to be effective when there is a large disc herniation that protrudes into the spinal canal or when herniated or protruding discal material has become calcified.

**Clinical Pearl**

Traction is less effective for large or calcified disc herniations.

**DISC BULGE OR HERNIATION**

In a number of clinical studies, spinal traction has been shown to relieve symptoms associated with a disc bulge or herniated nucleus pulposus.\textsuperscript{2,17,39} A prospective randomized trial found that lumbar traction can improve symptoms and clinical findings in patients with lumbar disc herniation and decrease the size of the herniated disc material as measured by CT.\textsuperscript{40} The primary proposed mechanism of symptom relief is reduction of the disc bulge or protrusion and thus reduction of compression on the spinal nerve roots. Traction is most likely to improve the patient’s outcome if it is applied soon after a discal injury when there is protrusion of soft nuclear discal material.

**Clinical Pearl**

Traction is most effective when applied soon after discal injury.

This improvement occurs because traction can reduce not only the protrusion that has occurred but can also reduce the risk of further protrusion.\textsuperscript{39}

In contrast, a number of studies have failed to demonstrate a significant clinical benefit in response to the application of traction to patients with discal injuries.\textsuperscript{40,8,41} This lack of positive effect may be related to the severity of the disc protrusions in the subjects studied, the use of insufficient traction force, or the use of sample sizes that were too small to detect a treatment effect. Despite these equivocal findings, spinal traction remains a common intervention for treating patients with discal protrusions and back or neck pain with or without radicular symptoms.

Because it is likely that any correction of a discal protrusion produced by spinal traction may be quickly lost if the patient returns to his or her prior activities, it is recommended that all patients be instructed in other techniques for reducing stresses on the spine after treatment with traction to avoid a rapid recurrence of symptoms.

**Clinical Pearl**

To maintain the effects of spinal traction, patients should also use other techniques to reduce stress on the spine.

Such techniques may include correction of posture and body mechanics, lumbar stabilization through exercise or use of a corset, self-traction, and a cautious, gradual return to prior activities. Other exercises and mobilization techniques may also assist in maintaining the symptom relief and correction of discal positioning achieved with spinal traction.

**NERVE ROOT IMPINGEMENT**

Traction has been reported to help alleviate signs and symptoms associated with spinal nerve root impingement, particularly if it is applied shortly after the onset of such symptoms.\textsuperscript{2} Traction is generally recommended as the treatment of choice for patients with neurological deficits from spinal nerve root impingement.\textsuperscript{42} Such impingement may be caused by bulging or herniation of discal material, as described previously, or by ligament encroachment, narrowing of the intervertebral foramen, osteophyte encroachment, spinal nerve root swelling, or spondylo-
Patients who have worsening symptoms with spinal loading and improved symptoms with decreased spinal loading are good candidates for traction.

Some studies have reported good results when using traction for the treatment of pain and other related neurological symptoms associated with nerve root impingement, whereas others have failed to demonstrate greater benefits with traction than with sham traction. Although the available data do not readily indicate which patients will benefit from spinal traction, clinically, in general, those patients who report aggravation of symptoms with increased spinal loading and easing of symptoms with decreased spinal loading are more likely to respond well to treatment with traction.

It has also been recommended that traction be considered for patients with symptoms of radiating pain or paresthesia that do not improve with trunk movements. The force of traction can be used to reduce the pressure on inflamed joint surfaces, whereas the small movements of intermittent traction may control pain by gating transmission at the spinal cord level. These movements may also help to maintain normal fluid exchange in the joints to relieve edema in or around the joints surrounding these joints, spinal traction may prove beneficial in the treatment of symptoms caused by joint hypomobility. However, spinal traction is not generally the optimal treatment if only individual segments are hypomobile because it applies a mobilizing force to multiple rather than single spinal levels. Such nonspecific mobilization could prove deleterious to the patient with hypomobility of one segment and hypermobility of adjoining segments. In such patients, the mobilizing force applied by traction would most probably cause the greatest increase in motion in the most extensible areas, the hypermobile segments, resulting in joint laxity, while having no effect on the mobility of the less mobile segments causing the patient’s symptoms. Adjusting the degree of spinal flexion during the application of traction localizes the mobilizing effect of the force to some degree and thus may help to alleviate this problem. For example, positioning the lumbar spine in more flexion localizes the force to the upper lumbar and lower thoracic spine, whereas positioning it in neutral or extension localizes the force to the lower lumbar area. Similarly, for the cervical spine, the flexed position focuses the forces on the lower cervical area, and the neutral or slightly extended position focuses the forces on the upper cervical area. More detailed recommendations for patient positioning are provided in the section on application techniques.

**Clinical Pearl**

Patients who have worsening symptoms with spinal loading and improved symptoms with decreased spinal loading are good candidates for traction.

**SUBACUTE JOINT INFLAMMATION**

Traction has been recommended for reducing the pain and limitations of function associated with subacute joint inflammation. The force of traction can be used to reduce the pressure on inflamed joint surfaces, whereas the small movements of intermittent traction may control pain by gating transmission at the spinal cord level. These movements may also help to maintain normal fluid exchange in the joints to relieve edema in or around the joints
caused by chronic inflammation. Spinal traction can be used safely in the subacute or chronic stages of joint inflammation; however, intermittent traction should be avoided immediately after an injury, during the acute inflammatory phase, when the repetitive motion may cause further injury or amplify the inflammatory response.

**Clinical Pearl**

Intermittent traction should be avoided immediately after an injury, during the acute inflammatory phase, and when repetitive motion may worsen an injury or increase inflammation. Static traction may be used at this time.

**PARASPINAL MUSCLE SPASM**

The maintained stretch of static traction or the repetitive motion of low-load, intermittent traction may help to reduce paraspinal muscle spasm. As noted previously, this effect may be a result of a reduction in pain and the consequent interruption of the pain-spasm-pain cycle or may be caused by inhibition of alpha motor neuron firing from depression of the monosynaptic response or stimulation of the GTOs. Higher load spinal traction may also alleviate protective paraspinal muscle spasms by reducing the underlying cause of pain, such as a disc protrusion or herniation or a nerve root impingement, thus interrupting the pain-spasm-pain cycle.

**CONTRAINDICATIONS AND PRECAUTIONS FOR USE OF SPINAL TRACTION**

The application of spinal traction is contraindicated in some circumstances, and it should be applied with extra caution in other circumstances. To minimize the probability of adverse consequences in all cases, traction should first be applied using a small amount of force, and the patient’s response to treatment should be closely monitored.

**Clinical Pearl**

Traction should always be applied with a low force at first, and the patient should be monitored for adverse responses.

If the patient’s condition worsens in response to traction, with symptoms becoming more severe, peripheralizing, increasing in distribution, or progressing to other domains (e.g., from pain to numbness or weakness), the treatment approach should be reevaluated and changed. If the patient’s signs or symptoms do not improve within two or three treatments, the treatment approach should be reevaluated and changed or the patient should be referred to a physician for further evaluation.

**Clinical Pearl**

Interruption of the pain-spasm-pain cycle or may be caused by inhibition of alpha motor neuron firing from depression of the monosynaptic response or stimulation of the GTOs. Higher load spinal traction may also alleviate protective paraspinal muscle spasms by reducing the underlying cause of pain, such as a disc protrusion or herniation or a nerve root impingement, thus interrupting the pain-spasm-pain cycle.

**CONTRAINDICATIONS FOR THE USE OF TRACTION**

- Where motion is contraindicated
- Acute injury or inflammation
- Joint hypermobility or instability
- Peripheralization of symptoms with traction
- Uncontrolled hypertension

**Where Motion is Contraindicated**

Traction should not be used if motion is contraindicated in the area to be affected. Examples include an unstable fracture, cord compression, or immediately after spinal surgery.

**Ask the Patient**

- Have you been instructed not to move your neck or back? If so, by whom?
- If wearing a brace or corset: Have you been instructed not to remove your brace at any time?
- How recent was your injury or surgery?

Any form of traction should not be used if motion in the area is contraindicated. Direct treatment with other physical agents, such as heat or cold, should be considered or other involved areas where motion is allowed can be treated.

**Acute Injury or Inflammation**

Acute inflammation may occur immediately after trauma or surgery or as the result of an inflammatory disease such as rheumatoid arthritis or osteoarthritis. Because intermittent or static traction may aggravate acute inflammation or interfere with the healing of an acute injury, traction should not be applied under these conditions.

**Ask the Patient**

- When did your injury occur?
- When did your pain start?

If the injury or onset of pain was within the last 72 hours, the injury is likely to still be in the acute inflammatory phase and traction should not be used. As inflam-
mation resolves, static traction may be used initially, with progression to intermittent traction as the area tolerates more motion.

Assess
• Palpate and inspect the area to detect signs of inflammation, including heat, redness, and swelling.

If signs of acute inflammation are present, it is recommended that the application of traction be delayed until they resolve.

Hypermobile or Unstable Joint
High-force traction should not be used in areas of joint hypermobility or instability because it may further increase the mobility of the area. Therefore the mobility of joints in the area to which one is considering applying traction should be assessed before the traction is applied. Joint hypermobility may be the result of a recent fracture, joint dislocation, or surgery, or it can be caused by an old injury, high relaxin levels during pregnancy and lactation, poor posture, or congenital ligament laxity. Joint hypermobility and instability, particularly of the C1-C2 articulations, is also common in patients with rheumatoid arthritis, Down syndrome, and Marfan syndrome as a result of degeneration of the transverse atlantar ligament. Therefore cervical traction should not be applied to patients with these diagnoses until the integrity of the transverse atlantar ligament and the stability of the C1-C2 articulations have been ascertained.

Ask the Patient
• Have you dislocated a joint in this area?
• Do you have rheumatoid arthritis or Marfan’s syndrome?
• Are you pregnant?

Assess
• Assess joint mobility in the area that will be affected by the traction. All levels of the cervical or lumbar spine, depending on which is being treated, should be assessed, not just the symptomatic ones, since traction can affect the mobility of multiple levels.
• Check the patient’s chart for any diagnosis of rheumatoid arthritis, Marfan syndrome, or Down syndrome and request radiographic studies to rule out C1-C2 instability before applying traction.

Traction should not be applied in areas where joint hypermobility is detected on manual or radiographic examination or to areas that have been previously dislocated. When some segments are hypomobile and adjacent segments are hypermobile, it is recommended that the hypomobile segments be treated with manual techniques rather than mechanical traction because manual techniques can mobilize individual spinal segments more specifically.

Peripheralization of Symptoms
Traction should be discontinued or modified immediately if it causes peripheralization of symptoms because, in general, progression of spinal symptoms from a central area to a more peripheral area indicates worsening nerve function and increasing compression. Continuing treatment when symptom peripheralization occurs could result in aggravation of the initial injury and prolonged worsening of signs and symptoms.

Tell the Patient
• Let me know immediately if you get more pain or other symptoms further down your arms or legs. Stop the traction if this occurs.

Assess
• Recheck sensation, motor function, and reflexes in the appropriate extremity or extremities, if the patient complains of peripheralization of symptoms.

Traction should be discontinued or modified if signs or symptoms peripheralize. Traction may be modified by decreasing the load or changing the patient’s position. Modified traction may be continued if peripheralization of symptoms no longer occurs. Mild aggravation of central symptoms alone in a patient with prior central and peripheral symptoms should not be a cause for discontinuation of treatment.

Uncontrolled Hypertension
Inversion traction should be avoided in patients with uncontrolled hypertension since inversion has been found to significantly increase blood pressure. In addition, one study found that in 40 patients with no history of hypertension, 10 minutes of cervical traction at 10% body weight caused increases in blood pressure (9 mm Hg increase in systolic and 5 mm Hg increase in diastolic pressure) and heart rate (7 beats per minute [bpm] increase). Although this mild increase in blood pressure may not be problematic in healthy individuals, it is recommended that clinicians assess a patient’s cardiovascular status before applying cervical traction to avoid exacerbating poorly controlled hypertension in some patients.

Ask the Patient
• Do you have high blood pressure? If so, is it well-controlled with medications?

Assess
• Take the patient’s blood pressure.

In a patient with a resting blood pressure of more than 140/90, blood pressure and heart rate should be checked after application of cervical traction and treatment discontinued if systolic or diastolic BP increases by more than 10 mm Hg or heart rate increases by more than 10 bpm.
PRECAUTIONS FOR THE USE OF TRACTION

**PRECAUTIONS for the Use of Traction**

- Structural diseases or conditions affecting the spine (e.g., tumor, infection, rheumatoid arthritis, osteoporosis, or prolonged systemic steroid use)
- When pressure of the belts may be hazardous (e.g., with pregnancy, hiatal hernia, vascular compromise, osteoporosis)
- Displaced anular fragment
- Medial disc protrusion
- When severe pain fully resolves with traction
- Claustrophobia or other psychological aversion to traction
- Inability to tolerate the prone or supine position
- Disorientation

In cases where traction should be applied with caution, the referring physician should be consulted before initiating traction. First, a low level of force should be applied, then progress slowly and monitor the patient’s response to the treatment closely at all times.

**Structural Diseases or Conditions Affecting the Bones of the Spine**

Traction should be applied with caution when the structural integrity of the spine may be compromised. Such structural compromise can occur with a tumor, infection, rheumatoid arthritis, osteoporosis, or prolonged systemic steroid use. In these circumstances, the spine may not be strong enough to sustain the forces of traction, and injury may result from the application of strong traction forces. Radiographic reports and other studies that may indicate the nature and severity of the structural compromise should be checked before deciding to apply traction to patients with these conditions.

**Ask the Patient**

- Do you have any disease affecting your bones or joints?
- Do you have cancer, an infection in your bones, rheumatoid arthritis, or osteoporosis?
- Do you take steroid medications? If so, how long have you taken them?

Only low-force traction should be applied to patients with structural compromise of the spine. For these patients, manual traction, which allows more direct monitoring of patient response, may be more appropriate.

**When the Pressure of the Belts May Be Hazardous**

The pelvic belts used for the application of mechanical lumbar traction may apply excessive abdominal pressure to pregnant patients or to those with hiatal hernia and may place excessive pressure on the inguinal region on those with femoral artery compromise. Compression of the femoral arteries in the inguinal region can be avoided by ensuring that the pelvic belt is positioned with its lower edge superior to the femoral triangle and by tightly securing the belt and keeping it in direct contact with the skin to prevent it from slipping down during treatment. There is also concern that pelvic or thoracic belts may apply excessive pressure to the pelvis or ribs of patients with osteoporosis. Because the thoracic belts used for fixation of the patient during the application of lumbar traction may constrict respiration, it is also recommended that lumbar traction be applied with caution to patients with cardiac or pulmonary disorders.

Cervical traction should be applied with caution to patients with cerebrovascular compromise, as indicated by a positive vertebral artery test, because poor placement of the halter may further compromise circulation to the brain. The halter should be positioned away from the carotid arteries in patients with compromise of these arteries. This is most easily achieved by using a halter that distracts via the occiput rather than one that applies force to both the occiput and the mandible.

**Ask the Patient**

- Are you pregnant?
- Do you have a hiatal hernia?
- Have you had any trouble with blocked arteries?
- Do you get pain in your calves when walking a short distance? This is a sign of intermittent claudication, indicating possible arterial insufficiency to the lower extremities.
- Do you have osteoporosis?
- Do you have problems with your breathing?
- Have you had a stroke?
- Do you get dizzy when you put your head back?

If compression by the belts used for mechanical traction is hazardous to the patient, one should consider using other forms of traction, such as self-traction or manual traction, that do not require the use of these belts. Fastening the belts less tightly is generally not recommended because they can slip during treatment, rendering the treatment ineffective or increasing pressure in the inguinal region. If the patient’s responses indicate possible compromise of the cervical or lower extremity vessels, it is essential that the halter or belts used for traction be positioned so that they do not compress these vessels.

**Displaced Anular Fragment**

Once a fragment of anulus has become displaced and is no longer connected to the body of the disc, traction is not likely to change the position of the disc fragment and therefore treatment with traction is not likely to improve the patient’s symptoms.

**Ask the Patient**

- Has a magnetic resonance imaging (MRI) or CT scan of your spine been performed? Please bring me the report(s) from that (those) test(s).

Traction should not be used to treat symptoms resulting from a displaced disc fragment that is no longer attached to the body of the disc.
Medial Disc Protrusion

It has been proposed that traction may aggravate symptoms caused by a medial disc protrusion because, in such circumstances, the medial movement of the nerve root caused by a traction force may increase the impingement of the disc on the nerve root (Fig. 10-4).54

Ask the Patient
• Has an MRI or CT scan of your spine been performed? Please bring me the report(s) from that (those) test(s).

When Severe Pain Resolves Fully with Traction

If severe pain resolves fully with traction, this may indicate that the traction has increased rather than decreased compression on a nerve root, causing a complete nerve block.

Ask the Patient
• After a few minutes of traction: Have your symptoms changed?

If the patient had severe pain and reports that the pain has decreased: Has the pain completely gone away or is it just less severe?

Assess
Test sensation, reflexes, and strength before treatment. Also, if the patient reports complete resolution of severe pain during treatment, check these again and assess for any changes.

If severe pain is fully relieved by traction, it is recommended that the clinician immediately recheck other indicators of nerve conduction, including sensation, reflexes, and strength, to rule out increasing nerve compression. If these are worse, traction should be stopped immediately. If these are not worse, the force of traction may be reduced by 50%, or the direction of the traction force modified, and traction may be continued. If traction is maintained at a level that causes a nerve block, the patient may sustain a severe nerve injury as the result of the treatment.

Claustrophobia or Other Psychological Aversion to Traction

A number of patients are psychologically averse to the use of traction because this procedure generally involves considerable restriction of movement and loss of control. In particular, patients with claustrophobia may not tolerate the restriction of movement required for the application of mechanical lumbar traction. In such cases, other forms of traction that do not require immobilization with belts, such as manual or positional traction, may be better tolerated.

Inability to Tolerate the Prone or Supine Position

Some patients cannot tolerate the prone or supine position for the period of time necessary for the application of traction. Such limitations may be the result of their spinal condition or other medical problems such as reflux esophagitis. In such cases, the use of supports, such as a lumbar roll, may allow the patient to tolerate the position; cervical traction may be applied in the sitting position; or for lumbar traction, some of the self-traction techniques may be effective.

Ask the Patient
• Does lying on your back with your knees bent for 15 to 20 minutes cause any problems for you?
• Does lying on your stomach for 15 to 20 minutes cause any problems for you?

Disorientation

It is recommended that mechanical traction not be applied to disoriented patients because they may move in the halter or belts, becoming entangled or altering the amount of force they receive. It is recommended that only manual traction techniques be used to treat disoriented patients.
PRECAUTIONS FOR THE USE OF CERVICAL TRACTION

PRECAUTIONS for the Use of Cervical Traction

• Temporomandibular joint (TMJ) problems
• Dentures

Temporomandibular Joint Problems
In patients with TMJ problems, or a history of such problems, it is recommended that a halter that only applies pressure through the occiput be used rather than one that applies pressure through both the mandible and the occiput because the latter may place pressure on the TMJs and thus aggravate preexisting joint pathology. Many clinicians use an occipital halter with all patients to avoid the possibility of causing TMJ problems in patients who did not have such problems previously.

Ask the Patient
• Do you have problems with your jaw?

Dentures
The patient who wears dentures should be instructed to keep the dentures in place during treatment with cervical traction because their removal can alter the alignment of the TMJs and may cause problems if pressure is applied to these joints through the mandible. An occipital halter should be used to protect dentures and the teeth, as well as the TMJ.

Ask the Patient
• Do you wear dentures?
• Do you have them in now?

ADVERSE EFFECTS OF SPINAL TRACTION

Although no systematic research has been performed on the adverse effects of spinal traction, some case reports suggest that prior symptoms may be increased by the application of lumbar traction exceeding 50% of the patient’s total body weight or by the application of cervical traction exceeding 50% of the weight of the patient’s head.37,53 These reports stand in contrast to the finding that the force of traction must be at least 50% of the patient’s body weight to achieve separation of the lumbar vertebrae.14 Because a rebound increase in pain after the initial application of high-force traction can occur, it is generally recommended that traction force be kept low for the initial treatment and then be gradually increased until maximum benefit is obtained.

Clinical Pearl
Traction force should be kept low for the initial treatment and then gradually increased, within the recommended range, to the point of maximum benefit.

Specific recommendations for the amount of traction force to be used for different regions of the spine and different spinal conditions are given in the section on application techniques.

It has been reported that some patients experience lumbar radicular discomfort after receiving treatment with intermittent cervical traction for cervical radicular symptoms.36,57 Thirty-three percent of the patients who were reported to experience this adverse effect had transitional lumbar vertebrae evident on radiographs, and 83% had evidence of spinal osteoarthritis. The onset of lumbar radiculopathy after cervical traction suggests that axial tension induced in the spinal cord’s dural covering was transmitted from the cervical spine to the lumbar nerve roots and that limitations in nerve root excursion caused by structural abnormalities and degenerative changes in these patients probably resulted in excessive tension being placed on the nerve roots, provoking lumbar radicular symptoms.

Other adverse effects of spinal traction have been described in detail in the section describing contraindications and precautions.

APPLICATION TECHNIQUES

Traction can be applied in many ways. At this time, traction is applied using electrical and weighted mechanical devices, self-traction, positional traction, and manual traction. In the past, traction was also applied using inversion techniques and purpose-built autotraction tables and for prolonged periods with very low loads.

Inversion traction, which is applied by placing the patient in a device that requires a head-down position, uses the weight of the patient’s upper body to apply traction to the lumbar spine. This form of traction was fairly popular in the past 10 to 20 years; however, most inversion traction devices have been removed from the United States market by their manufacturers because of concerns regarding potential adverse effects in patients with hypertension. Significant increases in systolic and diastolic blood pressure and ophthalmic artery pressure have been documented in subjects without cardiovascular disease or a history of hypertension in response to the application of inversion traction; therefore it is thought that the application of this type of traction could increase the risk of a stroke or myocardial infarction in the patient with uncontrolled hypertension.53,58,59 Because of these possible risks, the use of inversion traction is not recommended, and therefore instructions for its application are not provided in this book.

Autotraction, a form of self-traction that requires the use of a purpose-built table with sections that can be moved apart by the patient during treatment, was also popular for a number of years; however, this type of table is no longer being manufactured, thus directions for its application are also not provided in this book.

Patient immobilization using very low-load, prolonged static traction applied for hours to days was used to relieve symptoms aggravated by spinal motion.14 The benefits of this treatment were thought to come from the limited mobility and bedrest forced on the patient rather than
from the traction force. Although the application of traction in the hospital for this purpose was popular only a decade or two ago, it has fallen out of favor because of the growing awareness that most patients with back pain do not benefit from prolonged bed rest and inactivity. The significant cost of providing this treatment also limits its application.

When selecting the type of spinal traction, patient position, traction force, and duration and frequency of treatment to be used, the effects of these different parameters of treatment, the nature of the patient’s problem, and the patient’s response to prior treatments should be considered. Guidelines for the standard application technique for each of these types of traction and the advantages and disadvantages of each are provided in the next sections. However, if the clinician understands the principles underlying the application of this type of treatment, many of these techniques can be modified or adapted to suit individual clinical situations such as when a patient does not tolerate the standard position(s) used for treatment or when preferred equipment is not available.

For all forms of traction, the clinician should first determine if the presenting symptoms and problems are likely to respond to treatment with traction. The clinician should also determine that traction is not contraindicated for this patient or condition. Traction can be applied to the lumbar or cervical spine; however, some forms of traction are appropriate for only one area or the other, whereas others can be applied to either with appropriate modifications.

MECHANICAL TRACTION
Mechanical traction can be applied to the lumbar or cervical spine. A variety of belts and halters, as well as different patient treatment positions, can be used to apply traction to particular areas of the spine and to focus the effect on different segments or structures. Types of mechanical traction devices include electrical traction units, over-the-door cervical traction devices, and other home traction devices. Traction can be applied continuously (static traction) or intermittently. Electrical mechanical traction units can apply static or intermittent traction of varying force. With static traction, the same amount of force is applied throughout the treatment session. With intermittent traction, the traction force alternates between two set points every few seconds throughout the treatment session. The force is held at a maximum for a number of seconds, the hold period, and is then reduced, usually by about 50%, for the following relaxation period. The newest electrical mechanical traction devices also allow the user to control the rate of force application and allow for finer control of the force to more closely mimic forces applied during manually applied traction or other manual joint mobilization techniques. Although the manufacturers of these newer devices claim that these features improve outcomes, as yet no studies have been published evaluating the effects of these devices.

Weighted mechanical traction units apply static traction only, with the amount of force being determined by the amount of weight used.

Advantages of Mechanical Traction
- Force and time well-controlled, readily graded, and replicable.
- Once applied, does not require the clinician to be with the patient throughout the treatment.
- Electrical mechanical traction units allow the application of static or intermittent traction.
- Static weighted devices, such as over-the-door cervical traction, are inexpensive and convenient for independent use by the patient at home.

Disadvantages of Mechanical Traction
- Expensive electrical mechanical devices.
- Time-consuming to set up.
- Lack of patient control or participation.
- Restriction by belts or halter poorly tolerated by some patients.
- Mobilizes broad regions of the spine rather than individual spinal segments, potentially inducing hypermobility in normal or hypermobile joints.

Electrical Mechanical Traction Units
Most clinics have one or more electrical mechanical traction units available. These units use a motor to apply traction forces to the lumbar or cervical spine, statically or intermittently, and can be used to apply forces of up to 70 kg (150 lb). These units have the advantage of being able to apply static or intermittent traction to the lumbar or cervical spine, and they allow fine, accurate control of the forces being applied.

Clinical Pearl
Electrical mechanical traction units can apply static or intermittent traction to the lumbar or cervical spine with precise control and allow the patient to be in a variety of positions.

These units also allow considerable variation in patient position. The newer computerized models can finely control the speed of traction application, store a number of clinician- or patient-specific protocols, and track each patient’s pain severity and location over time. The most significant limitations of electrical mechanical traction devices are their cost and size (Fig. 10-5).
Over-the-Door Cervical Traction Devices

Over-the-door cervical traction units can be used for the application of static cervical traction only. The limited treatment flexibility of these devices makes them appropriate primarily for home use. In this setting, they have the additional advantages of being inexpensive, easy to set up, and compact (Fig. 10-6). Before using this device at home, the patient should be educated on positioning and the amount and duration of force to use.

Other Home Traction Devices

A number of other spinal traction devices are also available for home application of static or intermittent lumbar or cervical traction (Fig. 10-7). These devices offer more treatment options but are more expensive than over-the-door devices, are more complex to use, and take up more space in the home.

![FIG 10-6 Over-the-door traction device. Courtesy Chattanooga Group, Hixson, TN.](image)

![FIG 10-7 Examples of home traction devices. A, Courtesy The Saunders Group, Chaska, MN. B, Courtesy Glacier Cross, Inc, Kalispell, MT.](image)
**Application Technique 10-1**

### Mechanical Lumbar Traction

**Equipment Required for Electrical Mechanical Traction**
- Traction unit
- Thoracic and pelvic belts
- Spreader bar
- Extension rope
- Split traction table (optional)

**Equipment Required for Weighted Mechanical Traction**
- Traction device (ropes, pulley, weights)
- Thoracic and pelvic belts
- Spreader bar
- Weight bag for water, weights, or sand

**Procedure for Mechanical Lumbar Traction**

1. Select the appropriate mechanical traction device. Various devices are available for applying mechanical traction to the lumbar spine in the clinic or home setting. The choice depends on the amount of force to be applied, whether static or intermittent traction is desired, and the setting in which the treatment will be applied.
2. Determine optimal patient position. When positioning the patient, try to achieve a comfortable position that allows muscle relaxation while maximizing the separation between the involved structures. The relative degree of flexion or extension of the spine during traction determines which surfaces are most effectively separated. The flexed position results in greater separation of the posterior structures, including the facet joints and intervertebral foramina, whereas the neutral or extended position results in greater separation of the anterior structures, including the disc spaces (Fig. 10-8). In most cases, a symmetrical central force is used, in which the direction of force is in line with the central sagittal axis of the patient (Fig. 10-9); however, if the patient presents with unilateral symptoms, a unilateral traction force that applies more force to one side of the spine than to the other may prove to be more effective. A unilateral force can be applied by offsetting the axis of the traction in the direction that most reduces the patient’s symptoms. For example, if the patient presents with right low back and lower extremity pain that is aggravated by right sidebending and relieved by left sidebending, the traction should be offset to apply a left sidebending force.

For the application of traction to the lumbar spine, the patient may be positioned prone or supine. Supine positioning is more common; however, prone positioning may be advantageous if the patient does not tolerate flexion or being supine, or if the symptoms are reduced by extension or by being in the prone position. Greater lumbar paraspinal muscle relaxation and less EMG activity have also been reported during traction in the prone rather than the supine position. Clinically, symptoms of discal origin are also usually most reduced in the prone position, whereas the lumbar spine is in neutral or extension and the disc space is most separated (see Fig. 10-8), whereas symptoms caused by facet joint dysfunction are most reduced when the patient is positioned supine with the hips flexed, the lumbar spine is flexed, and the facet joints are most separated. Traction neutral positioning of the lumbar spine also localizes the force of the traction to the lower lumbar segments, whereas supine flexed positioning localizes the traction force to the upper lumbar and lower thoracic segments.

The patient should lie on a split traction table, with the area of the spine to be distracted positioned over the split, and if supine, with the lower extremities supported on a stool that does not interfere with the motion of the traction rope. A split traction table separates into two sections, with one section sliding away from the other when the sections are unlocked and traction is applied (Fig. 10-11). This type of table reduces the amount of traction force lost to friction between the patient and the table because the lower half of the patient’s body moves with the lower section of the table. Thus less traction force is needed when a split table is used than when a nonsplit table is used to provide the same amount of distractive force to the lumbar spine. Initially the patient should be positioned with the sections of the table locked together so that the table does not move as the patient moves into the treatment position. The sections should then be slowly unlocked, after the traction force has been applied, to control the speed at which the initial traction force is applied.

3. Apply the appropriate belts or halter. Heavy-duty nonslip thoracic and pelvic belts should be used to secure the patient during the application of mechanical lumbar traction (Fig. 10-12, A). These belts must be placed with the nonslip surface directly in contact with the patient’s skin and not over the clothing, and both belts must be securely tightened to prevent slipping when the traction force is applied.

**Clinical Pearl**

The nonslip belt surface should be placed directly in contact with the patient’s skin and not over clothing.

The belts can either be placed on the table at the appropriate level and then adjusted when the patient lies down on them, or they can be secured around the patient first and then secured to the table after the patient lies down. The thoracic belt is used to stabilize the upper body above the level at which traction force is desired to prevent the patient from being pulled down the table by the force on the pelvic belt and isolate the traction force to the appropriate spinal segments. The thoracic belt should be placed so that its lower edge aligns with the superior limit at which the traction force is desired, and with its upper edge aligned approximately with the xiphoid immediately below the greatest diameter of the thorax. The pelvic belt should be placed so that its superior edge aligns with the inferior limit at which traction force is desired, generally just superior to the iliac crests (or superior to the superior edge of the sacrum if the patient is prone) (see Fig. 10-9).

Newer belts, shaped to be more comfortable than the older models, and with Velcro attachments are also available (Fig. 10-12, Continued)
FIG 10-9 Central axis lumbar traction. Courtesy Chattanooga Group, Hixson, TN.

FIG 10-10 Prone lumbar traction with spine in neutral or slight extension. Courtesy Chattanooga Group, Hixson, TN.

FIG 10-11 Split traction table. Courtesy The Saunders Group, Chaska, MN.
Mechanical Lumbar Traction—cont’d

8. Their placement is slightly different than for the standard belt, and it is best to follow the manufacturer’s instructions when applying these belts. Instructions for applying the type of belt shown in Figure 10-12, B, are included on the Evolve web site.

When the patient is supine with the lumbar spine in slight flexion, as recommended to maximize distraction of the posterior spinal structures, the pelvic belt should be placed with the fastening anteriorly and the rope posteriorly so that the pull is primarily from the posterior aspect of the pelvis (see Fig. 10-9). When the patient is prone, with the lumbar spine in neutral or slight extension, as recommended to maximize distraction of the anterior spinal structures, the pelvic belt may be placed with the fastening posteriorly and the rope anteriorly so that the pull is primarily from the anterior aspect of the pelvis.

4. Connect the belts or halter to the traction device. Fasten the thoracic belt to the table above the patient’s head and connect the pelvic belt to the traction unit using a rope and a spreader bar.

5. Set the appropriate traction parameters (Table 10-1). See also the discussion of parameters in the next section. Select static or intermittent traction and then for static traction, set the maximum traction force and the total traction duration, or for intermittent traction, set the maximum and minimum traction force, hold and relax times, and the total traction duration.

6. Start the traction.

When applying traction to the lumbar spine, if a split table is being used, first allow the traction to pull for one hold cycle to take up the slack in the belt and rope and then during the following relaxation of the traction, release the sections of the table slowly. If static traction is being used, the sections of the table may be released after the traction force is applied. The therapist should manually control the rate of separation of the sections to prevent sudden motion of the patient and the lower section of the table. If a split table is not available, the traction device will take up the slack in the belt and rope during the first hold cycle. When using a split table, once the sections are released, the force of the traction pulls the patient and the lower section of the table simultaneously and so does not have to overcome friction between the patient and the surface of the table. For this to occur, it is essential that the lower section of the table actually move back and forth during the hold and relax cycles, rather than being stationary at its position of maximal excursion, where it will act as a static surface. The clinician should observe the traction being applied and the movement of the table for a few cycles and then make any necessary adjustments to ensure that the traction is producing the desired effect.

7. Assess the patient’s response.

It is recommended that the clinician assess the patient’s initial response to the application of traction within the first 5 minutes of treatment so that any adjustments can be made at that time if needed.

8. Give the patient a means to call you and to stop the traction.

Most electrical mechanical traction units are equipped with a patient safety cutoff switch that turns off the unit and rings a bell when activated. Instruct the patient to use this switch if he or she experiences any increase in or peripheralization of pain or other symptoms.


When the traction time is completed, lock the split sections of the table, release the tension on the traction ropes, and allow the patient to rest briefly before getting up and recompressing the joints. Then reexamine the patient.

### Recommended Parameters for the Application of Lumbar Spinal Traction

<table>
<thead>
<tr>
<th>Area of Spine and Goals of Treatment</th>
<th>Force</th>
<th>Hold/Relax Times (seconds)</th>
<th>Total Traction Time (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial/acute phase</td>
<td>13-20 kg (29-44 lbs)</td>
<td>Static</td>
<td>5 to 10</td>
</tr>
<tr>
<td>Joint distraction</td>
<td>22.5 kg (50 lbs); 50% of body weight</td>
<td>15/15</td>
<td>20 to 30</td>
</tr>
<tr>
<td>Decrease muscle spasm</td>
<td>25% of body weight</td>
<td>5/5</td>
<td>20 to 30</td>
</tr>
<tr>
<td>Disc problems or stretch soft tissue</td>
<td>25% of body weight</td>
<td>60/20</td>
<td>20 to 30</td>
</tr>
</tbody>
</table>

**FIG 10-12** Traction belts: old (A) and new (B) styles. Courtesy Chattanooga Group, Hixson, TN.
MECHANICAL LUMBAR TRACTION

Parameters for Mechanical Lumbar Traction

Static Versus Intermittent Traction. Mechanical traction may be administered statically, with the same force throughout the treatment, or intermittently, with the force varying every few seconds throughout the treatment. Some authors recommend that only static traction be applied to avoid a stretch reflex of the muscles; however, others report that static and intermittent traction are equally effective but that higher forces can be used with intermittent traction. No differences in lumbar sacrospinalis electromyographic (EMG) activity or vertebral separation have been found when static and intermittent traction of the same force have been compared. It is generally recommended that static traction be used if the area being treated is inflamed, if the patient’s symptoms are easily aggravated by motion, or if the patient’s symptoms are related to a disc protrusion. Intermittent traction with long hold times may also be effective for treatment of symptoms related to disc protrusion, whereas shorter hold and relax times are recommended for symptoms related to joint dysfunctions.

Clinical Pearl

Static traction is useful for inflammation, symptoms aggravated by motion, and symptoms caused by a disc protrusion. Intermittent traction is useful for symptoms caused by a disc protrusion or joint dysfunction.

Hold and Relax Times. If intermittent traction is selected, the maximum traction force is applied during the hold time and a lower traction force is applied during the relax time. The recommended ratio and duration of the hold and relax times depend on the patient’s condition and tolerance. In general, if intermittent traction is used for treatment of a disc problem, longer hold times, approximately 60 seconds, and shorter relax times, approximately 20 seconds, are recommended, whereas if traction is being used to treat a spinal joint problem, shorter hold and relax times of approximately 15 seconds each are recommended. Symptom severity should also be used as a guide for determining hold and relax times. When the patient’s symptoms are severe, both long hold and long relax times are recommended to limit the amount of movement. As the symptoms become less severe, the relax time can gradually be decreased, and when the discomfort has decreased to a local ache rather than a pain, the hold time can also be reduced so that when the symptoms are mild, the traction produces an oscillatory motion with very short hold and relax times of approximately 3 to 5 seconds each.

Clinical Pearl

Hold and relax times of approximately 15 seconds each are recommended to treat a spinal joint problem, shorter hold and relax times, approximately 20 seconds, are recommended, whereas if traction is being used during the phase of intermittent traction is not recommended because this can result in rebound aggravation of the patient’s symptoms.

Clinical Pearl

The traction force to the lumbar spine start at between 13 and 20 kg (30 and 45 lb).

Clinical Pearl

The traction force to the lumbar spine should start at between 13 and 20 kg (30 and 45 lb).

Clinical Pearl

Traction force to the lumbar spine should generally not exceed 50% of the patient’s weight.

Clinical Pearl

When intermittent traction is used, the relaxed force should be approximately 50% of the maximum force or less; however, total release of the force during the relaxed phase of intermittent traction is not recommended because this can result in rebound aggravation of the patient’s symptoms.

Authors vary in their recommendations with regard to the amount of force to be used for traction; however, most agree that the optimal amount of force depends on the patient’s clinical presentation, the goals of treatment, and the patient’s position during treatment. For all applications, the force should be kept low during the initial traction session to reduce the risk of reactive muscle guarding and spasms and to determine if traction is likely to aggravate the patient’s symptoms. The traction force can be increased gradually in subsequent sessions as the patient becomes used to the procedure. It is recommended that, for all applications, the traction force to the lumbar spine start at between 13 and 20 kg (30 and 45 lb). When the goal is to decrease compression on a spinal nerve root or facet joint, sufficient force to separate the facet joints in the area being treated must be used. In the lumbar spine, it has been shown that this requires a force of between 22.5 kg (50 lb) and approximately 60% of the patient’s body weight. When the goal is to decrease muscle spasm, stretch soft tissue, or exert a centripetal force on the disc by spinal elongation without joint surface separation, lower forces of 25% of total body weight for the lumbar spine are generally effective. When this is the goal, the application of a hot pack in conjunction with the traction may result in greater spinal elongation and thus more effective relief of symptoms.

Higher traction forces are needed when patient positioning, or the harness or table, requires the traction force to overcome gravity or friction between the patient and the table. For example, when lumbar traction is applied without a split table and the traction has to overcome the friction between the patient’s body and the surface of the table, higher traction forces may be necessary, whereas when gravity and friction are reduced, as occurs with lumbar traction when a split table is used, lower traction forces may be sufficient.

The force of traction can be adjusted during or between treatments. The force should be decreased during the treatment if there is any peripheralization of signs or symptoms or, as mentioned in the section on precautions, if there is complete relief of severe pain. If the patient’s symptoms are moderately decreased by traction, the force can be increased by 2 to 5 kg (5 to 15 lb) for lumbar traction at each subsequent treatment session until maximal relief of symptoms is achieved. Traction force to the lumbar spine should generally not exceed 50% of the patient’s body weight.

Clinical Pearl

When intermittent traction is used, the relaxed force should be approximately 50% of the maximum force or less; however, total release of the force during the relaxed phase of intermittent traction is not recommended because this can result in rebound aggravation of the patient’s symptoms.
**Total Treatment Duration.** There are no published studies comparing the effects of different traction treatment durations; however, most authors recommend that the duration of a patient’s first treatment with traction be brief (i.e., about 5 minutes if the initial symptoms are severe and 10 minutes if the initial symptoms are moderate) to assess the patient’s response. If severe symptoms are significantly relieved by brief low-force traction, the duration of treatment should be kept short; otherwise, symptom exacerbation after the treatment is likely. If the patient’s symptoms are partially relieved after 10 minutes of traction, it is recommended that the duration of the initial treatment not be extended; however, if symptoms are unchanged after 10 minutes, the hold force may be increased slightly or the angle of pull modified, and treatment may be continued for a further 10 minutes. Recommendations for the duration of subsequent treatments vary from as short as 8 to 10 minutes for treatment of a disc protrusion to as long as 20 to 40 minutes for this and other indications. Treatment for longer than 40 minutes is generally thought to provide no additional benefit.

**Treatment Frequency.** Some authors state that spinal traction must be administered daily to be effective; however, there are no published studies evaluating the outcome of different treatment frequencies.

### APPLICATION TECHNIQUE 10-2

**Equipment Required for Electrical Mechanical Traction**
- Traction unit
- Cervical traction halter
- Spreader bar
- Extension rope

**Equipment Required for Weighted Mechanical Traction**
- Traction device (ropes, pulley, weights)
- Cervical traction halter
- Weight bag for water, weights, or sand

**Procedure for Mechanical Cervical Traction**

1. Select the appropriate mechanical traction device. Various devices are available for applying mechanical traction to the cervical spine in the clinic or home setting. The choice depends on the region of the body to be treated, the amount of force to be applied, whether static or intermittent traction is desired, and the setting in which the treatment will be applied.
2. Determine optimal patient position. When positioning the patient, try to achieve a comfortable position that allows muscle relaxation while maximizing the separation between the involved structures. The relative degree of flexion or extension of the spine during traction determines which surfaces are most effectively separated. The flexed position results in greater separation of the posterior structures, including the facet joints and intervertebral foramina, whereas the neutral or extended position results in greater separation of the anterior structures, including the disc spaces (see Fig. 10-8). In most cases, a symmetrical central force is used, in which the direction of force is in line with the central sagittal axis of the patient; however, if the patient presents with unilateral symptoms, a unilateral traction force that applies more force to one side of the spine than to the other may prove to be more effective. A unilateral force can be applied by offsetting the axis of the traction in the direction that most reduces the patient’s symptoms. For example, if the patient presents with right neck or arm pain that is aggravated by right side bending and is relieved by left side bending, the traction should be offset so as to apply a left side bending force.

For the application of traction to the cervical spine, the patient may be in the supine or the sitting position (Fig. 10-13 and see Fig. 10-6). Certain cervical traction devices can only be used in one of these positions, whereas others can be used in either position. For example, over-the-door cervical traction units must be applied with the patient sitting, whereas the Saunders occipital cervical traction halter can only be used with the patient supine. In the supine position, the cervical spine is supported and non-weight-bearing, resulting in increased patient comfort and muscle relaxation and greater separation between the cervical segments than when the same amount of traction force is applied with the patient in the sitting position. When the patient is supine, cervical flexion, rotation, and sidebending can be adjusted for patient comfort and to focus the traction force on the involved area. When cervical traction is applied in the sitting position, cervical flexion and extension can be controlled to a limited degree by placing the patient facing toward (more flexion) or away from (neutral or more extension) the traction force; however, cervical sidebending and rotation are difficult to adjust in the sitting position. Placing the cervical spine in a neutral or slightly extended position focuses the traction forces on the upper cervical spine, whereas placing the cervical spine in a flexed position focuses the traction forces on the lower cervical spine. Maximum posterior elongation of the cervical spine is achieved when the neck and angle of pull are approximately 25 to 35 degrees of flexion, as shown in Figure 10-13. Different cervical halters have been developed to maximize patient comfort and avoid excessive pressure on the TMJs during traction.
MECHANICAL CERVICAL TRACTION—cont'd

the application of cervical traction (see Figs. 10-7 and 10-13). There are soft fabric halters that apply pressure through both the mandibles and the occiput, and soft fabric halters that apply pressure only through the occiput. The Saunders frictionless traction halter, which is solid and padded, is also designed to apply pressure only through the occiput. The adjustability of the halter, the patient position, and the status of the TMJs should all be considered in selecting the most appropriate cervical halter for a particular patient. The halter should be adjustable to accommodate variations in the shape and size of patients' heads and necks and to allow for different angles of traction pull. A halter that applies force through the mandibles and the occiput should allow adjustment of the distance between the occiput and spreader bar, the chin and spreader bar, and the mandibles and occiput. The tension on the straps should be adjusted so that the pull is comfortably and evenly applied to both the occiput and the mandibles. A halter that only applies pressure through the occiput should allow size adjustment and should be adjusted to fit snugly enough to stay on during the application of traction. The soft halters can be used in the sitting or supine position, whereas the Saunders halter can only be used in the supine position; however, the soft halters that apply pressure through the occiput tend to slip off the patient's head when traction is applied, even when appropriately adjusted for size, whereas the Saunders halter, which also avoids pressure on the TMJs, generally remains securely in place when traction is applied. The Saunders halter is also designed with a low-friction sliding component for the patient's head so that the traction force does not have to overcome friction between the patient's head and the table. Therefore slightly less force should be applied when using this type of halter than when using a soft fabric halter.

4. Connect the belts or halter to the traction device.

For cervical traction, all types of soft fabric halters are connected to the traction device by a rope and spreader bar, and the Saunders halter is connected directly to the traction device by a rope.

5. Set the appropriate traction parameters (Table 10-2; see parameter discussion in the next section).

Select static or intermittent traction and then for static traction, set the maximum traction force and the total traction duration, or for intermittent traction, set the maximum and minimum traction force, hold and relax times, and the total traction duration.

6. Start the traction.

The patient should be observed for the first few cycles of cervical traction to ensure that the halter is staying in place and exerting force through the appropriate areas and to ensure that the patient is comfortable and not experiencing any adverse effects from the treatment.

7. Assess the patient's response.

It is recommended that the clinician assess the patient's initial response to the application of traction within the first 5 minutes of treatment so that any adjustments can be made at that time if needed.

8. Give the patient a means to call you and to stop the traction.

Most electrical mechanical traction units are equipped with a patient safety cutoff switch that turns off the unit and rings a bell when activated. Instruct the patient to use this switch if he or she experiences any increase in or peripheralization of pain or other symptoms.


When the traction time is completed, lock the split sections of the table, release the tension on the traction ropes, and allow the patient to rest briefly before getting up and recompressing the joints. Then reexamine the patient.

### TABLE 10-2 Recommended Parameters for the Application of Cervical Spine Traction

<table>
<thead>
<tr>
<th>Area of the Spine and Goals of Treatment</th>
<th>Total Traction Force</th>
<th>Hold/Relax Times (seconds)</th>
<th>Total Traction (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial/acute phase</td>
<td>3 to 4 kg (7 to 9 lbs)</td>
<td>Static</td>
<td>5 to 10</td>
</tr>
<tr>
<td>Joint distraction</td>
<td>9 to 13 kg (20 to 29 lbs); 7% of body weight</td>
<td>15/15</td>
<td>20 to 30</td>
</tr>
<tr>
<td>Decrease muscle spasm</td>
<td>5 to 7 kg (11 to 15 lbs)</td>
<td>5/5</td>
<td>20 to 30</td>
</tr>
<tr>
<td>Disc problems or stretch soft tissue</td>
<td>5 to 7 kg (11 to 15 lbs)</td>
<td>60/20</td>
<td>20 to 30</td>
</tr>
</tbody>
</table>

### MECHANICAL CERVICAL TRACTION

**Parameters for Mechanical Cervical Traction**

The principles for selecting parameters for mechanical cervical traction are similar to those used for lumbar traction, with a few exceptions mentioned in the next section. For a detailed discussion of the principles for selecting treatment parameters for mechanical cervical traction, see the previous section on mechanical lumbar traction. It should be noted that cervical traction uses far less force than lumbar traction.

Intermittent traction may be most effective for reducing pain and increasing cervical ROM in a variety of cervical conditions and may be particularly helpful for reducing symptoms associated with mechanical neck disorders.

**Force.** The greatest difference between parameters used for lumbar and cervical traction is the amount of force. For all cervical traction applications, the traction force should start at 3 to 4 kg (8 to 10 lb).
The traction force to the cervical spine should start at 3 to 4 kg (8 to 10 lb).

When the goal is to decrease compression on a spinal nerve root or facet joint, sufficient force to separate the facet joints in the area being treated must be used. In the cervical spine, 9 to 13 kg (20 to 30 lb), or approximately 7% of the patient’s body weight, is generally sufficient to achieve this outcome.13,67,69 When the goal is to decrease muscle spasm, stretch soft tissue, or exert a centripetal force on the disc by spinal elongation without joint surface separation, 5 to 7 kg (12 to 15 lb) of force will generally be effective. Applying a hot pack in conjunction with the traction may result in greater spinal elongation and thus more effective relief of symptoms.

Higher traction forces are needed when patient positioning, or the harness or table, requires the traction force to overcome gravity or friction. For cervical traction, higher forces are needed when the patient is sitting and the traction has to overcome the force of gravity on the patient’s head. In contrast, when the patient is supine, gravity is not opposing the force of the traction and if the patient’s head. In contrast, when the patient is supine, gravity is not opposing the force of the traction and if the Saunders frictionless halter is used, there is little friction, so lower traction forces may be sufficient.

The force of traction can be adjusted during or between treatments. The force should be decreased during the treatment if there is any peripheralization of signs or symptoms or, as mentioned in the section on precautions, if there is complete relief of severe pain. If the patient’s symptoms are moderately decreased by mechanical cervical traction, the traction force can be increased by 1.5 to 2 kg (3 to 5 lb) at each subsequent treatment session until maximal relief of symptoms is achieved. Traction force to the cervical spine should generally not exceed 13.5 kg (30 lb).

**APPLICATION TECHNIQUE 10-3**

**Procedure for Self-Traction: Sitting**

1. Sit in a sturdy chair with arms.
2. Hold on to the arms of the chair and push down with the arms, lifting the trunk to reduce the weight on the spine (Fig. 10-14). The patient may grade the force of the traction by varying the force of the downward pressure on the arms of the chair and thus the degree of unweighting of the spine; however, the patient should keep the feet on the floor at all times in order to control lumbopelvic position.

**Procedure for Self-Traction: Between Corner Counters**

1. Stand in a corner with solid counter surfaces behind the patient.
2. Place the forearms on the counter and push down with the arms in order to decrease the weight on the spine by unweighting the feet (Fig. 10-15). The patient should leave the feet on the ground in order to control lumbopelvic position.

**Procedure for Self-Traction: Overhead Bar**

1. Stand in a partial squat under a horizontal bar.
2. Hold onto the bar and pull to reduce the weight on the spine (Fig. 10-16). The patient should leave the feet on the ground in order to control lumbopelvic position.

**Advantages**
- Minimal or no equipment needed.
- Easy for patient to perform.
- Easy for patient to control.
- Can be performed in many environments and thus many times during the day.

**Disadvantages**
- Low maximum force, therefore may not be effective.
- Requires strong, injury-free upper extremities.
- Cannot be used for the cervical spine.
- No research data to support the efficacy of this form of traction.
- Patient must have adequate postural awareness and control to position the body appropriately for maximum benefit.

**SELF-TRACTION**

Self-traction is a form of traction that uses gravity and the weight of the patient’s body, or force exerted by the patient, to exert a distractive force on the spine. Self-traction can be used for the lumbar but not the cervical spine.

Self-traction of the lumbar spine is appropriate for home use by the patient whose symptoms are relieved by low loads of mechanical traction or that are associated with mild to moderate compression of spinal structures. Because the amount and duration of force that can be applied by self-traction is limited by the upper body strength of the patient and the weight of the lower body, self-traction is not generally effective when high forces are required to relieve symptoms with mechanical traction or when distraction of the spinal joints is necessary. Self-traction can be applied in a several ways, a few of which are described in Application Technique 10-3. All methods of self-traction attempt to fix the patient’s upper body and use either the body weight or the force of the arms to pull on the lumbar spine. Positions and ways to apply self-traction other than those described can be developed by the clinician or the patient who is familiar with the principles of self-traction.

**Clinical Pearl**

Traction force to the cervical spine should not exceed 13.5 kg (30 lb).
POSITIONAL TRACTION

Positional traction involves prolonged placement of the patient in a position that places tension on one side of the lumbar spine only (Fig. 10-17). This type of traction gently stretches the lumbar spine by applying a prolonged low-load longitudinal force to one side of the spine. Although the low force associated with this form of traction is unlikely to cause joint distraction, it may effectively decrease muscle spasm, stretch soft tissue, or exert a centripetal force on the disc by spinal elongation without joint surface separation. Positional traction may be used to treat unilateral symptoms originating from the lumbar spine and can be a valuable component of a patient’s home program during the early stages of recovery when symptoms are severe and irritable.

MANUAL TRACTION

Manual traction is the application of force by the therapist in the direction of distracting the joints. It can be used for the cervical and lumbar spine, as well as for the peripheral joints. There are many techniques for applying manual traction; however, because manual traction is generally classified as manual therapy rather than as a physical agent, only a few basic techniques for applying manual traction to the spine are described here. For more detailed descriptions of these and other techniques for applying manual traction to the spine or to the peripheral joints, please consult a manual therapy text.11,76
FIG 10-17 Positional traction to stretch and distract the left lumbar area.

### APPLICATION TECHNIQUE 10-4  
**POSITIONAL LUMBAR TRACTION**

**Equipment Required**
- Pillow(s)

**Procedure**

The patient should do the following:
1. Lie on the side, with the involved side up and a pillow under the waist at approximately the level of the dysfunction. The pillow acts to sidebend the lumbar spine away from the involved side, opening the joints and disc spaces on the involved side.
2. Rotate toward the involved side by moving the lower shoulder forward and the upper shoulder back.
3. Rotate further toward the involved side by straightening the inferior lower extremity, bending the superior lower extremity, and hooking the superior foot behind the inferior leg. Rotation toward the involved side further stretches and opens the involved area.
4. Adjust flexion/extension to the position of greatest comfort and symptom relief.
5. Maintain the position for 10 to 20 minutes.

**Advantages**
- Requires no equipment or assistance.
- Inexpensive.
- Can be applied by the patient at home.
- Low force, thus not likely to aggravate an irritable condition.
- Position readily adjustable.

**Disadvantages**
- Low force, thus not likely to be effective where joint distraction is required.
- Requires agility and skill by the patient to perform correctly.
- No research data to support the efficacy of this form of traction.

### APPLICATION TECHNIQUE 10-5  
**MANUAL TRACTION**

**Procedure for Manual Lumbar Traction**
1. Position the patient in the position of least pain. This is usually supine, with the hips and knees flexed.
2. Position yourself. Kneel at the patient’s feet, facing the patient.
3. Place your hands in the appropriate position, behind the patient’s proximal legs, over the muscle belly of the triceps surae (Fig. 10-18).
4. Apply traction force to the patient’s spine by leaning your body back and away from the patient, keeping your spine in a neutral position.
5. Maintain this force for at least 15 seconds. Apply the force for 5 minutes or longer, for static traction, if the patient’s symptoms are relieved by traction and aggravated by motion. Apply the force for 15 to 30 seconds, then release for 15 to 30 seconds, for intermittent traction, for patients whose symptoms are relieved by traction and motion.
6. Adjust the force of the traction according to the desired outcome and the patient’s report.

**Procedure for Manual Cervical Traction: Patient Supine**
1. Position the patient supine.
2. Position yourself. Stand at the head of the patient, facing the patient.
3. Place your hands in the appropriate position. Supinate your forearms so your hands are facing up; place the lateral border of your second finger in contact with the patient’s occiput and your thumbs behind the patient’s ears.
4. Apply traction. Apply force through the occiput by leaning back, keeping your spine in a neutral position (Fig. 10-19).

**Procedure for Manual Cervical Traction: Patient Sitting**
1. Position the patient in the sitting position.
2. Stand behind the patient.
3. Place your hands in the appropriate position. With your arms in a neutral position, place your thumbs under the patient’s occiput and the rest of your hands along the side of the patient’s face.

*Continued*
4. Apply traction. Apply traction through the patient’s occiput by lifting up (Fig. 10-20). Adjust the force of the traction according to the desired outcome and the patient’s report. Manual traction to the cervical spine may also be static or intermittent.

**Advantages**
- No equipment required.
- Short setup time.
- Force can be finely graded.
- Clinician is present throughout treatment to monitor and assess the patient’s response.

**Disadvantages**
- Limited maximum traction force, probably not sufficient to distract the lumbar facet joints.
- Amount of traction force cannot be easily replicated or specifically recorded.
- Cannot be applied for a prolonged period of time.
- Requires a skilled clinician to apply.

- Can be applied briefly, before setting up mechanical traction, to help determine if longer application of traction will be beneficial.
- Can be used with patients who do not tolerate being placed in halters or belts.
**DOCUMENTATION**

When applying traction, document the following:

- Type of traction
- Area of the body where traction is applied
- Patient’s position
- Type of halter if one is used
- Maximum force
- Total treatment time
- Response to treatment

With intermittent traction, also document the following:

- Hold time
- Relax time
- Force during the relax time

Documentation is typically written in the SOAP (Subjective, Objective, Assessment, Plan) note format. The following examples only summarize the modality component of treatment and are not intended to represent a comprehensive plan of care.

**EXAMPLES**

When applying intermittent (int) mechanical (mech) cervical (cerv) traction (txn) to an upper extremity (UE), document the following:

**P:** Pt reports R UE pain from shoulder to wrist aggravated by turning his neck to the right or bending his neck backward.

**O:** Pretreatment: R UE pain 6/10 from shoulder to wrist. Cervical ROM 20% backward bend, 20% R sidebend, aggravating R UE pain.

**Intervention:** Int mech cerv txn, pt supine, soft occipital halter. 10 kg/5 kg, 60 sec/20 sec, 15 min.

**Posttreatment:** Pt reports R UE pain 4/10 from shoulder to elbow. Cervical ROM 40% backward bend, 50% R sidebend.

- Increase force to 12 kg/7 kg next treatment.
- Pt tolerated cerv txn well, with decreased pain and increased cervical ROM.
- Pt able to perform self-traction appropriately and had improved symptoms.
- Pt advised to perform self-traction as above every 20 min at work.

When instructing a patient in the application of self-traction to a lower extremity (LE), document the following:

**P:** Pt reports low back and L LE pain that increases with sitting.

**O:** Pretreatment: Pt unable to sit >30 min without low back and L LE pain increasing to 8/10.

**Intervention:** Pt instructed in self-traction in chair with arms. Pt unweighted approx 50% of body weight, 30 sec hold/relax x 3.

**Posttreatment:** Low back and L LE pain decreased 50% for 2-3 hr after self-traction, pt able to continue working in sitting position for 2 hr without getting out of his chair.

- Pt able to perform self-traction appropriately and had improved symptoms.
- Pt advised to perform self-traction as above every 20 min at work.

When applying lumbar positional traction, document the following:

**P:** Pt reports low back pain that awakens her 3-5 × per night.

**O:** Pretreatment: Low back pain 5/10 when lying in bed at night.

**Intervention:** Lumbar positional traction, R sidelying with pillow at waist, R sidebend, L rotation x 20 minutes.

**Posttreatment:** Pain decreased to 2/10.

- Pt had successful trial of positional traction with decreased pain.
- Pt to perform traction as above at home 2-3 × per day, including immediately before sleeping.

**CLINICAL CASE STUDIES**

The following case studies summarize the concepts of spinal traction discussed in this chapter. Based on the scenario presented, an evaluation of the clinical findings and goals of treatment are proposed. These are followed by a discussion of the factors to be considered in the selection of spinal traction as the indicated intervention and in selection of the ideal patient position, traction technique, and traction parameters to promote progress toward the goals.

**CASE STUDY 10-1**

**Radiating Lower Back Pain**

**Examination**

**History**

TR is a 45-year-old man who has been referred to physical therapy with a diagnosis of a right L5, S1 radiculopathy. He reports constant mild to moderately severe (4-7/10) right low back pain that radiates to his right buttock and lateral thigh after sitting for more than 20 minutes and that is relieved to some degree by walking or lying down. He reports no numbness, tingling, or weakness of the lower extremities. The pain started about 6 weeks ago, the morning after TR spent a day stacking firewood, at which time he woke up with severe low back pain and right lower extremity pain down to his lateral calf; he also had difficulty standing up straight. He had similar problems in the past; however, they always resolved fully after a couple of days of bed rest and a few aspirins. TR first saw his doctor regarding his present problem 5 weeks ago and at that time was prescribed a nonsteroidal antiinflammatory drug (NSAID) and a muscle relaxant and was told to take it easy. His symptoms improved to their current level over the next 2 weeks but have not changed since that time. He has also been unable to return to his job as a telephone installer since the onset of symptoms 6 weeks ago. An MRI scan last week showed a mild posterolateral disc bulge at L5-S1 on the right. The patient has had no previous physical therapy for his back problem.

**Tests and Measures**

The patient’s weight is 91 kg (200 lb). The objective examination is significant for a 50% restriction of lumbar ROM in forward bending and right sidebending, both of
which cause increased right low back and lower extremity pain. Left sidebending decreases the patient’s pain. Passive straight leg raising is 35 degrees on the right, limited by right lower extremity pain, and 60 degrees on the left, limited by hamstring tightness. Palpation reveals stiffness and tenderness to right unilateral posterior-anterior pressure at L5-S1 and no notable areas of hypermobility. All other tests including lower extremity sensation, strength, and reflexes are within normal limits.

What is the likely cause of this patient’s problem? What symptoms point to this as the cause? What type of traction would be most suitable? Why did you select this type of traction?

**Evaluation, Diagnosis, Prognosis, and Goals**

**ICF Level** | **Current Status** | **Goals**
--- | --- | ---
Body function and structure | Right low back pain with radiation to right buttock and lateral thigh | Decrease pain to 1/10-3/10 in 1 week
Restricted lumbar ROM and nerve root mobility on the right (limited right straight leg raise) | Eliminate pain completely in 3 weeks
Bulging L5-S1 disc | Return lumbar ROM and SLR to normal

**Activity**

Decreased sitting tolerance
Unable to stand straight or lift

Increase sitting tolerance to 1 hour in 1 week
Stand straight in 1 week
Lift 20 lbs in 2 weeks

**Participation**

Unable to work

Return to limited work duties within 2 weeks
Return to full work duties within 1 month

**Diagnosis**

Preferred Practice Pattern 4F: Impaired joint mobility, motor function, muscle performance, ROM, and reflex integrity associated with spinal disorders.

**Prognosis/Plan of Care**

The distribution of this patient’s pain and its response to changes in loading indicate that his symptoms are probably related to the mild posterolateral disc bulge at L5-S1 on the right noted on his MRI scan. Traction is an indicated intervention for reducing symptoms associated with a disc bulge or lumbar nerve root compression and therefore should be considered for this patient. Studies have shown that lumbar traction can reduce disc protrusions and effectively relieve related symptoms. Traction is most likely to be effective for this patient if it is applied in conjunction with other treatment techniques, including strengthening, stabilization and stretching exercises, joint mobilization, and body mechanics training. Treatment in the clinic should be integrated with a complete home program. The use of spinal traction is not contraindicated in this patient because there is no displaced fragment of anulus or areas of hypermobility and there are no indications of a hiatal hernia or a cardiac or pulmonary condition that may be aggravated by use of the belts for mechanical traction.

**Intervention**

Electric mechanical traction is the best option for this patient because this type of traction allows the greatest control of lumbar traction force and the application of sufficient force to distract the lumbar vertebrae. Prone positioning, if tolerated, will place the spine in a neutral or slightly extended position and thus provide greater separation of the disc spaces anteriorly and to localize the force to the lower lumbar segments.

A traction force of 25% of the patient’s body weight may be sufficient to help this patient reach the set goals of treatment because this amount of traction force can produce a centripetal force on the lumbar disc and reduce a disc displacement. However, traction force as much as 50% of the patient’s body weight may be needed if joint distraction is required to alleviate this patient’s symptoms. Initial treatment should use a low force of approximately 25% of the patient’s body weight, or 13 to 20 kg (25 to 50 lb), to allow assessment of the patient’s response to the intervention and minimize the risk of protective muscle spasms. The traction force may then be increased for subsequent treatments, if necessary, until a level is reached at which the patient responds with approximately a 50% reduction in symptom severity after treatment. The application of a hot pack in conjunction with traction may improve the patient’s response to the intervention by increasing superficial tissue extensibility and decreasing pain.31,32

Intermittent traction with a long hold time, approximately 60 seconds, and a short relax time, approximately 20 seconds, is likely to have most effect on the discs. Static traction may also be effective. The initial treatment should be limited to 10 minutes if the patient reports some reduction of symptoms in this time. If this does not reduce the patient’s symptoms, the treatment time may be extended to up to 20 to 40 minutes for subsequent treatments.

If the application of mechanical traction in the manner described relieves this patient’s symptoms and particularly if lower forces and lower durations of treatment are effective, the use of self-traction or positional traction at home, with the patient lying on the left side with the left side bent and right rotation, may also help this patient progress toward his treatment goals.
Documentation
S: Pt reports constant 4/7/10 R low back pain radiating to the R buttock and lateral thigh after sitting for more than 20 minutes, relieved somewhat by walking or lying down.
O: Pretreatment: 50% restricted lumbar ROM with forward bend and R sidebend, limited by R low back and R LE pain 7/10. L sidebend decreases pain. Passive SLR 35 degrees on R, limited by R LE pain, and 60 degrees on L, limited by hamstring tightness. Tenderness to palpation R posterior-anterior pressure at L5-S1.
Intervention: Intermittent mech lumbar txn, pt prone. 22 kg/11 kg (48 lb/24 lb), 60 sec/20 sec, 10 minutes.
Posttreatment: 50% restricted lumbar ROM with R forward and sidebend. Pain 4/10 with R sidebend.
A: Pt tolerated txn well, and symptoms improved.
P: Continue intermittent mech txn at these parameters once daily. Teach patient positional lumbar txn.

CASE STUDY 10-2

Osteoarthritis with Facet Joint Degeneration

Examination

History
AW is a 75-year-old woman who has been referred to physical therapy with a diagnosis of osteoarthritis with moderately severe facet joint degeneration at C4 through C6 observed on x-ray. She complains of bilateral neck pain that is worse on the right than on the left. She also reports that her neck is stiff first thing in the morning, loosening up throughout the day but becoming stiff and sore late in the afternoon and for the rest of the evening. She has no complaints of upper extremity pain or stiffness; however, the neck stiffness makes her feel unsafe while driving, and when the pain is severe, she is unable to participate in her sewing class at the local senior center. She has had similar but gradually worsening symptoms intermittently for the past 20 years, and her symptoms are always more severe during the winter. In the past, AW has been referred to physical therapy for treatment of these symptoms, and her treatment has included traction, heat, massage, and a few exercises. Within four to six visits this combination of interventions helps relieve her symptoms for about a year until the following winter.

Tests and Measures
The objective examination reveals a kyphotic thoracic posture with a forward head position. Cervical ROM is restricted by approximately 50% in all planes, and there is moderate hypertonicity of the cervical paraspinal muscles and stiffness of all the cervical facet joints on passive intervertebral motion testing, with the lower cervical joints being stiffer than the upper cervical joints. Shoulder flexion and abduction are limited to 140 degrees bilaterally, and all other objective tests, including upper extremity sensation, strength, and reflexes, are within normal limits for this patient’s age.

What are the indications for spinal traction in this patient? What other physical agent would be useful for this patient in conjunction with traction? How would you improve her long-term benefits? What should you examine (including elements of the history, as well as tests and measures) before applying traction to this patient?

Evaluation, Diagnosis, Prognosis, and Goals

Evaluation and Goals

<table>
<thead>
<tr>
<th>ICF Level</th>
<th>Current Status</th>
<th>Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body function and structure</td>
<td>Neck pain and stiffness</td>
<td>Decrease pain by 50%</td>
</tr>
<tr>
<td>Kyphotic thoracic posture</td>
<td>Improve posture</td>
<td></td>
</tr>
<tr>
<td>Loss of neck movement in all planes</td>
<td>Prevent symptoms recurence</td>
<td></td>
</tr>
<tr>
<td>Hypertonic paraspinal cervical muscles</td>
<td>Increase active and passive cervical ROM to 75% of normal</td>
<td></td>
</tr>
<tr>
<td>Limited bilateral shoulder flexion and abduction</td>
<td>Improve soft tissue mobility</td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>Unable to turn head to see far to the side or behind</td>
<td>Improve ability to turn head so patient can see all the way to the side</td>
</tr>
<tr>
<td>Unable to look down to write or sew for &gt;10 minutes</td>
<td>Increase tolerance for looking down to 30 minutes</td>
<td></td>
</tr>
<tr>
<td>Participation</td>
<td>Able to drive but feels unsafe</td>
<td>Improve ability to drive safely within 2 weeks</td>
</tr>
<tr>
<td>Unable to participate in sewing class</td>
<td>Return to full participation in sewing class within 2 weeks</td>
<td></td>
</tr>
</tbody>
</table>

Diagnosis
Preferred Practice Pattern 4B: Impaired posture.

Prognosis/Plan of Care
Cervical spinal traction is indicated for the treatment of joint hypomobility, particularly when multiple spinal segments are involved, and for the relief of symptoms caused by subacute joint inflammation. Spinal traction may also help alleviate this patient’s spinal pain by gating its transmission at the spinal cord or by reducing joint compression and inflammation. Intermittent traction may help to reduce symptoms resulting from inflammation by facilitating normal fluid exchange in the joints to relieve edema caused by chronic inflammation. This change, combined with stretching of the periarticular soft tissue structures, may increase spinal joint and soft tissue mobility and cervical active ROM. Applying a deep or superficial heating agent to this patient’s neck, before or during the application of traction, may optimize the benefits of the treatment by increasing soft tissue extensibility to facilitate greater increases in soft
tissue length. As in previous years, traction and other passive modalities alone are likely to result in only temporary control of this patient’s symptoms; however, more long-lasting benefits may be achieved by additionally addressing her posture and thoracic mobility and by modifying her home activities.

At the age of 75, this patient should be cleared for impairment of vertebral or carotid artery circulation and for osteoporosis before the application of cervical traction. If she normally wears dentures, she should wear them during the treatment. It is important to not assume that because this patient has tolerated traction well in the past, she will tolerate it equally well at this time, particularly if she has experienced any medical events, such as a cerebrovascular accident, since she was last treated with traction.

**Intervention**

Once this patient is cleared for the application of traction, a trial of manual traction is recommended to assess her response to traction and to help determine the ideal position before considering the use of other forms of traction. If manual traction affords her some relief of symptoms, then electrical mechanical traction should be used in the clinic to provide optimal efficiency and consistency of treatment. An occipital halter should be used to avoid compression on the temporomandibular joints (TMJs), and the patient should be positioned supine, with her cervical spine in about 24 degrees of flexion, to achieve maximum separation of the lower cervical joints and elongation of the posterior spinal structures.

As with all traction treatments, the force of traction should initially be low, at approximately 4 kg (10 lb), for the first session. The amount of force may then be increased by 1.5 to 2 kg (3 to 5 lb) at each subsequent session until optimal symptom control is achieved. A low amount of force, of 5 to 7 kg (12 to 15 lb), which can elongate the cervical spine without distracting the joints, will probably be sufficient to alleviate this patient’s symptoms, and the use of more force will probably not provide greater benefit. The traction force should not exceed 13 kg (30 lb) at any time. Intermittent traction should employ short hold and relax times of approximately 15 seconds each because this ratio is generally effective at reducing symptoms associated with the joints. The total duration of the traction treatment should be between 10 and 40 minutes, depending on the patient’s response.

Because this patient presents with recurrent symptoms that are probably a result of progressive and chronic osteoarthritis, it is also recommended that she obtain and be instructed in the use of a simple mechanical traction device, such as an over-the-door cervical traction unit, for use at home. She may then use this device to treat aggravations of similar symptoms that she may experience in the future.

---

**CASE STUDY 10-3**

**Neck Pain in a Patient with Rheumatoid Arthritis**

**Examination**

**History**

MS is a 30-year-old female high school teacher. She was diagnosed with rheumatoid arthritis at the age of 22 and has been referred to physical therapy for treatment of neck pain. She complains of constant and severe pain in her neck that is aggravated by all neck movements, and she reports intermittent dizziness that is brought on by moving from sitting to standing or by looking up. The neck pain started about 3 or 4 years ago and has gradually become more severe, while the dizziness started only a few weeks ago. MS reports that at this time the pain keeps her awake at night and the dizziness interferes with her ability to write on the chalkboard when she is at work. MS has no numbness or tingling of her extremities and reports that no x-ray films have been taken of her neck in the last 3 years.

**Tests and Measures**

Her objective exam reveals postural abnormalities, including standing with approximately 20 degrees of hip and knee flexion bilaterally, bilateral genu valgum, a moderately increased lumbar lordosis, a flat thoracic spine, and a forward head position. The flat thoracic spine and forward head position are maintained in sitting. Cervical ROM testing was deferred at the initial evaluation due to the severity of the patient’s reports of pain with motion. Her upper extremity strength was 4+/5 throughout the available ROM, and her upper extremity sensation and reflexes were within normal limits.
What part of this patient’s history needs further evaluation before the use of traction? Would you expect complete relief of symptoms in this patient?

Evaluation, Diagnosis, Prognosis, and Goals

<table>
<thead>
<tr>
<th>ICF Level</th>
<th>Current Status</th>
<th>Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body function</td>
<td>Neck pain and stiffness</td>
<td>Ascertain the ligamentous stability and bony integrity of her upper cervical spine. Relieve pain and dizziness. Improve cervical ROM. Improve sleep until pt able to sleep through night. Improve chalkboard writing to 100% of normal in 1 month.</td>
</tr>
<tr>
<td>and structure</td>
<td>Dizziness</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Abnormal posture</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Limited cervical ROM</td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>Unable to sleep</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unable to write on chalkboard</td>
<td></td>
</tr>
<tr>
<td>Participation</td>
<td>Decreased ability to teach</td>
<td>Return to teaching full time without restrictions in 1 month.</td>
</tr>
</tbody>
</table>

Diagnosis

Preferred Practice Pattern 4D: Impaired joint mobility, motor function, muscle performance, and ROM associated with connective tissue dysfunction.

Plan of Care

Although treatment goals could include resolving any of the above impairments or functional limitations, this patient’s reports of dizziness associated with neck pain and the diagnosis of rheumatoid arthritis should alert the clinician to the possibility that this patient may have an unstable C1-C2 articulation as a result of ligamentous instability or, she may have osteoporosis as a result of prolonged systemic steroid use. Because instability at C1-C2 poses a significant risk to the patient, and because the presence of osteoporosis requires special caution with the application of traction, the initial goal, before applying traction or any other treatment, should be to ascertain the ligamentous stability and bony integrity of her upper cervical spine. Because these both require radiographic studies that must generally be ordered by a physician, the patient should be referred back to her physician for further evaluation.

If all radiographic reports indicate that her upper cervical spine is stable and that she does not have osteoporosis, she may return to physical therapy for treatment of her complaints, with goals as listed in the previous table. Because this patient has a systemic disease that affects the joints and that appears to have caused permanent changes in other joints, including her hips and knees, complete relief of symptoms or return of ROM will probably not occur.

Prognosis

If all tests indicate that spinal traction is not contraindicated, then traction may improve this patient’s cervical mobility and decrease her neck pain. Distraction or mobilization of the cervical joints or relaxation of the cervical paraspinal muscles can achieve these effects. Cervical traction may also help alleviate this patient’s dizziness because she associates this symptom with neck motion; however, her dizziness may be a result of an inner ear or vestibular dysfunction, which would also be affected by head position, in which case this symptom would probably not respond to treatment with traction. Although traction may reduce this patient’s symptoms sufficiently to allow her to write on a chalkboard, it is recommended that job site adaptations, such as the use of an overhead projector, also be instituted to reduce the stress on her cervical spine.

Intervention

To constantly monitor this patient’s severe symptoms and to allow adjustment of the traction force and direction during the treatment, manual traction should be used initially. If the patient reports moderate relief of her pain with manual traction, then optimal cervical positioning for traction should be determined, and static mechanical traction may be substituted if it is thought that a longer duration of treatment would be beneficial. Static cervical traction may be provided by an electrical or weighted device, but in either case, it is recommended that the patient be treated supine rather than sitting, to achieve maximum muscle relaxation, and it is recommended that low forces be used initially because of the severity of the patient’s symptoms.

As treatment progresses, the force of traction may be increased up to a maximum of 13 kg (30 lb) to achieve joint distraction if necessary, and intermittent traction may be used if this is more comfortable as the patient tolerates more motion. Treatment with spinal traction should occur in conjunction with postural education and recommendations for home or work site modifications to minimize the risk of symptom reaggravation or progression.

Documentation

9: Pt reports neck pain worsening over the last 4 years and dizziness that began 3 weeks ago, which is worse when looking up and moving from sitting to standing.

0: Pretreatment: Neck pain 8/10, 20 degree hip and knee flexion bilaterally, bilateral genu valgum, lumbar lordosis, flat thoracic spine, and forward head position when standing. Flattened thoracic spine and forward head position when sitting. Cervical ROM testing deferred. UE strength 4+/5 throughout.

Continued
CHAPTER REVIEW

1. Traction is a mechanical force applied to the body to distract joints, stretch soft tissue, relax muscles, or mobilize joints. Types of spinal traction used today include electrical mechanical traction, weighted mechanical traction, over-the-door cervical traction, various home traction devices, self-traction, positional traction, and manual traction.

2. Traction may be static (continuous force) or intermittent (varying force). Static traction is recommended when the area being treated is inflamed, if the patient's symptoms are aggravated by motion, or if the patient's symptoms are related to a disc protrusion. All the types of spinal traction listed can be used to apply static traction. Intermittent traction is used for symptoms related to disc protrusion and joint dysfunction. Electrical mechanical traction units and manual techniques can be used to apply intermittent traction.

3. Spinal traction can be used to relieve signs, symptoms, and functional limitations associated with disc bulge or herniation, nerve root impingement, joint hypomobility, subacute joint inflammation, and paraspinal muscle spasm. The effects and clinical benefits of spinal traction depend on the amount of force used, the direction of the force, and the status of the area to which the traction is applied.

4. Selection of a spinal traction technique depends on the nature of the problem being treated, specific contraindications, and whether the treatment is to be applied in the clinic or at home.

5. Spinal traction is contraindicated where motion is contraindicated, with an acute injury or inflammation, with joint hypermobility or instability, with peripheralization of symptoms with traction, and with uncontrolled hypertension. Precautions for the application of spinal traction include structural diseases or conditions affecting the spine, when the pressure of the belts may be hazardous, displacement of an anular fragment, medial disc protrusion, severe pain fully relieved by traction, claustrophobia, intolerance of the prone or supine position, disorientation, TMJ problems, and dentures.

6. The reader is referred to the Evolve web site for further exercises and links to resources and references.

ADDITIONAL RESOURCES

Web Sites

- Chattanooga Group: Chattanooga supplies a variety of physical agents, including traction devices. The web site has product photos and information, including instructions for the use of some products. It is possible to search for products by body part or by modality. www.chattgroup.com

GLOSSARY

- **Anulus fibrosus**: A ring of fibrocartilage that forms the outer layer of the intervertebral disc.
- **Herniated disc**: Bulging of the intervertebral disc into the spinal canal.
- **Herniated nucleus pulposus**: Bulging of the nucleus pulposus of the intervertebral disc into the spinal canal.
- **Intermittent traction**: Traction in which the force varies every few seconds.
- **Intervertebral disc**: Structure located between the vertebrae that acts as a shock absorber for the spine.
- **Joint distraction**: The separation of two articular surfaces perpendicular to the plane of articulation; the widening of a joint space.
- **Manual traction**: Application of force by the therapist in the direction of distracting the joints.
- **Mechanical traction** (electrical mechanical traction): Application of static or intermittent force by an electrical motor, through belts or a halter, in the direction of distracting the joints of the spine.
- **Nucleus pulposus**: Elastic, pulpy substance found at the center of an intervertebral disc.
- **Over-the-door cervical traction**: Application of static force to the neck, through a halter, using a device hung on a door that can be adjusted to provide differing amounts of distractive force.
- **Positional traction**: Prolonged specific positioning to place tension on one side of the lumbar spine.
- **Self-traction**: A form of traction that uses gravity and the weight of the patient’s body, or force exerted by the patient, to exert a distractive force on the spine.
Spondylolisthesis: Forward displacement of one vertebra on another that can cause nerve root compression and pain.

Static traction: Traction in which the same force is applied throughout treatment.

Traction: A mechanical force applied to the body in a way that separates, or attempts to separate, joint surfaces and elongate soft tissues surrounding a joint.

REFERENCES