Lumbar Traction: A Review of the Literature

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Traction has been used as a medical intervention since antiquity. In modern time, James Cyriax popularized lumbar traction during the 1950s and 1960s as a treatment for disc protrusions. Today, traction continues to be a commonly employed modality for treating patients with back and leg pain. The purpose of this paper was to review the existing literature on lumbar traction and to identify aspects of this modality in need of further study.

Lumbar traction is commonly used to treat patients with back pain. Typically, clinicians rely on expert opinion in making decisions about when and how to implement lumbar traction. The purpose of this paper was to review current knowledge of lumbar traction and to identify what, if any, empirical evidence supports the expert opinions. This review found that whereas the mechanical effects of lumbar traction are well substantiated, the results of studies examining clinical effectiveness are conflicting. The failure to conclusively demonstrate the clinical benefit of lumbar traction may be related to the varied diagnostic categories and treatment techniques employed in the studies. Of the 10 types of lumbar traction described in the literature, static and intermittent mechanical traction are the two most commonly used. Indications, contraindications, and treatment techniques for these two types of traction are discussed. Based on the findings of this review, further study is needed to determine optimal treatment duration, frequency, and mode of administering lumbar traction. Also, classification systems to identify patients most likely to benefit from traction need to be developed and validated.

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MECHANICAL EFFECTS OF LUMBAR TRACTION

Cyriax (7) described three beneficial effects of traction: *1*) distraction to increase the intervertebral space, *2*) tensing of the posterior longitudinal ligament to exert centripetal force at the back of the joint, and *3*) suction to draw the protrusion toward the center of the joint. Other effects attributed to traction include widening of the intervertebral foramen (33), flattening of the lumbar lordosis (2), and distraction of the apophyseal joint (12).

The mechanical effects of traction on the lumbar spine are well documented in the literature. Worden and Humphrey (38) reasoned that if traction causes vertebral separation, then adequate force should result in an increase in body height. Five healthy subjects received a maximum of 59.9 kg of traction up to 15 times over a 22-day period. Traction force was applied to the chin and thorax in the cephalad direction and to the pelvis and ankles in the caudal direction, with the subjects positioned supine. Traction was administered for 60 minutes, with 1- to 3-minute rest periods every 10 minutes. The authors reported 8–11.5 mm increases in standing height, with some retention of these height increases after several days of traction. Twomey (36) documented vertebral separation with traction by applying 9 kg of sustained traction to the spinal columns of 23 male cadavers. A significant increase in length of the lumbar columns was recorded. Eighty-five percent of the length increase occurred immediately after application of the traction, and 60% of the increase was due to vertebral separation. Spinal columns composed of healthy discs demonstrated greater vertebral separation than columns with signs of disc degeneration.

In another study investigating vertebral separation, Colachis and Strohm (4) studied the effects of 22.7 and 45.4 kg of traction in 10 healthy subjects. They reported significant increases in total mean posterior vertebral separation with 22.7 kg of traction and increases in total mean anterior and posterior separation with a traction force of 45.4 kg. The greatest increase in posterior vertebral separation occurred at the L4–5 level.

Several studies have used diagnostic imaging to document changes in disc herniation. Mathews (23) administered epidural injection of contrast medium to 11 patients with sciatica and a limited straight-leg raise. Lateral radiographs were taken before, during, and after traction. Radiographic findings included reduction of disc prolapse, vertebral separation, and flow of contrast material into the disc spaces. Gupta and Ramarao (14) used epidurography to evaluate the effects of 10–15 days of continuous 36.3-kg traction on prolapsed discs. In 10 of the 14 cases studied, there was marked clinical improvement, and the radiographic indications of defects were no longer evident.

In a more recent study, Onel et al (28) used computed tomography to study the effects of traction on disc herniation in 30 patients. The herniated nuclear material retracted during traction in 78.5% of median herniations, 66.6% of posterolateral herniations, and 57.1% of lateral herniations. Other mechanical changes were noted, including widening of disc spaces, separation of apophyseal joint facets, increase in neural foramina, and thinning of the ligamentum flavum. The authors attributed retraction of the herniated nuclear material during traction to a suction effect of negative intradiscal pressures and a pushing effect of the posterior longitudinal ligament. Twenty-eight of the 30 cases of lumbar disc herniation showed clinical improvement following a 1-month course of conservative treatment that included traction. Of the two cases that failed to improve, one demonstrated a large herniation filling the spinal canal, and the second showed calcification of a protruded disc.

During active traction, L3 disc pressure increased from a standing resting value of 270 kPa to 540 kPa.

Changes in lumbar intervertebral disc pressures during active (autotraction) and passive traction were studied by Andersson et al (1). The pressure within the nucleus of the L3 disc of four healthy adults (mean age = 21.8 years) was measured using a pressure transducer built into the tip of a needle. In active traction, the subject wore a pelvic harness attached to a spring-force scale and, using his or her arms, pulled on a frame at the head of the traction table to register a 500-N force on the scale. In passive traction, one investigator pulled on the pelvis, and another pulled under the arms. Active traction was maintained for 2 minutes, and passive traction was maintained for 30 seconds. During active traction, L3 disc pressure increased from a standing resting value of 270 kPa to 540 kPa. During passive traction, the disc pressure generally remained at the resting value, averaging 280 kPa. The authors attributed the increased disc pressures during active traction to strong contraction of trunk musculature. In summary, empirical evidence exists to document vertebral separation, reduction of disc herniation, and changes in intervertebral disc pressures with the application of traction to the lumbar spine.

CLINICAL EFFECTIVENESS OF LUMBAR TRACTION

Despite substantial evidence to support mechanical effects, the clinical effectiveness of pelvic traction as conventionally administered by physical therapists remains controversial (9,26,33). Cheatle and Esterhai (3) surveyed 534 orthopaedic surgeons and physiatrists to evaluate their decision-making process in considering use of pelvic traction. Of 213 completed questionnaires, 28% responded they would prescribe traction for radicular low back pain. Fifty-four percent indicated that their rationale for using traction was to ensure bedrest, whereas 17% reported that the purpose of traction was to decrease nerve root/disc pressure. Clinicians were asked to specify treatment parameters and type of traction, but this information was not reported by the authors. Cheatle and Esterhai contended that there is minimal scientific basis or clinical support for the use of pelvic traction, and that this intervention may be both physically harmful by promoting muscle deconditioning and psychologically detrimental by reinforcing passive health care behavior.

Challenging this assertion, there are reports of clinical trials documenting favorable outcome following lumbar traction. Hood and Chrisman (18) studied 40 patients with a diagnosis of ruptured intervertebral disc. Thirty-nine of the subjects reported both leg and back pain. Positive straight-leg raise signs were noted in 38 subjects. Patients received 29.5–31.8 kg of split-table, intermittent pelvic traction for 20 minutes. Physical therapy was administered daily and consisted of a heat treatment followed by traction. Subjects were surveyed approximately 18 months following treatment and were classified using the following criteria: excellent = asymptomatic, employed full-time; good = symptoms greatly improved, occasional minor backache and fatigue; poor = symptoms the same or worse. Twenty-one patients (52.5%) were rated as good or excellent. Eighteen of the 19 patients showing poor results following traction underwent surgery, with 16 of the surgical patients demonstrating disc protrusion lying below or medial to the nerve root.

Of the 10 types of traction described, sustained and intermittent mechanical traction were most widely employed in the empirical studies.

In another supportive study, Lidstrom and Zachrisson (22) randomly assigned 62 patients with low back and sciatic pain of more than 1 month in duration to one of three treatment groups. The conventional treatment group received heat, massage, and mobilizing and isotonic strengthening exercises for the spine. The alternative treatment group received pelvic traction with isometric abdominal and hip extensor exercises. Traction was administered for 20 minutes in the intermittent mode (4 seconds hold; 2 seconds rest) and at a force approximately 43–53% of body weight. The control group received hot packs and rest. Subjects received a total of 10 treatment sessions over a period of 1 month. Outcome was assessed using three measures: *1*) based on clinical evaluation, an orthopaedic surgeon categorized each patient's condition as noticeable improvement, status quo, or noticeable change for the worse; *2*) patients rated their own progress using the same three categories listed above; and *3*) patient use of analgesics before and after treatment was compared. Ratings made by the orthopaedic surgeon ($\chi^2 = 13.70, p < .01$) and by the subjects ($\chi^2 = 13.51, p < .01$) showed significantly greater improvement and less need for analgesics in the alternative treatment group than in the conventional or control groups.

The results of other studies investigating lumbar traction are equivocal. Mathews and Hickling (24), in a double-blind study of 27 patients with sciatica or cruralgia, compared treatment with 36.3 to 61.2 kg of traction to controls receiving a maximum of 9.1 kg of force. Both groups received 30 minutes of traction daily, 5 days a week for 3 weeks. The treatment group reported 28.8% improvement over initial levels of pain and demonstrated a 3.1° gain in straight-leg raise ability compared with an 18.9% improvement in pain and a 0.7° gain in leg raise in the control group. The authors claimed that the small sample size prevented the results from achieving statistical significance, but they failed to report their target level of significance.

Mathews and Hickling's (24) study was a pilot for a more recent project that concurrently evaluated manipulation, traction, sclerosant, and epidural injections (25). Five-hundred-thirteen subjects were assigned to treatment groups based on signs and symptoms. Patients with low backache, asymmetrical restriction of spine movements, and asymmetrical restriction of straight-leg raise or the femoral nerve stretch test were allocated to evaluate the effectiveness of traction in providing relief from sciatica. These 131 subjects were then randomly assigned to the traction group ($N = 77$) or to the control group ($N = 54$). The traction group received at least 45 kg of force on a friction-free table for 30 minutes, 5 days a week. The control group received infrared heat to the low back for 15 minutes, three times a week. All patients were given a supply of paracetamol tablets and were instructed in posture and back care. Pain was assessed using a six-point visual analogue scale. A pain score of 5 or 6 was categorized as "recovered," and scores of 1–4 were categorized as "not recovered." After 2 weeks of treatment, 52% of the traction group and 50% of the control group had "recovered" ($p < 0.1$). A subgroup of females under age 45 was found to have more highly significant outcomes ($p < 0.05$). Subsequent authors have expressed an unwillingness to accept the 0.1 level of significance reported in this study as an indicator of treatment effect (34).

Recommendations for duration of individual treatment sessions vary from a few minutes to 40 minutes.

In another study with unclear implications for lumbar traction, Coxhead et al (6) used a factorial design of 16 treatment groups. They assessed traction, exercise, manipulation, and corset, singularly and in combination, in 334 patients with sciatica. The intensity and duration of traction was left to the therapist's discretion, and specific amounts of traction force were not reported. After 4 weeks of treatment, a significant subjective improvement in symptoms with increasing numbers of types of treatments was reported. However, no specific treatment or combination of treatments, including traction, was responsible for this effect.

Other investigators reported no treatment effect with bedside traction. Pal et al (29) assigned 41 patients admitted to the hospital for back pain and sciatica to either a treatment group receiving 5.4–8.2 kg of continuous bed traction or a control group receiving 1.4–1.8 kg of traction. They found no significant difference between groups in analgesic consumption, pain score, straight-leg raise angle, neurological deficit, or return to work.

Differences in diagnostic category, type of traction, treatment technique, and outcome measures make it difficult to compare studies and draw definitive conclusions about the clinical effectiveness of traction. Nevertheless, lumbar traction remains a common intervention in treating the patient with back pain.

TYPES OF LUMBAR TRACTION

At least 10 types of pelvic traction (12,16,27,33) have been described in the literature. Continuous or bed traction uses low weights for extended periods of time. Cailliet (2) attributes the benefit of continuous traction to reducing the effects of gravity and decreasing the lumbar lordosis. However, Pal et al (29), as noted previously, found no treatment effect in their evaluation of bed traction. Sustained traction uses heavier weights applied steadily for short periods of time. Intermittent traction is similar to sustained traction in intensity and duration but utilizes a mechanical unit to alternately apply and release the traction force at preset intervals (16). Manual traction is applied as the clinician's hands and/or a belt are used to pull on the patient's legs (21).

Autotraction utilizes a specially designed table that is divided into two sections that can be individually tilted and rotated. The patient provides the traction force by pulling with the arms and/or pushing with the feet. Investigations of autotraction have reported favorable clinical results but no change in size or location of lumbar disc herniation (11,35).

Positional traction maintains flexion and rotation of the spine with bolsters to achieve distraction of a specific vertebral motion segment (30). The 90/90 traction technique is self-administered and marketed as appropriate for home treatment (5). The patient, positioned in 90° of hip and knee flexion, tilts the pelvis and flattens the lumbar lordosis by pulling on a rope that traverses the unit's frame and attaches to a pelvic harness.

In inversion traction, the patient is suspended by the ankles or thighs in the head down position, allowing the weight of the upper body to act as a traction force. Studies of the cardiovascular effects of inversion traction have reported significant increases in blood pressure and ophthalmic artery pressure in young, healthy subjects (15,40), warranting additional precautions for using this method. Haskvitz and Hanten (15) recommended that inversion traction be avoided in patients who are hypertensive or unaware of their blood pressure status. Zito (40) listed certain ocular problems, such as glaucoma and detached retina, as contraindications for inversion traction and suggested that users consider undergoing a dilated retinal examination before inversion.

Gravity lumbar traction, in which a chest harness secures the patient as the treatment table is tilted to a vertical position, uses the weight of the lower half of the body to provide a traction force. Pool traction is administered in an aquatic setting. Results of a trial of pool traction in patients with chronic low back pain and disability found no treatment effect on vocational status or pain level (27).

Of the 10 types of traction described, sustained and intermittent mechanical traction were most widely employed in the empirical studies investigating effects of traction. Thus, the remainder of this paper describes these two types of traction, including indications, contraindications, and treatment techniques.

INDICATIONS AND CONTRAINDICATIONS

Traditionally, lumbar traction has been advocated for the treatment of back and root pain due to herniated nucleus pulposus, degenerative disc disease, and foraminal stenosis. Traction may be beneficial in treating joint hypomobility, contracted connective tissue, adhesions, apophyseal joint impingement, and muscle spasm (12,33,39). Erhard (10) described a traction category in his classification system for patients with low back syndrome. Patients with symptoms of radiating pain and/or paresthesia that do not improve with trunk movements are considered appropriate for treatment with traction. The primary contraindications (7,12,17) for traction are listed in the Table.

Spinal malignancy	Uncontrolled hypertension
Cord compression	Cardiovascular disease
Spinal infection	Severe respiratory disease
Osteoporosis	Aortic aneurysm
Hiatal hernia	Abdominal hernia
Acute lumbago	Rheumatoid arthritis
Pregnancy	Severe hemorrhoids

TABLE. *Contraindications for lumbar traction.*

TREATMENT TECHNIQUE

Factors such as patient position, treatment mode, traction force, duration and frequency should be considered in administering mechanical lumbar traction. Cyriax (8) and Saunders and Saunders (33) offer detailed guidelines for administering traction treatments. These guidelines for traction technique are based largely on clinical practice rather than controlled investigation. In the description that follows, these and other expert opinions will be outlined, along with existing empirical evidence. The reader is referred to textbooks by Cyriax (8) and Saunders and Saunders (33) for detailed descriptions of their respective approaches to administering spinal traction.

Patient Position

The patient may be positioned prone or supine, with the traction belts exerting a pull to the anterior or posterior aspect of the joint. Cyriax (8) and Saunders and Saunders (33) used the criteria of patient comfort, pattern of pain and limitation of trunk movement, and treatment goals and effectiveness to determine appropriate patient and pelvic strap positioning. However, there is very little empirical evidence to support the recommendations of these experts. Weatherell (37) studied 17 normal subjects and observed significantly less lumbar sacrospinalis electromyographic activity during static pelvic traction in the prone position than in the supine position. Muscle relaxation is considered essential to achieving optimal effects of traction

(7). However, Weatherell's results need to be replicated in a group of symptomatic patients before the prone position can be declared more effective than supine lying.

Treatment Mode

Mechanical traction may be administered statically or intermittently. Cyriax (7) claimed static traction was essential to fatigue the muscles and allow the traction force to act on the joints. He believed intermittent traction elicits a stretch reflex and is ineffective in reducing disc protrusions. In contrast, Rogoff (31) asserted that the same result can be achieved with either static or intermittent traction, although patients are able to tolerate much higher forces when traction is applied intermittently. Saunders and Saunders (33) related treatment mode to diagnosis, recommending static traction or longer hold-rest periods in treating disc protrusions and intermittent traction with shorter hold-rest periods in treating joint hypomobility and degenerative disc disease.

The limited empirical evidence available tends to support Rogoff's viewpoint. Hood et al (19) found no difference in lumbar sacrospinalis electromyographic activity during intermittent or static traction. Similarly, Colachis and Strohm (4) found no significant difference in vertebral separation when 45.4 kg of static or intermittent traction was applied.

Traction Force

Effective forces for static and intermittent traction generally range from 31.8 to 68.0 kg, averaging approximately 45 kg (16). Judovich (20) demonstrated the importance of employing adequate force in order to achieve the mechanical effects of lumbar traction. Using cadavers and live subjects, Judovich determined that 54% of the weight of a body segment is required to overcome surface resistance between the treatment table and the body. The lower body segment, below L3, weighs approximately 49% of total body weight. Therefore, traction forces must exceed 26% of total body weight (.49 × .54 = .26) to affect the lumbar spine. Judovich proposed the use of a "split-bed" to eliminate surface resistance by rendering the lower body segment free to move with the mobile lower section of the bed. Testing this proposal, Goldish (13) demonstrated the mechanical efficiency of split-table traction using a 34-kg sandbag to simulate the weight of the lower body segment of a 68-kg person. With the split table open, only 1.5 kg of a 45.4 kg traction force were lost to friction, whereas with the table closed, 16.2 kg were lost to friction.

Treatment Duration

Recommendations for duration of individual treatment sessions vary from a few minutes to 40 minutes. Saunders and Saunders (33) recommended 8–10 minutes of spinal traction in treating disc protrusion, whereas Hickling (16) advocated 20–40 minutes. Both authors advised shorter treatment duration and force during the initial treatment session in order to assess the patient's reaction to traction. No empirical reports evaluating the effects of treatment duration were found in the literature.

Treatment Frequency

Hickling (16) and Cyriax (8) claimed that traction must be administered daily to be effective. However, a review of the literature yielded no clinical trials evaluating outcome under varied frequencies of treatment. In spite of this lack of research, the issue of treatment frequency is gaining importance in clinical practice. Some health care insurance policies are increasingly limiting both the total number of visits and the treatment frequency of reimbursable physical therapy services (32). Therefore, there is a pressing need for definitive evidence to support the contention that daily traction is more effective than less frequent treatment.

CONCLUSION

The mechanical effects of lumbar traction are well documented in the literature. In contrast, studies of the clinical effectiveness of traction offer conflicting results, with some studies supporting the use of traction and others reporting equivocal findings. Difficulty in demonstrating effectiveness may be related to variability in current clinical practice. Clinicians typically utilize expert opinion in making decisions about the use of traction. Despite the long history of traction as a physical therapy modality, many aspects of this intervention require further study. Classification systems that identify patients likely to benefit from traction must be developed and validated. Also, many of the factors involved in administering traction have not been systematically investigated. Further research is needed to determine optimal treatment mode, duration, and frequency of lumbar traction treatments. JOSPT

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