

The Saunders Group, Inc.

Saunders Lumbar Traction

Effective Treatment for Lumbar Pain and Dysfunction

A comprehensive guide to unique features and therapeutic benefits of the Saunders Lumbar HomeTrac[®] Deluxe and the Saunders Lumbar STx[®], including *Frequently Asked Questions*, and a summary of medical literature.

The Saunders Group, Inc.

4250 Norex Drive

Chaska, MN 55318

(952) 368-9214

(952) 368-9249 fax

www.thesaundersgroup.com

© 2004 The Saunders Group, Inc. 500244 -4.04

The Saunders STx[®] and the Saunders Lumbar HomeTrac[®] Deluxe

Distinguishing Features and Therapeutic Benefits

The Saunders Group, Inc. offers two options for home lumbar traction – the Saunders STx[®] and the Saunders Lumbar HomeTrac[®] Deluxe. Why are Saunders home lumbar traction devices different from other brands?

1. **Saunders home lumbar traction devices provide a therapeutic force.** The STx and Lumbar HomeTrac Deluxe can deliver forces of up to 200 lbs (90 kg). Studies show that a minimum force of up to 40-50% of the patient's body weight on a friction-free surface is necessary to cause vertebral separation.^{6,12} Adequate vertebral separation is required to achieve a *decompression* effect. Saunders home lumbar traction devices incorporate a split treatment surface that *actively* moves to impart the tractive force. *If the physician prescribes home lumbar traction with a specific force, the Lumbar HomeTrac Deluxe and STx are the first home traction devices developed to ensure the patient is getting the prescribed force with a friction-free surface.*
2. **Saunders home lumbar traction devices offer a variety of patient positioning options.** The patient can be easily positioned so that the lumbar curve is in any degree of flexion, neutral or extension. In supine (back-lying), pillows under the knees can be used to increase flexion. Pillows are removed for neutral or slight extension positioning. More extension can be achieved with a rolled towel or wedges placed under the pelvic belt. This is only possible because the lower half of the treatment surface actually moves and provides the pulling force. With traditional traction where the patient's lower body is pulled along the table, positional towels or wedges would not be practical. The ability to achieve extension in supine is important because prone (stomach-lying) traction is difficult to achieve in a home situation without assistance.
3. **Saunders home lumbar traction devices ensure the best home traction technique.** Because of their unique features, the STx and Lumbar HomeTrac Deluxe truly replicate clinical traction. The Saunders Group's CEO Duane Saunders literally "wrote the book" on lumbar traction technique, when he authored the 1st edition of *Evaluation, Treatment and Prevention of Musculoskeletal Disorders* in 1982—ten years before The Saunders Group came to be. Saunders home lumbar traction devices are the only devices specifically developed to adhere to these time-tested principles.
4. **Saunders home lumbar traction devices provide objective and safe treatment.** The STx and the Lumbar HomeTrac Deluxe have pressure relief valves that limit the maximum amount of force to a safe level - 200 lbs (90 kgs). Their designs also incorporate an easy-to-read gauge that ensures precise implementation of the health care practitioner's instructions.

Lumbar Traction Frequently Asked Questions

What is the Theoretical Basis for Using Lumbar Traction?

Effects of Spinal Traction

Spinal traction can cause many effects. Among these are distraction or separation of the vertebral bodies, a combination of distraction and gliding of the facet joints, tensing of the ligamentous structures of the spinal segment, widening of the intervertebral foramen, straightening of spinal curves and stretching of the spinal musculature. *Decompression* is a term used by some equipment manufacturers and practitioners to describe one of the many effects of traction. Used in this context, decompression means, "unweighting due to distraction and positioning".

Given these theoretical effects, the indications for traction are A) herniated disc or radiculopathy; B) any condition in which mobilization and stretching of soft tissue is desired; and C) any condition in which opening the neural foramen is desired.

Other interesting effects have been reported in the literature. Manual traction with forces of 30 and 60% of the patient's body weight has been shown to immediately improve straight leg raise testing in subjects with and without back pain.¹⁸ Traction has been theorized to reduce pain by relieving pressure on the dorsal root ganglion or mechanically stimulating large diameter myelinated nerve fibers, thereby silencing ectopic discharge. Improved nerve conduction could result from improved blood flow or alleviation of mechanical compression resulting from traction.¹⁸

What Are the Indications for Lumbar Traction?

Degenerative Disc or Joint Disease

In one of the few controlled trials studying cervical traction, Zylbergold and Piper showed that patients receiving traction had significantly better outcomes than a control group.³³ Improvements were noted in range of motion, need for further treatment and medication use. Most of the patients in this trial had diagnoses of degenerative disc disease. Although the study did not look at lumbar degenerative disc, it provides a theoretical basis for a trial of lumbar traction for degenerative conditions.

Many people have narrowing of the disc space and intervertebral foramen without signs and symptoms of spinal nerve root impingement, or even neck or back pain. Asymptomatic patients in whom degenerative changes or osteophytes have been present for some time may have a sudden onset of symptoms related to a certain activity or position. A very fine line must exist between cases in which irritation of tissues occurs and does not occur. The traction treatment may somehow move, separate or realign the segment in such a way as to relieve the irritation. Other pain control mechanisms discussed above may play a part. Goldish speculates that the degenerated disc may benefit from traction because lowering intradiscal pressure by traction may affect the nutritional state of the nucleus pulposus.⁸

Joint Hypomobility (Soft Tissue Stiffness)

Traction may be regarded as a form of mobilization since it involves the passive movement of the disc and facet joints by mechanical or manual means. Any condition of joint hypomobility may respond favorably to traction. One argument against using traction for mobilization is that it is nonspecific and simultaneously affects several segments. However, when traction is applied to a series of spinal segments, each segment receives an equal amount of traction. If the force applied is sufficient to mobilize the involved segment, it is irrelevant that other segments are also receiving the same amount of traction unless, of course, traction is contraindicated at those other segments.

Traction may be the treatment of choice for patients who need mobilization but cannot tolerate certain manual techniques involving rotation, side bending, flexion or extension. Chronic patients with degenerative disc or joint disease and generalized hypomobility often fit this profile. The chronically stiff patient can often tolerate relatively strong traction forces when, at the same time, manual techniques involving movement into the restricted barriers are irritating and cause exacerbation of symptoms. The more severe or chronic the symptoms, the more likely traction will be the preferred technique.

Facet Impingement (Subluxation)

When facet joints become restricted due to mechanical impingement, capsular tightness, or subluxation, manual mobilization and manipulation techniques are often used to free the restrictions. Manual techniques that isolate the individual joints are sometimes the best techniques. However, traction is another treatment option, particularly if the patient cannot tolerate manual techniques because of increased pain or sensitivity.

Muscle Spasm

Both traction and stretching exercises can relieve muscle spasm. Traction offers the added benefit of decompressing or separating painful joint structures. If the pain is relieved by traction, muscle spasm will be relieved as a result of relaxation of nociceptive reflexes.⁸

Herniated Disc and Radiculopathy

Perhaps one of the most significant indications for lumbar traction is to treat herniated disc and/or radicular pain. Evidence shows that traction has an effect on the disc and radiculopathy symptoms. In actual clinical practice, lumbar traction is often performed in combination with passive extension exercises to treat lumbar herniated disc.^{7,25,26} Clinically one would argue that it is the combination of treatment interventions that results in success, not either intervention in isolation.

Several articles report favorable results using traction to treat herniated disc and radiculopathy. These articles are summarized beginning on page 8.

I Use a McKenzie Approach to Treat Herniated Disc. Why Do I Need Traction?

Many health care providers have had considerable success using the posture correction and lumbar extension exercises often referred to as “the McKenzie approach” to treat lumbar herniated disc. Duane Saunders is a strong advocate of this approach. However, some patients experience a peripheralization of their symptoms when they try the posture correction/extension exercise protocol. These patients all too often receive surgery or epidural injection because “conservative care” has failed. Lumbar traction, if administered correctly, will often allow the patient to progress with the McKenzie program.

Saal and Saal²⁵ reported a treatment protocol that resulted in 90% good or excellent outcomes and a 92% return-to-work rate in 64 patients with herniated lumbar disc with radiculopathy. Their treatment regime included pain control measures, back school and specific exercises using a McKenzie approach. Additionally, they used traction in the most severe subset of patients (those having peripheralization of symptoms with a trial of extension exercises). When a trial of extension exercises caused centralization of the low back pain without exacerbating the radicular pain, traction was not included in the protocol. However, when patients experienced refractory radicular pain following extension exercises (indicating a more severe condition), traction was used. Even though the results cited were not specific to traction treatment alone, the protocol Saal and Saal report is commonly practiced in clinical settings, and recommended in the textbook, *Evaluation, Treatment and Prevention of Musculoskeletal Disorders, Part I - The Spine, 4th Edition.*²⁶

Why does traction as a precursor to extension exercises work? Onel’s study suggests that the disc space widening that occurs during traction causes a temporary decrease in intradiscal pressure that “sucks” the herniated nuclear material back into place.²⁰ This effect is temporary, but may cause just enough relief to allow patients to tolerate extension without peripheralization of symptoms.

How Much Force Is Recommended for Lumbar Traction?

The traction force must be great enough to effect a structural change (movement) at the spinal segment. There is consensus in the literature that a force of 40-50% of the patient’s body weight is necessary to cause vertebral separation.^{6,12} In one of the earliest lumbar traction studies, Cyriax reported a visible separation between lumbar vertebrae with static traction of 120 lbs for 15 minutes.⁵ Other studies have reported measurable separation in the lumbar spine at forces ranging from 80 to 200 lbs.^{10,14,16} Judovich advocated a force equal to one-half the patient’s body weight on a friction-free surface as a minimum to cause therapeutic effects in the lumbar spine.¹²

What is the Best Patient Position for Home Lumbar Traction Treatment?

The amount of flexion or extension desired is determined by the goal(s) of the treatment. For example, if the treatment goal is to increase extension mobility, the patient should be positioned in an extended position during traction. When in doubt, apply traction with the patient in a normal lordotic position. The patient with acute herniated disc may not tolerate a position of normal lordosis. If this is the case, the treatment must be given in flexion initially with the goal of gradually working toward a normal lordotic position. Foraminal stenosis is usually more effectively treated with the lumbar spine in a flexed (flattened) position. Joint hypomobility and degenerative disc/joint disease may be treated in flexion, neutral, or extension.

With Saunders home lumbar traction devices, more flexion can be achieved by placing pillows or bolsters under the knees in the supine position. More extension can be achieved by placing rolled towels or wedges in the lumbar area in the supine position and keeping the legs relatively straight. The prone position can also be used to achieve extension, but it is difficult for patients to apply traction by themselves in prone. We find the prone position is rarely necessary with proper supine positioning.

What are Common Treatment Parameters for Lumbar Traction?

While every patient will need individualized consideration, there are some general guidelines that apply to lumbar traction treatment. These guidelines are not meant to be a substitute for good clinical judgment and experience. For more detailed information, refer to the Saunders textbook, *Evaluation, Treatment and Prevention of Musculoskeletal Disorders, Part I - The Spine, 4th Edition*.²⁶

For conditions requiring separation of the intervertebral spaces for a therapeutic effect, a relatively high force (40-50% of the body weight) and low treatment times (8-12 minutes) are recommended. The general rule is: The higher the force, the lower the treatment time. We rarely use traction for more than 20 minutes. In most cases, the static mode of traction is preferred, especially when treating herniated disc or irritable conditions. Sometimes, an intermittent method is preferred for patient comfort. In such cases, we recommend at least a 60 second hold period (e.g., 60 second hold, 10 second rest).

If this is your patient's first trial with traction, or if the patient's condition is irritable, it is wise to start at less than 50% of the body weight and gradually increase the force over several sessions. The patient's symptoms should always be the guide. A little post-treatment muscle soreness is common, but too much soreness or an increase in peripheral symptoms is a sign that the force may have been increased too quickly.

Initially, clinical lumbar traction may need to be performed daily. Patients can be weaned off traction as the condition improves and they are able to tolerate more exercise. For chronic conditions, ongoing traction may be beneficial to manage symptoms. A major benefit of prescribing home lumbar traction is the fact that multiple treatments can be done in a single day—this is particularly beneficial for acute and subacute conditions.

What Does the Literature Say About Lumbar Traction?

Epidurography and CT investigations have shown that high force traction can reduce disc protrusions and relieve spinal nerve root compression symptoms.^{9,15,20} However, reviews summarizing lumbar traction clinical trials have concluded that there is no significant difference in outcomes for patients treated with lumbar traction compared to control groups.^{2,23,26,28} Before one concludes that traction is of no benefit, it is important to critically read the individual clinical trials cited in the reviews.

Some of the studies that showed lumbar traction was ineffective were performed with very low forces.^{21,30,31} For example, results from Pal's study using only 20 lbs of lumbar traction are irrelevant for any modern clinician using the recommended 40-60% of the patient's body weight!²¹ In other studies, patient selection criteria were poorly defined. Most studies tended to group all patients with low back pain together and did not distinguish between sub-groups, by diagnosis, or by chronicity. The only two studies that looked specifically at traction for herniated disc AGAIN used inadequate force in their treatment group.^{30,31} No published clinical trial has studied the effects of using adequate force on sub-groups of patients that clinical experts would actually expect to benefit from lumbar traction.

Because of these serious flaws, it is clear that a well-designed clinical trial on lumbar traction has not yet been published. Considering the theoretical and radiologic evidence available (see Onel²⁰, Gupta and Ramarao⁹, and Mathews¹⁵), sufficient justification exists for a trial of lumbar traction to treat herniated disc with radiculopathy, particularly because other treatment options (epidural injection and surgery) are far more costly and invasive. For other indicated conditions, a trial of lumbar traction is worthwhile because of the anecdotal evidence linking subjective, objective and functional improvements to traction treatment, when other interventions have failed.

In fact, a survey of over 1200 physiotherapists in the United Kingdom showed a very high usage of lumbar traction to treat low back pain, despite the lack of evidence in the literature. The highest proportion of physiotherapists surveyed indicated that "nerve root pain" was their most frequent reason to use traction.¹¹

Lumbar Traction Efficacy in Medical Literature

The Natural History of Herniated Nucleus Pulposus with Radiculopathy, by Komori, et al¹³

Komori and colleagues used magnetic resonance imaging (MRI) to evaluate morphologic changes of lumbar herniated nucleus pulposus (HNP) as a result of conservative treatment of 77 patients. All of the patients had a herniated disc with associated symptoms of unilateral lower extremity pain, muscle weakness and positive neural tension signs. The patients were treated with rest, pain relieving medications and pelvic traction at an outpatient clinic. None of the patients received epidural corticosteroid injections. All patients were evaluated more than twice using the same MRI scanner. The authors accounted for intra and inter-observer reliability regarding the patient's clinical evaluations and interpretations of the MRI scans.

Results of clinical outcomes were classified as follows:

- Excellent – Radicular pain disappeared, and neurological deficits showed improvement
- Good – Radicular pain decreased and neurological deficits improved
- Poor – Radicular pain or neurological deficits showed no improvement

In 64 of the patients, the disc herniation was reduced on MRI with corresponding clinical improvement. This relationship was statistically significant. Thirteen patients had no changes on MRI despite clinical improvement. Of the 77 patients, 62 had excellent and good clinical outcomes. In general, morphologic changes in the disc lagged behind clinical improvement, although the HNP finally decreased in size.

The authors attributed the improvement in clinical symptoms to improved blood flow. They theorized that the improved blood flow occurs prior to the actual reduction of the HNP, accounting for the clinical improvement occurring prior to morphologic changes detected by MRI. The mean number of days between the first and last MRI was 262.

The results of this study support the use of pelvic traction for the treatment of lumbar disc herniation with radiculopathy. The concept of improved blood flow as the primary reason for improved clinical symptoms with reduction in the HNP at a later time supports a high frequency of traction for short periods of time, e.g. 2 times per day for 10 minutes each time.

Epidurography in the Reduction of Lumbar Disc Prolapse by Traction, by Gupta and Ramarao⁹

Gupta and Ramarao used epidurography to evaluate before and after traction treatment of 14 lumbar disc prolapse cases. All of the cases had sciatica and/or low back pain which interfered with routine work, they had not been relieved of symptoms with an initial 7 to 10 days bed rest, and epidurograms verified a disc defect confirming and correlating with the clinical diagnosis. Bilateral skin traction was applied with adhesive plaster secured to both thighs and 60 to 80 lb (27-36 kg) suspended over the end of a bed which had been raised 12 inches. Traction was continued for 10 to 15 days with 15 to 20 minute rest periods every 3 to 4 hours.

Twelve of the 14 cases showed reduction or absence of the disc prolapse with marked improvement in clinical symptoms. All of the patients were encouraged to perform back extension exercises following discharge. Nine cases were followed for 2 years, and there was no reoccurrence of symptoms and patients were attending routine work.

The results reported by Gupta and Ramarao support the use of relatively high force traction for defined lumbar radicular symptoms that do not respond to bed rest. Their method was very time-intensive, with patients receiving traction nearly continuously for at least 10 days. In the present health care environment, placing a patient in a hospital for continuous traction is not feasible, nor does it appear necessary. However, the protocol does support the concept of traction treatment being given more than once a day or a few times per week.

Computed Tomographic Investigation of the Effect of Traction on Lumbar Disc Herniations, by Onel, et al²⁰

The authors designed a traction table to fit into the opening of a CT scanner so that CT scans of the lumbar spine were obtained before and during the application of lumbar traction. Thirty patients diagnosed with lumbar disc herniation were placed in the gantry of the CT scanner and traction of 45 kg force (99 lb) was applied. After 15 minutes of traction a second CT scan was taken. The total time to complete the CT scan was 25 minutes. Therefore, the total traction time was 40 minutes. The patients' age range was 20-40 years. Body weights ranged from 55 to 68 kg (121 to 150 lb), indicating that heavy traction of 66 to 81% body weight was used. The patients' diagnoses were confirmed with CT scan and clinical signs and symptoms.

The changes observed on CT scan during traction were impressive. The herniated nuclear material was retracted in 21 of the 30 patients. Subsequently, all patients were hospitalized and given conservative treatment, which included lumbar traction for one month (20 treatments). At the conclusion of the 20 treatments all patients were re-evaluated. Twenty eight of the 30 (93.3%) had improved. The clinical tests of forward bending, straight leg raising, deep tendon reflexes, sensory impairment and muscle weakness all were statistically significant as well as clinically significant to the patients. They were able to return to daily activity without pain and disability. This continued to be the case at 6 months follow-up.

In one of the resistant cases the disc herniation filled the spinal canal and in the other the disc was calcified. Both of these patients received surgery as no long-term improvement occurred with conservative treatment.

In another study, Nachemson and Elfstrom showed that the interdiscal pressure decreased from 66 to 26 lbs at the L-3 disc with a traction force of 66 lbs.¹⁹ In the present study, Onel, et al, theorize that with a force of 45 kg (99 lb) a greater negative pressure is created, allowing the disc to recede. They also opine that the concomitant blood flow increase improves healing.

Lumbar Traction: A Double-Blind Controlled Study for Sciatica, by Matthews and Hickling¹⁷

Matthews and Hickling conducted a randomized trial of lumbar traction treatment for sciatica. Twenty seven patients were in the study, 13 in the traction group and 14 in the control group. The authors defined sciatica as severe well delineated pain posterior in the leg and radiating past the knee or pain on the anterior thigh or shin. Back movement was required to be limited and either the sciatic or femoral nerve stretch test was positive.

Traction was applied on a plain couch using a force of at least 80 lb (36 kg) applied through a pelvic harness, the trunk secured with a thoracic harness. Treatment was given 30 minutes daily 5 days per week for 3 weeks. The control group went through the same procedure except the traction force was never greater than 20 lb (9 kg). The measurements used to determine change were the straight leg raise and the patients' report of pain.

The results indicated that the average pain improvement was 28.8% for the treatment group and 18.9% for the control group. Straight leg raise was improved in the treatment group. The results were not statistically significant but there was a trend for patients to improve with traction treatment. The amount of time required to administer traction treatment was questioned considering the lack of statistically significant benefit. The amount of time to administer the traction treatment was not reported.

In Matthews and Hicklings' study, even if statistical significance had been achieved, the results would have been questioned because of the small sample size and issues of reliability. A fact that should not be overlooked, however, is the improvement of the treatment group. It should be noted that a split or sliding traction table was not used. Consequently, approximately $\frac{1}{4}$ of the 80 lb traction force was lost in overcoming the friction between the patient and the table. Clinical improvement in spite of these limitations is noteworthy.

Mechanical Traction in Lumbar Disc Syndrome, by Parsons and Cummings²²

The authors describe a traction method popularized by Dr. James Cyriax in the 1950's. One hundred patients had lumbar disc syndrome that did not respond to manipulation. Daily high force traction (80-200 lbs or 36-91 kg) was used in conjunction with extension exercises and posturing.

Eighty-six patients had excellent or good outcomes. Poor relief was obtained with 12 patients, and most of these had experienced symptoms for many months. Two patients were termed "failures" and had subsequent surgery, which revealed a displaced fragment of annulus, rather than a herniated nucleus pulposus.

Nonoperative Treatment of Herniated Lumbar Intervertebral Disc with Radiculopathy. An Outcome Study, by Saal and Saal²⁵

Saals' study was not specifically about lumbar traction, but about a comprehensive treatment protocol that included lumbar traction for a specific subset of patients. The records of patients with lumbar herniated nucleus pulposus without significant stenosis were studied retrospectively. These patients took part in an aggressive rehabilitation program, incorporating back school, exercise and pain control measures. Part of the pain control protocol involved performing extension exercises. If the patient could not perform extension without an exacerbation of peripheral pain, a trial of lumbar traction was used. If the trial was successful in decreasing peripheral pain, it was continued.

Results of the 58 subjects studied indicated that the protocol was highly successful. Only 6 patients had surgery (4 of these had significant stenosis). Of the remaining 52 patients, 50 were considered successes (having "Excellent" or "Good" outcomes). Forty-eight returned to work.

Interestingly, 18 subjects (31%) had received a second opinion regarding surgical intervention and had been advised to have surgery as soon as possible to avoid long-term complications. Of this subgroup, 15 were considered successes.

References

1. Beurskens A., et al: Efficacy of Traction for Nonspecific Low Back Pain: 12-Week and 6-Month Results of a Randomized Clinical Trial. *Spine* 22(23):2756-2762, 1997.
2. Bigos S, Bowyer O, Braen G, et al. *Acute Low Back Problems in Adults*. AHCPR publication 95-0642. Rockville, Md: Agency for Health Care Policy and Research, Public Health Service, US Dept of Health and Human Services; 1994.
3. Crisp E: Disc Lesions. Livingstone, Edinburgh 1960.
4. Crisp E: Discussion on the Treatment of Backache by Traction. *Proc R Soc Med* 48:805, 1955.
5. Cyriax J: The Treatment of Lumbar Disk Lesions. *Brit Med J* 2:14-34, 1950.
6. Cyriax J: Treatment by Manipulation. Massage and Injection. *Textbook of Orthopaedic Medicine*, Vol 2, 10th edition. Bailliere-Tindall, London 1980.
7. Delitto A, Erhardt RE and Bowling RW: A Treatment-Based Classification Approach To Low Back Syndrome: Identifying And Staging Patients For Conservative Treatment, *Phys Ther* 75(6):470-489, 1995.
8. Goldish G: Lumbar Traction. In *Interdisciplinary Rehabilitation of Low Back Pain*. CD Tollison and M Kriegel, eds. Williams and Wilkins, Baltimore MD 1989.
9. Gupta RC, Ramarao SV. Epidurography in the Reduction of Lumbar Disc Prolapse by Traction. *Archives of Physical Medicine and Rehabilitation* 59:322-327, 1978.
10. Harris R: *Massage, Manipulation and Traction*. E. Licht, New Haven CT 1960.
11. Harte AA, Gracey JH and Baxter GD. Current Use of Lumbar Traction in the Management of Low Back Pain: Results of a Survey of Physiotherapists in the United Kingdom. *Arch Phys Med Rehabil* 86:1164-1169, 2005.
12. Judovich B: Lumbar Traction Therapy. *JAMA* 159:549, 1955.
13. Komori H, Shinomiya K, Nakai O, et al., The Natural History of Herniated Nucleus Pulposus with Radiculopathy. *Spine* 21:225-229, 1996.
14. Lawson G and Godfrey C: A Report on Studies of Spinal Traction. *Med Serv J Can* 12:762, 1958.
15. Mathews J: Dynamic Discography; A Study of Lumbar Traction. *Ann Phy Med* 9:275-279, 1968.
16. Mathews J: The Effects of Spinal Traction. *Physiotherapy* 58:64-66, 1972.
17. Matthews JA, Hickling J, Lumbar Traction: A Double-Blind Controlled Study for Sciatica. *Rheumatology and Rehabilitation* 14:222-225, 1975.
18. Meszaros T, et al: Effect of 10%, 30%, and 60% Body Weight Traction on the Straight Leg Raise Test of Symptomatic Patients with Low Back Pain. *J Orthop Sports Phys Ther* 30(10):595-601, 2000.
19. Nachemson A and Elfstrom G: Intravital Dynamic Pressure Measurements in the Lumbar Discs. *Scand J Rehabil Med (Suppl 1)*: 1, 1970.
20. Onel D, Tuzlaci M, Sari H, et al. Computed Tomographic Investigation of the Effect of Traction on Lumbar Disc Herniations. *Spine* 14:82-90, 1989.
21. Pal P, Mangion P, Hossian MA, Diffey L. A Controlled Trial of Continuous Lumbar Traction in the Treatment of Back Pain and Sciatica. *Br J Rheumatol* 25:181-183, 1986.
22. Parsons, WB and Cumming, JDA. Mechanical Traction in Lumbar Disc Syndrome. *Canadian Med J* 77:7-10, 1957.
23. Philadelphia Panel Evidence-Based Clinical Practice Guidelines on Selected Rehabilitation Interventions for Low Back Pain. *Phys Ther* 81(10):1641-1674, 2001.
24. Professional Distribution Systems, Inc., 1160 South Rogers Circle, #A, Boca Raton, FL 33487
25. Saal, JA and Saal, JS: Nonoperative Treatment of Herniated Lumbar Intervertebral Disc with Radiculopathy. An Outcome Study. *Spine* 14(4):431-437, 1989.
26. Saunders HD and Ryan RS: Evaluation, Treatment and Prevention of Musculoskeletal Disorders, Volume 1, *The Spine*. 4th Edition. The Saunders Group, Chaska, MN 2004.
27. Scientific Approach to the Assessment and Management of Activity-Related Spinal Disorders. A Monograph For Clinicians. Report of the Quebec Task Force on Spinal Disorders. *Spine* 12(7 Suppl):S1-59, 1987.
28. van der Heijden G, et al: The Efficacy of Traction for Back and Neck Pain: A Systematic, Blinded Review of Randomized Clinical Trial Method. *Phys Ther* 75:93-104, 1995.
29. VAX-D Medical Technologies USA, L.C., 38549 U.S. Hwy. 19 North, Palm Harbor, FL 34684
30. Weber H, Ljunggren E, Walker L. Traction Therapy in Patients With Herniated Lumbar Intervertebral Discs. *J Oslo City Hosp* 34: 61-70, 1984.
31. Weber H. Traction Therapy in Sciatica Due to Disc Prolapse. *J Oslo City Hosp* 23:167-176, 1973.
32. Yates D: Indications and Contraindications for Spinal Traction. *Physiotherapy* 58:55, 1972.
33. Zylbergold R and Piper M: Cervical Spine Disorders: A Comparison of Three Types of Traction. *Spine* 10:867-871, 1985.