

DECOMPRESSION RESEARCH

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Emerging Technologies: Preliminary Findings

DECOMPRESSION, REDUCTION, AND STABILIZATION OF THE LUMBAR SPINE: A COST-EFFECTIVE TREATMENT FOR LUMBOSACRAL PAIN

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INTRODUCTION

Pain in the lumbosacral spine is the most common of all pain complaints. It causes loss of work and is the single most common cause of disability in persons under 45 years of age (1). Back pain is the most dollar-costly industrial problem (2). Pain clinics originated over 30 years ago, in large part, because of the numbers of chronic back pain patients. Interestingly, despite patients' reporting good results using "upside-down gravity boots," and commenting on how good stretching made them feel, traction as a primary treatment has been overlooked while very expensive and invasive treatments have dominated the management of low back pain. Managed care is now recognizing the lack of sufficient benefit-cost ratio associated with these ineffective treatments to stop the continued need for pain-mitigating services. We felt that by improving the "traction-like" method, pain relief would be achieved quickly and less costly. Although pelvic traction has been used to treat patients with low back pain for hundreds of years, most neurosurgeons and orthopedists have not been enthusiastic about it secondary to concerns over inconsistent results and cumbersome equipment. Indeed, simple traction itself has not been highly effective; therefore, almost no pain clinics even include traction as part of their approach. A few authors, however, have reported varying techniques which widen disc spaces, decompress the discs, unload the vertebrae, reduce disc protrusion, reduce muscle spasm, separate vertebrae, and/or lengthen and stabilize the spine (3-12). Over the past 25 years, we have treated thousands of chronic back pain patients who have not responded to conventional therapy. Our most successful approach has required treatment for 10-15 days, 8 hours a day, involving physicians, physical therapists, nurses, psychologists, transcutaneous electrical nerve stimulator (TENS) specialists, and massage therapists in a multidisciplinary approach which has resulted in 70% of these patients improving 50-100%. Our program has been recognized as one of the most cost-effective pain programs in the US (13). The average cost of the successful pain treatment has been cited as less than half the national average (13).

Our protocol combined traditional, labor-intensive physical therapy techniques to produce mobilization of the spinal segments. This, combined with stabilization, helped promote healing. In addition we used biofeedback, TENS, and education to reinforce the healing processes. We wanted to produce a simpler and more cost-effective protocol that could be consistently reproduced. The biofeedback and education could be easily replicated. The problem was producing spinal mobilization to the degree that we could decompress a herniated nucleus and relieve pain. Stabilization would come after pain relief.

The DRS System was developed specifically to mobilize and distract isolated lumbar segments. Using a specific combination of lumbar positioning and varying the degree and intensity of force, we produced distraction and decompression. With fluoroscopy, we documented a 7-mm distraction at 30 degrees to L5 with several patients. In fact, we observed distraction at different spinal levels by altering the position and degree of force. We set out to evaluate the DRS system with outpatient protocols compared to traditional therapy for both ruptured lumbar discs and chronic facet arthroses.

Figure 1. The DRS System.

Subjects. Thirty-nine patients were enrolled in this study. There were 27 men and 12 women, ranging in age from 31 to 63. Twenty-three had ruptured discs diagnosed by MRI. Of these, all but four had significant sciatic radiation, with mild to moderate L5 or S1 hyperalgesic. All had symptoms of less than one year.

The facet arthrosis patients also underwent MRI evaluations to rule-out ruptured discs or other major pathologies. They had experienced back pain from one to 20 years. Six had mild to moderate sciatic pain with significant limitations of mobility.

METHODOLOGY

Patients were blinded to treatment and were randomly assigned to traction or decompression tables. Traction patients were treated on a standard mechanical traction table with application of traction weights averaging one-half body weight plus 10 pounds, with traction applied 60-seconds-on and 60-seconds off, for 30 minutes daily for 20 treatments. Following the traction, Polar Powder ice packs and electric stimulation were applied to the back for 30 minutes to relieve swelling and spasm, and patients were then instructed in use of a standard TENS use to be employed at home continuously when not sleeping. After two weeks, the patients received a total of three sessions with an exercise specialist for instruction in and supervision of a limbering/strengthening exercise program. They were re-evaluated at five to eight weeks after entering the program.

Decompression patients received treatment on the DRS System, designed to accomplish optimal decompression of the lumbar spine. Using the same 30 minute treatment interval, the patients were given the same force of one-half the body weight plus 10, but the degree of application was altered by up to 30 degrees. The effect was to produce a direct distraction at the spinal segment with minimal discomfort to the patient.

Eighty-six percent of ruptured intervertebral disc (RID) patients achieved "good" (50-89% improvement) to "excellent" (90-100% improvement) results with decompression. Sciatica and back pain were relieved. Only 55% of the RID patients achieved "good" improvement with traction, and none excellent."

Of the facet arthrosis patients, 75% obtained "good" to excellent" results with decompression. Only 50% of these patients achieved "good" to "excellent" results with traction.

Table 1. Patient assessment of pain relief secondary to decompression and to traction.

Method Rating RID Facet arthrosis Decompression excellent 7 (50%) 2 (25%)

good 5 (36%) 4 (50%) poor 2 (14%) 2 (25%) Traction excellent 0 2 (25%) good 5 (55%) 2 (25%) poor 4 (45%) 4 (50%)
Excellent = 90 - 100% improved
Good = 50 - 89% improved
Poor = < 50% improved

DISCUSSION

Since both traction and decompression patients received similar treatment (except for the differences in the traction table versus the decompression table) with similar weights, ice packs, and TENS, the results are quite enlightening. The decompression system is encouraging and supports the considerable evidence reported by other investigators stating that decompression, reduction, and stabilization of the lumbar spine relieves back pain. The computerized DRS System appears to produce consistent, reproducible, and measurable non-surgical decompression, demonstrated by radiology.

Of equal importance, the professional staff facilities required, as well as the time and cost, are all significantly reduced. Since the more complex treatment program of the last 25 years has already been shown to cost 60% less than the average pain clinic, the cost of this simpler and more integrated treatment program should be 80% less than that of most pain clinics—a most attractive solution to the most costly pain problem in the US. In addition, patients follow a 30-day protocol that produces pain relief yet allows them to continue daily activities and not lose workdays.

SUMMARY

We have compared the pain-relieving results of traditional mechanical traction (14 patients) with a more sophisticated device which decompresses the lumbar spine, unloading of the facets (25 patients). The decompression system gave "good" to "excellent" relief in 86% of patients with RID and 75 % of those with facet arthroses. The traction yielded no "excellent" results in RID and only 50% "good" to "excellent" results in those with facet arthroses. These results are preliminary in nature. The procedures described have not been subjected to the scrutiny of review nor scientific controls. These patients will be followed for the next six months, at which time outcome-based data can be reported. These preliminary findings are both enlightening and provocative. The DRS system is now being evaluated as a primary intervention early in the onset of low back pain—especially in workers' compensation injuries.

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Effects of vertebral axial decompression on intradiscal pressure

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The object of this study was to examine the effect of vertebral axial decompression on pressure in the nucleus pulposus of lumbar discs. Intradiscal pressure measurement was performed by connecting a cannula inserted into the patient's L4-5 disc space to a pressure transducer. The patient was placed in a prone position on a VAX-D therapeutic table and the tensionmeter on the table was attached via a pelvic harness. Changes in intradiscal pressure were recorded at resting state and while controlled tension was applied by the equipment to the pelvic harness. Intradiscal pressure demonstrated an inverse relationship to the tension applied. Tension in the upper range was observed to decompress the nucleus pulposus significantly, to below -100 mm Hg.

SURGICAL procedures utilizing conventional and percutaneous approaches have established the merits of decompression of intravertebral disc spaces in the management of low-back pain syndrom associated with lumbar disc herniation. 4, 12, 13, 15 Surgery will continue to play an important role in the treatment of patients with low-back pain and sciatica associated with herniated discs and degenerative disc problems. However, for patients who are not candidates for surgery, there is a need to establish a conservative approach that offers an effective means of returning the patient to a functional level of activity. Considerable controversy exists in regard to the various techniques currently employed. Aside from basic bed rest, there are a few noninterventional modalities that have been adopted as standards of therapy. Manipulative techniques for mechanical low-back pain associated with posterior facet syndrome of muscle strain have not been found as useful in the management of herniated or degenerated lumbar discs. Similarly, other modalities including ultrasound treatments, various electrical stimulation techniques, short-wave therapy, acupuncture, steroid injections, and the administration of anti-inflammatory agents and muscle relaxants all have a following among some practitioners but fall short of addressing the underlying problems associated with intervertebral disc lesions. All of these treatment methods fail by comparison to surgery, in our opinion, because they have the common problem of not relieving the pain from neurocompression or from the stimuli associated with a prolapsed nucleus pulposus. The only noninterventional method

that has been shown to hold any promise of relieving pressure on vital structures of the lumbar region is that of distraction of the lumbar vertebrae by mechanical forces applied along the axis of spinal column. 2,3,5,14

There has been some investigation into the effects of distracting segments of the spinal column excised from cadavers, 11, 14 as well as radiological studies that provided evidence that the application of certain forms of tension can distract vertebral bodies. 3,5 On the other hand, there are equally pertinent studies that failed to demonstrate any positive effects from other methods of applying spinal tractions. 1,10 Nachemson and Elfstrom⁶⁻⁹ have studied the effects of movement and posture on intradiscal pressure. Their measurements show pressure changes caused by positioning and posture range between 25 and 275mm Hg. Suggesting that some positions and postures may be inadvisable for patients suffering from lumbar disc lesions. Anderson, et al.,¹ and others have shown that certain traction techniques can actually cause an increase in intradiscal pressure, which would be undesirable in the treatment of low-back pain associated with herniated discs and a neurocompression etiology.

A new form of therapy, termed "vertebral axial decompression," has recently been introduced in the physical therapy department of the Rio Grande Regional Hospital. This treatment modality has shown considerable promise in relieving low-back pain associated with herniated discs or degenerative disc disease of the lumbar vertebrae in patients who are considered candidates for surgery. The purpose of this research project was to investigate the influence of this new treatment modality to intradiscal pressure in the lumbar spine of patients receiving this form of therapy. Fig.1 Photograph illustrating the equipment and the position of the patient as the system is activated. The caudal end of the table extends, applying tension to the pelvic belt. Upper body movement is restrained by having the patient grasp the hand grips. A graph of the tension applied is plotted by a chart recorder on the control console and the intradiscal pressure readings are entered on the same graph at the apex of each distraction curve.

Clinical Material and Methods

Five cases were selected from among individuals who were referred for a neurosurgical consultation and had previously sustained a work-related injury that resulted in herniation of a lumbar disc at one of more levels. The diagnosis in each case was confirmed by magnetic resonance imaging. The patients chosen were scheduled for percutaneous discectomy. Introduction of the cannula for the purpose of performing percutaneous discectomy offered an opportunity to measure pressure changes in the disc prior to the operative procedure.

The patient was prepared and a cannula was inserted under local anesthesia into the nucleus pulposus of the L4-5 intervertebral

disc using anteroposterior and lateral fluoroscopy to position the end. With the cannula in place, the patient was moved to a VAX-D table. The VAX-D equipment is routinely utilized in our nonsurgical treatment program for patients suffering from low-back pain. The equipment consists of a split table design with a tensionmeter mounted on the caudal, moveable section. The patient lies in a prone position and grasps hand grips to restrain movement of the upper body, which is supported on the fixed section of the table (Fig.1)

The cannula was then connected to a pressure monitor using a disposable pressure transducer. The lines were filled with normal saline. The pelvic harness designed for this therapy was fastened around the pelvic girdle and connected to the tensionmeter via straps attached to the harness. When the system was activated the caudal section supporting the lower body extended slowly, applying a distraction force via the pelvic harness connected to the tensionmeter. The level of tension was preset by the operator on the control console and observed and plotted on a chart recorder. The movement of the table was stopped and held when the desired tension was reached. An average course of therapy consisted of 30-minute sessions on the table once a day for 10 to 15 days. During each session the patient undergoes alternating cycles of distraction and relaxation, the timing and periodicity having been programmed by the therapist.

In this study various distraction tensions, ranging from 50 to 100 lbs, were used for vertebral axial decompression therapy. The distraction tensions applied were monitored on a digital readout and recorded on a continuous graph tracing by a chart printer incorporated in the control console. The resulting changes in intradiscal pressure in the L4-5 nucleus pulposus were observed on a digital readout on the pressure monitor, and the readings were entered onto the chart recording at the point when the apex of distraction tension was achieved. The pressure readings were then applied to the negative-range calibrated curves prepared for each transducer to derive accurate intradiscal pressure readings.

TABLE 1

Effects of lumbar traction on intradiscal pressure* *See Fig.2 for graphs of data points.

Measurements in the first two positions could not be translated accurately and are omitted (see text).

Fig.2 Graphs showing the intradiscal pressures recorded in the L4-5 nucleus pulposus of three patients (Case 3, *upper*; Case 4, *center*; and Case 5, *lower*) with herniated disc at this level. Pressure is plotted against distraction tensions consistent with the range of tension recommended as the therapeutic protocol of the equipment used in this study.

The biological transducers employed in this study are primarily designed to measure pressure changes in the positive range. Following each procedure the pressure monitor and the disposable pressure transducer used for each patient were individually calibrated and a correction curve was plotted showing the transducer readings versus actual pressures, to correct for the nonlinearity of the instrumentation in the range of negative pressures achieved. A pneumatic calibration analyzer with a accuracy of 2% was used for this purpose.

Results

Intradiscal pressure measurements showed that distraction tension routinely applied by the VAX-D equipment reduced the intradiscal pressure significantly to negative levels in the range of -100 to -160 mm Hg. The relationship between distraction tensions and intradiscal pressure changes for three patients is presented in Table 1. The extent of decompression (measured in mm Hg) shows an inverse relationship to the tension applied and may be expressed by a polynomial equation.

Discussion

Intradiscal pressure changes were monitored in five patients. When the first two patients were tested, it was not recognized that biological transducers produce nonlinear measurements in the negative ranges at the levels achieved in this study. Since the disposable units had been discarded it was not possible to translate the findings accurately: however the intradiscal pressures were observed to be significantly lowered. Also the findings were consistent with the later three patients, for whom the transducers were retained and individually calibrated, permitting accurate interpretation of the results.

An interesting observation was that changes in intradiscal pressure appeared to be minimal until a threshold distraction tension was reached. When the threshold was exceeded the intradiscal pressure was observed to decrease dramatically to levels in excess of 300 mm Hg below the positive pressure observed prior to the application of the pelvic tension. As indicated in the curves plotted for intradiscal pressures versus distraction tension, it appeared that the decrease in pressure tends to level off as the applied distraction tensions approached 100 lbs. The concept of a threshold distraction tension and the levels observed in these trials are consistent with radiographic studies of vertebral body separation reported in other publications.²

The results indicate that it is possible to lower pressure in the nucleus pulposus of herniated lumbar discs to levels significantly below 0 mm Hg when distraction tension is applied according to the protocol described for vertebral axial decompression therapy. These findings may offer a plausible explanation for the mechanism of action for this therapeutic modality. Future research is warranted to study the decompression phenomenon achieved with this technology and its relationship to clinical outcome in patients with anatomical dysfunction of the lumbar spine. We are preparing a follow-up study on the clinical efficacy of this treatment modality.

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Disclosure

The authors have no financial interest in either the equipment or the methodology advanced in this study.

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Back to the Future: Non Surgical Solutions to Spinal Disc Rehab with Spinal Decompression

Spinal Decompression is the most effective treatment for herniated discs and more doctors are looking into this breakthrough procedure that is 86%-91% successful without drugs or surgery.

(PRWEB) June 19, 2006 -- Working out can be a welcome release from stress and tension. But for those stricken with lower back pain, this experience can easily crank up your pain. Most gym enthusiasts know that once you injure a disc (the soft jelly material between your spinal vertebrae) it can severely limit your exerciseroutine and quality of life.

For many, this is due to collective loading of stress on to the spine – due to bad posture, repetitive tasks, and use of weighted machines. Over time, these activities begin to restrict normal motion, and the spinal discs deform as a result of pressure changes within the disc—leading to a loss of disc space and degenerative arthritis.

One of the reasons that your discs do not heal properly after an injury, is that as we age the blood supply to the disc diminishes. Without a proper blood supply, the tissue does not heal properly and the injured disc continues to degenerate. On the contrary, if you injure your muscle or bone, it heals in a shorter period of time, because of its blood supply. An example would be a fracture, once a bone is fractured the bone is stronger in the fractured area, than prior to the injury. On the other hand, when a disc is injured, it cannot heal properly and the result is a permanent weak link. Over time, excessive forces on the disc, can cause this injury to flair up and resulting in a life time of pain and suffering.

For many years, surgery has been the only option for pain relief. However, due to recent advances in medical technology, there is a new revolution in a non-surgical technique that is FDA approved and safe.

This new therapy is Spinal Disk Decompression.

The treatment uses specialized equipment to position the discs and ligaments to receive adequate blood flow to heal and strengthen .Decompression Therapy works to relieve pressure among herniated discs, ultimately allowing blood, nutrients and water to flow through the affected areas and increasing the ability to recover. A typical treatment requires a commitment of four to six weeks, each session lasting 25-45 minutes long. The patient relaxes on a decompression table, while watching his or her favorite DVD as the time passes. The treatment is a gradual process, gently allowing the herniated discs to return to their natural state. Clinical studies have been performed to evaluate the effect of spinal decompression on herniated discs.

The physical findings of patients with herniated and degenerative disc disease, show that 86% of patients who complete the therapy report immediate resolution of symptoms. Physical examination findings show improvement in 92% of patients over the course of treatment.

“These findings demonstrate a significant, lasting improvement, compared to the results derived from traditional surgery. In my opinion, this procedure has the potential to become a primary treatment for herniated disc injuries and spinal pain management.” explained Dr. Steven Shoshany, a Manhattan based Chiropractor and expert in non-surgical spinal disc herniation treatment.

The American health care system spends more than \$50 billion dollars annually on back pain treatment. According to the American Chiropractic Association, one half of all Americans admit to having back pain each year and chronic back pain is the number one disability in persons under age 45.

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PAIN MANAGEMENT
A Practical Guide for Clinicians
FIFTH EDITION
Chapter 20:

New Concepts in Back Pain Management:

Decompression, Reduction, and Stabilization

C. Norman Shealy, M.D., Ph.D., F.A.C.S.

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Volume 1

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New Concepts in Back Pain Management: Decompression, Reduction, and Stabilization

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ABSTRACT

A thorough evaluation of previous traction techniques reveals no consistent pattern in prior literature. We have evaluated a variety of devices and found that seven major factors are important in achieving optimal clinical results. These include: (1) split table design to minimize effects of gravity; (2) flexion of the knees for hip relaxation; (3) controlled flexion of the lumbar spine during treatment which alters the location of distraction segmentally; (4) comfort and non-slippage of the pelvic restraining belt; (5) comfort and non-slippage of the chest restraint; (6) concomitant use of TENS, heat, ice, and myofascial release; and (7) a graduated limbering, strengthening, and stabilization exercise program. Using this system, successful pain control was achieved in 86% of patients studied with ruptured intervertebral discs and 75% of those with facet arthrosis.

INTRODUCTION

New advances centering on the use of specific segmental distraction as an adjunct to managing low back pain with and without neuropathic sciatica are reported here. These should be of special interest to both primary eye care and multidisciplinary medical specialists when symptoms persist despite comprehensive management of acute back pain.

The utility of physical modalities has been well established in many forms (Wall & Melzack, 1984); however, the use of traction techniques has been largely empirical. Relatively few studies have specifically discussed ergonomics and the biomechanics of spinal pathology as it relates to practical clinical outcomes employing powered or weight distraction forms of therapy.

Previous outcome studies have lacked the applied principles of quantifications and biomechanics that correlated clinical data with a specific diagnosis resulting from structural abnormalities such as discal herniation, lumbar facet arthropathy, foraminal stenosis, and motion segment abnormality syndromes or their comorbid combinations (Anderson, Schultz, & Nachemson, 1968; Lind, 1974; Bettann, 1957; Binkley, Strafford, & Gill, 1995). Anatomically, the low back is relatively clinically inaccessible.

A reevaluation of mechanical therapy is needed since the various etiologies have overlapping features. Different symptom complexes associated with dysfunction due to complex ipsilateral, contralateral, and segmental neural networking, as well as combines somatic and autonomic neural interactions, may serve to confound the clinician. A novel approach to mechanotherapy is presented to review these six considerations: (1) outcomes validation (2) relative safety, (3) ease to use by the patient or healthcare professional, (4) introduction of new principles of treatment, (5) appropriate utilization, and (6) cost effectiveness resulting in shortened morbidity with optimal improvement.

TYPES OF LOW BACK PAIN

Classically, there are four broad categories of low back pain syndrome, each requiring different treatment pathways (O'Brien, 1984; Bogduk, 1987):

1. **Acute muscular-low back pain** which is usually self-limiting
2. **Acute low back pain** involving sciatic radiation:
 - A. With neurological dysfunction
 - B. Without neurolog
3. **Chronic low back pain** which has recurring symptoms modified by therapy
4. **Neoplastic low back pain syndrome** that is recurring, but eventually becoming progressive, constant, and intractable.

Each type of low back syndrome has common features which vary with the intensity of symptoms: (1) regional pain, (2) impairment and mechanical dysfunction exacerbated by activities of daily living, and (3) mood and behavioral changes. All need to be addressed for overall successful outcomes.

PRINCIPLES OF BIOMECHANICS

Mechanical traction is the technique of applying a distracting force to produce either a realignment of a structural abnormality or to relieve abnormal pressure on nociceptive receptor systems (Colachis & Strohm, 1969; Cyriax, 1950; Gray & Hosking, 1963; Judovich, 1954; Nachemson, 1966). Frequently, both problems co-exist in differing combinations, which generates a number of clinical concerns. Should treatment be constant or intermittent? What is the reasonable duration of treatment? Should gravity or a weight formula based on the patient's weight be utilized to determine the amount of force for the treatment? Can both mechanoreceptors and chemoreceptors that produce unwanted symptoms be integrated and harmonized.

It has been previously described that the distracting force must be greater than the specific pathophysiology causing symptoms, and these mechanisms must be individualized for each patient (Judovich, 1995). Caution not to exacerbate symptoms should always be exercised. The old maxim "no pain, no gain" is both passé and disingenuous. The magnitude of the force correlates with the amount of distraction and must be closely monitored. At what force do we obtain better and more successful results, while reducing costs and morbidity? Katz et al. (1986) reported that 25% of the bodyweight as a traction force applied to 15 degrees positive elevation from the parallel prone plane for a 14-day series was found to be effective. We differ in our findings, as will be reported below (Katz et al., 1986).

When successful, the patient clinically reports symptomatic improvement of well-being and objective clinical verification of (1) improved range of motion, (2) reduction of verifiable regional muscle spasm, (3) improvement in regional tenderness by evaluating health professionals, and (4) improved neuropathic signs when compared to pretreatment findings. How can there be more individualized bioclinical integration? Pathophysiology of regional low back pain syndromes varies on a highly personal, individualized basis in such factors as etiology, causation, resulting activity dysfunction, and

psychopathological considerations. These factors must not be overlooked or underestimated in prescribing treatment.

HISTORY OF TRACTION

A review of the "Annotated Bibliography on the History of Traction" (Appendix A) summarizes 41 articles, from Neuwirth, Hilde, and Campbell in 1952 to Engel, Von Korff, and Katon in 1996.

The reader is referred to Appendix A for a review from medieval times to the present. A summary of this bibliography leads to the following conclusions:

1. Clinical outcomes are highly variable.
2. These are different types of traction techniques, such as intermittent or constant.
3. Variable angles of traction may be applied.
4. Differing weight sequences may be utilized.
5. Suspension devices are useful.
6. Time-scheduled sequences are described, but without specific guidelines and with many variables.

The present chapter is not intended to criticize the previous authors or data presented, but demonstrates that many variables being considered lack quantification. Neurological surgeons have gained extensive experience dealing with and managing problems of intracranial pressure using methods of quantification and have now applied those principles to the intradiscal pressure manometry for clinical correlation of low back pain syndrome.

The first application of quantification by relatively recent studies of quantitative intradiscal pressure changes has been reported by Ramos and Martin (1994). By cannulizing the nucleus pulposus of L4-5 and monitoring intradiscal pressure

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via a pressure transducer, three patients were observed to have lowered pressures below 100 mm Hg as a result of traction technique.

Other methods employing visualization were advanced by Gray (Gray et al., 1968) Radiological assessment of the effect of body traction was reported by Gray et al. (1968). Using only body's weight with a thoracic restraint and only a 12-degree incline, significant lengthening of the spine occurred within 5 minutes and even more significantly after this modified gravity reduction traction for 25 minutes.

Combined studies by Anderson, Schultz, and Nachemson (1968) of intervertebral disc pressure during traction demonstrated by radiographic studies concluded that disc space increases in height and lumbar disc protrusion can be reduced during traction. Myelographic evidence of disc herniation was found to disappear after traction (Anderson, Schultz, & Nachemson, 1968).

Shealy and Borgmeyer (1997) introduced a new biomedical application device that can apply all these positive effects to individual disc levels. To clinically document improvement, clinical data combined with radiofluoroscopy was employed. This new approach delivers precise treatment to decompress the lumbar disc space and then stabilize once asymptomatic through a program of physical rehabilitation.

THE DRS SYSTEM

The major goal of the DRS System (Fig. 1) is decompression, reduction, and stabilization of the lumbar spine. In a series of 50 patients with chronic pain, 23 having ruptured intervertebral disc and 27 with facet joint pain, it was noted that *conventional* spinal traction was less effective and biomechanically insufficient for optimal therapeutic outcome. Extensive observations led to the conclusion that five major factors were important for lumbar traction efficacy:

Fig. 1. The DRS decompression-reduction-stabilization device.

1. Separation of the lumbar component of the joint
2. Flexion of the knees
3. Flexion of the lumbar spine by raising the angle of distraction
4. Comfort and nonslippage of the pelvic belt

For patients with ruptured intravertebral discs who have not experienced significant improvement or at least a 50% reduction in their pain level after five DRS sessions (1 week), addition of colchicines is helpful; 1 mg of intravenous colchicines, with 2 g of magnesium chloride and 100 mg of vitamin B6, is administered daily for 5 days (Appendix C). If significant improvement occurs during the 5-day colchicines treatment, then the patient continues with the DRS system and continues to take oral colchicines (0.6 mg daily) for 6 months, along with magnesium oral spray (allowing at least 200 mg of magnesium for sublingual absorption daily.)

As an anti-inflammatory, we concentrate upon the use of bromelain proteolytic enzyme, 1,000 mg 30 minutes prior to each meal and at bedtime (Seligman, 1962; LotzWinter., 1990). If this is not sufficient, the patient may take any desired over-the-counter nonsteroidal anti-inflammatory drug (Benedetti & Butler, 1990). Obviously, patients often choose these and use a wide variety. The major complications of nonsteroidals include gastric erosion/ulceration and potential liver, kidney, and/or bone marrow toxicity.

CLINICAL RESULTS

In our study, 19 of 23 patients (86%) with ruptured intervertebral discs were markedly improved, and 75% of those with facet arthrosis (20-27) similarly reported a 50-100% reduction in pain.

These results are based upon a pain analog scale with patient evaluation before and no later than 1-4 weeks after completion of therapy. All patients with pain reduction of 50-100% showed improvement in flexibility and total physical activity.

CONCLUSION

A thorough evaluation of the literature reveals no clinical outcomes to correlate with different techniques. In our review and experience, no single device incorporates all seven major factors that are important in achieving clinical results. These include: (1) split table separation; (2) flexion of the knees; (3) flexion of the lumbar spine to raise the angle and distraction segmentally; (4) comfort and, nonslippage of the pelvic restraining belt; (5) comfort and nonslippage of the chest restraint; (6) concomitant use of TENS, heat, ice, and myofascial release; and (7) a graduated limbering, strengthening, and stabilization exercise program. Using this system, successful pain control is achieved in 86% of patients with ruptured intervertebral discs and 75% of those with facet arthrosis.

Because of space constraints, we did not discuss the psychological and psychiatric management of pelvic pain technique, and the reader is referred to other sources. It is worthwhile to consider also that by alternating the pathophysiology of the macro-mechanoreceptor-pain pathway, we may secondarily affect the chemoreceptors as well as reduce noxious stimuli of the richly enervated somatoautonomic lumbar spine, thereby reducing the chronicity of activity-related lumbar pain syndrom. This benefit may also reduce need for medications.

The new DRS system is a welcome addition to the problematic low back pain syndrome. The DRS system appears to be cost effective it merits more widespread utilization and awaits additional ergonomic studies. This approach can provide pain relief, and physicians are invited to take advantage of this gratifying treatment approach.

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APPENDIX A: ANNOTATED BIBLIOGRAPHY ON THE HISTORY OF TRACTION

- ⌚ Anderson, G.B.J., Schultz, A.B., & Nachemson, A.L.
(1968). Intervertebral disc pressures during traction.
Scandinavian Journal of Rehabilitation Medicine, Suppl.,
9 88-91

Pressures in the third lumbar discs were measured in individuals during active and passive traction. During active traction, an increase in pressure was always recorded, with increases corresponding to larger traction forces. During passive traction, the pressure remained close to the resting pressure, sometimes increasing and sometimes decreasing slightly.

An advertisement for something called a Back A Traction, a Swedish gravity traction table, currently being sold for \$995 (which is similar to an ad from 1978), states: "The unique feature of Back-A-Traction is a sliding backrest. You will experience and unloading of pressure from your joints and vertebrae even at an angle of 15 degrees." At 30 degrees, the traction is greater. The author states that the traction "relieves the pressure on pinched nerves and gives the vital fluids free access to lubricate your joints, helps align your pelvis and correct spinal curvatures, improves blood circulation, etc."

- ⌚ Batmen, E.H. (1975). Therapeutic advantages of intermittent traction in musculoskeletal disorders. *GP*.
XVI (5), 84-88

Treatment was directed at 210 patients with intermittent traction; 190 derived good results, with only 38 requiring some additional treatment. Sixteen of the 190 who did well required subsequent treatment after 3-6 months. In no case was any harmful effect observed. The author even reports improvement in patients with arthritis of the knees and hips, as well as stiff shoulders. Weak and constant pull was found to be ineffective, and strong and constant pull led to ligamentous overstretching and neurovascular tension, but intermittent gradual increasing pull, with complete relaxation and maximum traction, restored anatomic and physiologic equilibrium.

Contraindications were inflammation, infection, acute arthritis, trophic changes with disc protrusion, acute torticollis, myositis, and cases, which respond to the first treatment with increasing pain. For lumbar traction, the author reports that elevation of the patient's legs with flexion of the knees or supporting them at an angle of 45 degrees gave much more comfort. The average treatment was 30 minutes. Only 50 pounds of pressure was used in the lumbar spine.

- ⌚ Binkley, J., Strafford, P.W., & Gill, C. (1995). Interrator reliability of lumbar accessory motion mobility testing. *Physical Therapy*, 75 (9), 786-795.

In 18 subjects with low back pain, six different "orthopedic physical therapists" evaluated posterior-anterior accessory motion mobility at each of six levels, L1 to the sacral base, with the mobility being recorded on a nine-point scale. There were only 69% intraclass correlation coefficients. Conclusions are: "There is a poor interpreter agreement on determination of the segmental level of a marked spinouts process. There is poor Interrator reliability of P-A accessory mobility testing in the absence of corroborating clinical data. Caution should be exercised when physical therapists make clinical decisions related to the evaluation of motion at a specific spinal level using P-A accessory motion testing."

- ⌚ Bogduk, N. (1987). Pathological anatomy of the lumbar spine. *Clinical anatomy of the lumbar spine*. New York: Churchill-Livingstone. Bogduk defines mechanical disorders of the lumbar spine as follows.

Acute locked back: "A painful condition of sudden onset that occurs during attempted lifting." This pain is eased by flexion and aggravated by straightening.

Zygapophysial joint mechanism: He considers this Zeniscusentrapment, which is capsular traction, which may include a fibroadipose meniscoid tissue, which fails to re-enter the zygapophysial joint cavity after some type of movement. In such a case, "the meniscoid impacts the margin of the articular process and enters the subcapsular recess at the upper or lower pole of the joint." Again, flexion

reduces impaction. He points out that fragments of articular cartilage resembling the meniscoid may be formed in these joints and a plate of cartilage may be torn and moved.

Intervertebral disc mechanism: Another cause of an acute locked back might be posterolateral extrusion of disc nuclear material along a fissure in the posterolateral annulae.

Lumbar disc herniation: Expulsion through the annulus fibrosa of some portion of the nucleus pulposus. He comments that disc protrusion and disc prolapse are "sometimes used in relation to this phenomena -to imply subtle differences." He describes end-plate fractures, with vertebral end plates being more prone to fracture than failure of an annulus fibrosis. They are considered a "normal feature of aging and degeneration."

Disc degeneration: The mechanism by which due degeneration or degradation become symptomatic are additional stresses on the annulus fibrosis during weight bearing, flexion, and arthrosis of the zygapophysial joint.

- ⌚ Braaf, M.M., & Rosner, S. (1960). Chronic headache: A study of over 2,000 cases. *New York State Journal of Medicine*, 60, 3987-3994.

Braaf and Rosner consider that lesions of the cervical spine are one of the principal causes of persistent headache, chronic headache of cervical origin is a referred symptom caused by compression or irritation of one or more cervical nerve roots or portions thereof, trauma to the cervical spine is the prime factor in producing cervical nerve root irritation, and headache can be treated successfully by cervical traction. They state that 80% are completely relieved on a permanent basis with traction. Another 15% obtain satisfactory relief to carry on normal existence with this approach. They consider cervical traction specific for headache of cerebral origin and by far the most effective method, and maximum benefit is obtained only when it is carried out in a supine position. Traction should be performed as an office procedure, with treatment continued at least 3 months.

- ⌚ Braaf, M.M. & Rosner, S. (1963). *The Treatment of Headaches*. *New York State Journal of Medicine*, March 15, pp. 687-693

"In chronic headache definite, physical signs have been found consistently in the neck. Localized cervical tenderness, spasm of the muscles at the back of the neck, and restrictive movements of the neck are most common physical

findings...especially pronounced during the headache phase." A wide variety of abnormalities of the cervical spine, is seen. There are often motor, sensory, and reflex changes in the upper extremity. Major radiologic findings of the cervical spine are "usually very definite," especially on lateral films, both with the patient in neutral and with the head hyperextended, "similar to those found in lesions of the cervical disks." There is often loss of lordosis, narrowing of intervertebral spaces, osteophytic growths, and narrowing of intervertebral foramina, but at least loss of normal cervical curve is very consistent.

The best treatment in these authors' opinion is a combination of head traction and an intramuscular injection of 200mg of thiamin chloride. Thiamin chloride gives poor therapeutic results, but the addition of thiamin chloride to head traction makes the head traction more effective. Treatments "may have to be carried out daily, for the first week" and then three times a week for up to 2-3 months. "It has been demonstrated conclusively that head-traction, to be effective, must be carried out in the supine position." Sitting or standing traction often makes the patient worse. "The position of the head can be varied according to the angulation of the cervical curve" found on x-ray. That is, they change the angle to optimize normal lordosis. They use 5-60 pounds of weight, but never more than is comfortably tolerated. They begin with 5-10 pounds and gradually increase the weight. Aggravation of pain indicates too much force. They obtained complete alleviation of headache in 60% of patients, good results in an additional 30% (that means over

50% improvement), and poor results in only 10%. For migraine, figures are slightly less favorable" and therapy takes longer but they still consider this quite remarkable. They have found this type of head traction therapy effective in Horton's cephalgia, idiopathic headache, posttraumatic (post concussion) headache, tension headache, psychogenic headache, headaches due to temporal arteritis, atypical trigeminal neuralgia, sphenopalatine neuralgia, headaches due to cervical arthritis, and Meniere's syndrome.

Interestingly, the researchers reported that intranasal sphenopalatine ganglion block with 2% pontocaine helped, "even though this therapy never resulted in complete alleviation of the headache." They report that injection of 2% pontocaine hydrochloride in the upper cervical region is effective in relieving headaches in most cases, but results unfortunately are only temporary. Injection of 10 cc of 1% procaine intravenous over a 2 to 3 minute period was reported, with dramatic results in 100 consecutive cases. Exercise of neck muscles essentially maintains the improvement obtained in traction because the muscles are remarkably weak. "Exercises are directed toward strengthening muscles at the back of the neck as well as muscles of the shoulder-girdle." Diathermy and massage of the muscles are often helpful as well. They emphasize that the diagnosis of psychogenic headache is inappropriate, since many of these patients are cured with this type of treatment.

⊕ Braaf, M.M., & Rosner, S. (1965). More recent concepts on the treatment of headache. *Headache*, 5, 38-44

"Cervical traction is the most effective method, not only for giving symptomatic relief, but also for preventing the occurrence of headache on permanent basis... Chronic headache can be prevented by early recognition of the cervical lesion as a cause of the headache followed by adequate treatment directed towards the cervical spine."

④ Burton, C. & Nida, G. (1976) *Gravity lumbar reduction therapy program*. Minneapolis: Sister Kenny Institute.

In 1972, Dr. Burton started using a type of traction by a canvas chest harness, which he designed, in which he "hung" daily for 10 days a patient with a classic ruptured disc at L5-S1. This became the basis for gravity lumbar reduction, with the patient tilting upright in a chest harness, with the body's weight hanging below that from 30 degrees to 90 degrees. The harness was designed to have its lowest strap tightened under the rib cage and the upper straps grasp the rib cage to effect an equal distribution of pressure. They built up to a total of 4 hours of hanging traction per day and said that anything less than 4 hours with a minimum of 40 degrees elevation of the body was inadequate. They continued such treatment for 1-4 weeks, with those with ruptured discs being maintained an average of 10-14 days. The most significant complication was intolerance because of increased pain or a drop in blood pressure. They stated that the greatest value was when there was low back pain with sciatica due to a ruptured disc.

④ Colachis, S.C. Jr., & Strohm, B.R. (1969). Effects of intermittent traction on separation of lumbar vertebrae. *Archives of Physical Medicine & Rehabilitation*, 50, 251-258

Ten subjects (from 22-25 years of age) were placed in the Supine position with the thighs flexed 70 degrees and legs parallel to a split traction table. They used an angle of rope pull of 18 degrees and a traction force of 50 pounds applied for 10 seconds, followed by a rest period of 5 seconds, with traction given intermittently for 15 minutes. After a rest period of 10 minutes, a 100-pound traction force was applied in the same number for 15 minutes intermittently, and after another rest period of 5 minutes, another 100-pound traction force was applied continuously for 5 minutes. Lateral radiographs were taken before, during, and after the application of the traction force. There was a statistically significant increase in total mean posterior vertebral separation with 50 pounds of

traction force and a significant increase in total mean anterior and posterior separation when a traction force of 100 pounds was applied. The greatest increase in posterior vertebral separation during traction occurred at the L4-5 and the least at the L5-S 1 interspace with this particular approach with the rope at 18 degrees, but it is worth noting that there were changes all the way to T12-L1. For instance, at 100 pounds of intermittent traction, there was an increase in the posterior vertebral separation at T12-L1 of 0.7 mm, 0.4 at L1-2, 1.5 at L2-3, 1.4 at L3-4, 1.55 at L4-5, and 0.1 at L5-S1, an actual total elongation of the entire lumbar spine of 4.95 mm. With continuous traction of 100 pounds for 5 minutes after 5-minute rests, the mean total was 5.25 mm longer than prior to the traction.

⌚ Cyriax, J. (1950) The Treatment of Lumbar Disc Lesions.
British Medical Journal. December 23, 1434-1438

Cyriax states, "Sustained traction is the method of choice for ambulant patients with pulpy herniations whose symptoms warrant treatment. Distraction at the affected joint has two effects. (1) Increase in the interval between the vertebral bodies, thus enlarging the space into which the protrusion must recede. (2) Tautening of the joint capsule. Naturally, when the stack is taken up, the ligaments joining the vertebral bodies exert centripetal force all around the joint; this tends to squeeze the pulp back into place. Thus, sustained traction merely represents a way of achieving in a very short time the same effect as rest in bed for some weeks."

Bands around the mid-chest and pelvis with 200-300 pounds of pressure were applied for 2-3 periods of 20 minutes each, with 5 minutes rest in between. Treatment was carried out daily until the patient was well, usually 1-2 weeks. Sustained traction was described as using "the greatest possible traction" that the patient will permit for "as long as is reasonable."

- ④ Cyriax, J.H.(1955) Discussion on the treatment of backache by traction. *Proceedings of the Royal Society of Medicine*, 48, 805-814

Cyriax mentions that some people do better prone and some supine. Patients were treated once or twice a day for half to one hour each time. Traction weight may be only 100 pounds with a "small woman," but up to 200 pounds in a "large man." He emphasized, "As soon as the traction becomes effective, certain alternations in the pain are felt by the patient." The changes are that the pain usually ceases, but a unilateral lumbar pain may become central, a root pain may become a lumbar pain, a root pain may shorten (that is, move from the calf to the thigh above it), a root pain may remain in the same place but become less intense, or the pain may remain unaltered.

He emphasized that the patient must be treated daily; otherwise, it is not worth doing. He abandons treatment if pain is not improved after 12 sessions, and treatment is continued up to at least 4 weeks if necessary. In some patients with constant backache, adequate therapy may require 2-3 months.

The indications, in his opinion, are a protrusion of a disc, failure of manipulation, impaired nerve conduction (a weak muscle, absent ankle jerk, or cutaneous analgesia), failure of epidural local anesthetics, reference of pain to the coccyx or genital area, first and second lumbar disc lesions, and recurrence of pain after laminectomy. He considers contraindications to traction as "purely annular displacements," painful are during trunk flexion, pain caused by side flexion away from the painful side, pain which ceases as soon as the traction is applied but increases significantly when traction is released, and patients with impaired cardiac or respiratory function.

- ④ Deets, D., Haupt, K., & Haupt, S.S. (1977) Cervical traction: A comparison of sitting and supine positions. *Physical Therapy*, 57 (3), 256-261

These authors also feel that a supine position is much more effective than a sitting position.

There is greater posterior intervertebral separation, increased relaxation, decreased muscle guarding, and increased stability, with less force needed. Deep heat and massage prior to traction was recommended. They measured separation of the disc space in the same subjects sitting and supine, using 30 or 40 pounds of weight, and they got greater increase in interspace measurement in the supine position.

- ⌚ Dettori, J.R., Bullock, S.H., Sutlive, T.G., Franklin, R.J., and Patience, T. (1995) The Effects of Spinal Flexion and Extension Exercises and their associated postures in patients with acute low back pain. *Spine*, 20, 2303-2312

Subjects (149) with acute back pain were given flexion exercises, extension exercises, and postural extension exercises. There was no difference in outcome between flexion of extension exercise groups. However, either exercise was slightly more effective than no exercise.

- ⌚ Engel, C.C., Von Korff, M., & Katon, W.J. (1996) Back pain in primary care: Predictors of high health-care costs. *Pain*, 65 (1,3), 197-204

The authors studied 159 back pain patients consecutively presenting in a primary clinic of an HMO. Their conclusion is that a minority of primary care back pain patients' account for a majority of healthcare costs. Increasing chronic pain was the strongest independent predictor of high back pain costs. Increasing pain persistence and a disc disorder with or without sciatica were also significantly predictive of high back pain costs. Arthritis was weakly associated with high cost variables, compared to non-disc, non-arthritis pain. Increasing depression was weakly but not statistically associated with high back pain costs. They quote other statistics suggesting that the etiology of back pain is unclear in at least 79% of men and 89% of women. Only 2% of patients ultimately require surgery, and only 16.9% have a disc disorder and/or sciatica. They emphasize, "Often, however, prescribed therapies such as bed rest, opioid analgesics, and muscle relaxants or sedatives do not

reliably ameliorate chronic pain and may acutely diminish patient functioning."

- ⌚ Goldfish, G.D. Lumbar traction (source of this book undetermined).

Among other things, the author states that no significant distraction of the lumbar disc was produced at less than 50 pounds of traction. He mentions that Cyriax has hypothesized that traction could actually produce negative intradiscal pressure, strong enough to suck the herniated disc back in.

- ⌚ Gose, G. (1996) *Clinical study...The efficacy of V.A.X-D therapy.*

- ⌚ Chicago: University of Illinois, April 10.

The author states that 20 treatments of V.A.X-D therapy have been proven to be effective in about three-quarters of all patients who have any combination of facet syndrome, degenerative disc, or single disc herniation. Private transmittal. On April 12, 1978, the senior author received a package from Gravity Guidance, Inc. (816 Union, Pasadena, California). The material discussed an inversion gravity system where people were hung upside-down by the ankles. The following are statements from these materials: "Realign vertebrae, correct internal derangement-visceral, vascular, and skeletal, relieves pressure on nerves and articular surfaces. Permits the protrusion of the disk to be drawn back and heal in the proper position. Sucks the nucleus to a more central position-away from the sensitive posterior part of the annulus. Pulp protrusions are reducible by full body load. Increases the range of motion and joint play. Distributes pressure equally in all directions and dissipates force. Decompresses the body (SPINE). Increases the volume capacity of the nuclear space (disk). Reduces degenerative changes in the disk and bone." Attached to that is mention of a patent number, 3,380,447.

- ④ Gray, F.J., & Hosking, H.J (1963). A radiological assessment of the effect of body weight traction on the lumbar disc spaces. *The Medical Journal of Australia*, December 7, 953-955

These authors used a traction table with the patient supine. The thoracic harness holds the body as the table is tilted a foot down, so the patient's body is really doing the traction. They used only a 12-degree incline, and after 85 minutes they noticed that even a higher angle of 0 degrees gave no significant further lengthening, but 5 minutes at 12 degrees was quite significant. These results indicate that "compared with the horizontal supine position, the lumbar disc spaces were widened significantly at an incline of 12 degrees after traction for 5 minutes, and even more significantly after traction for 85 minutes."

- ④ Gupta, R.C., & Ramarao, M.S. (1978). Epidurography in reduction of lumbar disc prolapse by traction. *Archives of Physical Medicine & Rehabilitation*, 59, 322-327

Fourteen patients, 7 of whom had multiple disc protrusions and the others a single disc protrusion, were treated for 10-15 days with traction applied by bilateral skin traction with a heated plaster on both sides, with 60-80 pounds of weight and the foot of the bed elevated 9-12 inches. Patients with massive disc prolapse tolerated the heavy skin traction better than those with less protrusion. Ten of the 14 patients showed definite clinical improvements, with decrease in back pain and sciatica, normal straight leg raising, and complete or partial recovery of sensory deficit. In all these cases, the lateral epidurograms revealed normal anterior contrast column, and the PA epidurograms showed no defect in nine cases, showing that the disc had reduced to its normal position. In one case, although there was definite clinical improvement and decrease, there was still a slight persistent defect. Two patients with motor deficits showed improvement. In two cases, only minimal improvement in clinical condition occurred after the traction, and interestingly, their epidurograms showed persistence of the same defects. They showed an

average vertebral distraction during traction of 0.5 mm. The authors followed nine of the cases for 1-2 years with no recurrence of symptoms.

⌚ Hadler, N.M., Carey, T.S., Garrett, J., & the North Carolina Back Pain Project (1995) The influence of indemnification by workers' compensation insurance on recovery from acute backache. *Spine, 20, 210-215*
Of 1,633 patients seen, 505 were insured by workers' compensation. These 505 were compared with 861 who had been employed on any job for pay within 3 months of the onset of backache, but whose care was not underwritten. "Those with compensatable back pain were more likely to categorize their tasks as physically demanding and had taken more time off work in the month before the baseline interview. Recovery of the sense of wellness they enjoyed before the episode of back pain was delayed. Recovery of function or return to work was not delayed." The conclusion: "Each of these associations is a reproach to the fashion in which workers' compensation insurance for regional back pain serves the ethic that is its *raison d'être*."

⌚ Hirschberg, G.G. (1974) Treating lumbar disc lesion by prolonged continuous reduction of intradiscal pressure. *Texas Medicine, 70, 58-68*.
The author mentions treating several hundred patients with sciatica resulting from lumbar disc lesion. Conservative treatment usually consisted of bed rest and pelvic traction. There are no real details about traction, and he really emphasizes prolonged bed rest.

⌚ Hood L., & Chrisman, D. (1968). Intermittent pelvic traction in the treatment of the ruptured intervertebral disc. *Journal of the American Physical Therapy Association, 48 (1), 21-30*
"The present survey indicates that intermittent pelvic traction is of value in treating the patient with a ruptured intervertebral disc...The patient with a nerve root compression from above and list away from the affected side would be expected to have the best results." One year or more later, they

presented excellent results in 15%, good results in 52.5%, and poor results in 47.5%. Excellent meant a symptomatic and employed full-time; good meant symptoms greatly improved with occasional minor low backache and fatigue.

The treatment consisted of a heat with hydrocollator packs of ultrasound, followed by intermittent pelvic traction. The patient was placed on a traction table with the legs raised to flatten the lumbar spine. They used a canvas traction belt around the pelvis and a thoracic corset around the rib cage to restrain the upper body. Traction force was most frequently set at 65-70 pounds, although initial treatments were usually given at 55 pounds.

Interestingly, they show a photograph from 1544 with an accrued traction table with the patient being hanged from above. This looks very much like what Chuck Burton did. They quote Neuwirth et al., in which up to 220 pounds of traction was used. Judovich, back in the 1950s, presented a new method of intermittent traction, and he stated that a constant pull was intolerable to the average patient, but intermittent traction could be tolerated and would give improved results. Cyriax, as early as 1950, also suggested that sustained traction gave much more effective results than bed rest. Cyriax, used 200-300 pounds of pelvic traction for two or three periods of 20 minutes, with 5 minutes of rest between periods, given daily for up to 2 weeks. Cyriax stated that traction "creates an increased space between the vertebrae, permitting the return of the prolapsed material." He also stated that the tightened ligaments helped to squeeze the protrusion back in place. The authors also report a study by Christman et al. on patients with back pain, sciatica, and a positive sciatic nerve stretch test with either weakness or loss of a tendon reflex; 51% of the patients had good or excellent results with traction.

⌚ Judovich, B.D. (1954) Lumbar traction therapy dissipated force factors. *Lancet*, 74, 411-414

In the cervical area, this author reported that it required 30-40 pounds to demonstrate a beginning

widening of the intervertebral spaces. In the lumbar spine, he used 80-85 pounds of traction in most people, but at least 90 pounds or more in heavier patients. Keeping the bed level, he found that raising the legs in slings during the traction helped significantly. Even in heavy patients, it required 10 pounds less traction if the legs were flexed over a firm bolster. Hyperextension increases pain. Flexion of the spine decreases pain and improves results. In both live people and cadavers, "the average surface traction resistance of the body is approximately 54% of total body weight. The lower body segment-transverse section through L3, L4 interspace-weighs approximately 48% of total body weight. Approximately 54% of the weight of the lower body segment is also required to overcome its surface traction resistance. This is equal to approximately 26% of the total body weight. The force, therefore, that is dissipated with leg or pelvic traction is approximately 26% of the entire body weight. Only adequate weight in excess of this amount has a stretch effect upon the lumbar spine."

Ⓢ Judovich, B.D. (1995) Lumbar traction therapy-Elimination of physical factors that prevents lumbar stretch. *Journal of the American Medical Association*, 159 (6) 549-550

The author emphasizes that in a living being, the force necessary to overcome "surface traction resistance" is approximately 54% of the weight of the body. "Tone and elasticity of tissues appear to have no practical bearing upon the required force." Interestingly, he emphasizes that the lower body from the L3-4 interspace composes 49% of the entire body weight; thus, 26% of the entire body weight is calculated as an approximate average necessary to overcome resistance of the lower half of the body. This is called the "dissipated force factor." This particular force is "completely neutralized and lost as a stretch force to the lumbar spine." He emphasizes thus that the first 40-45 pounds are "lost" as a lumbar stretch force. Thus, he emphasizes further that one must exceed an average of 80 pounds of weight in order to begin to produce any type of effective lumbar traction.

Lawson, G.A., & Godfrey, C.M.(1958) A report on studies of spinal traction. *Medical Services Journal of Canada*, 14,762-771. These authors used spinal traction with weights up to 100 pounds on the cervical area and 150 pounds on the lumbar region for varying amounts of time and showed increases of up to 4 mm with the disc spaces in the lumbar area.

- ⌚ Lehmann, J.F., & Brunner, G.D. (1958) A device for the application of heavy lumbar traction: Its mechanical effects. *Archives of Physical Medicine & Rehabilitation*, 39, 696-700

These authors describe a hydraulic device that delivers heavy lumbar traction in an upright position. They state that "under traction the proper alignment of the vertebrae of the lumbar spine is maintained. The machine produced a statistically significant widening of the intervertebral spaces and a therapeutic stretch of the lumbar musculature."

- ⌚ Lidstrom, A., & Zachrisson, M (1970) Physical therapy of low back pain and sciatica. *Scandinavian Journal of Rehab Medicine*, 2, 37-42.

In 62 patients treated with sciatica, use of intermittent traction as recommended by B. Judovich in 1954, using one half of the body weight plus an additional 30-40 pounds of intermittent traction, revealed a "statistically they treated patients with "isometric training of the abdominal muscles." They used the Fowler position for the traction. Actually, the traction force was in general given over a 20-minute period with 4 seconds of hold and 2 seconds of rest. The traction force used for a patient weighing 50 kg was 58 pounds; for one weighing 55 kg, 61 pounds; for one weighing 60 kg, 63 pounds; and for one weighing 70 kg, 69 pounds. Basically, they had improvement in 100% of those treated with traction.

- ⌚ Lind, G., (1974) Auto-traction: Treatment of low back pain and sciatica. Dissertation. Sweden: University of Linkoping.

Radiographic studies performed during traction have demonstrated that the disc space increased in height and that lumbar disc protrusion was reduced. Myelographic evidence of disc herniation was found to disappear after traction. In active traction the subject's pelvis was fitted with a harness attached to a solid metal frame. The subject applied traction by pulling with the arms on another frame at the head end of the table. The pressure is exerted by the patient. They called this auto-traction. Patients were all lying on their left side when this was done. Passive traction was produced by two investigators, one pulling on the patient under the arms and the other on the pelvis. No specific weights in either case were listed.

④ Loeser, J (1996) Editorial comment: Back pain in the workplace II. *Pain*, 65 (1) 7-8

Dr. Loeser reports that "malingerer is rare, delusions of pain ever rarer." He further goes on to state that 80% of the adult population has back pain at some time or another, and at any one time 14% have had back pain in the previous 2 weeks. Loeser states that the overwhelming majority of those who do submit a claim for their back pain return to work within a few weeks, but that there are two million chronic disabled back pain patients in the United States. "There is increasing evidence that the treatments rendered to those with nonspecific back pain have no efficacy." Loeser emphasizes that the rate of surgery for low back pain is directly related to the number of surgeons and not to the population. He also wagers "that the number of chiropractic treatments is related to the number of chiropractors, not citizens." He goes on to say that the same could be said for acupuncture treatments, physical therapy, or any other treatments for low back pain. "Healthcare is a social convention, driven only in small part of anatomy, pathology, or physiology." He believes that a "good argument can be made that our current method for diagnosing, treating, and compensating claimants with nonspecific low back pain leads to increased paid, suffering, impairment, disability, and costs.

Patients are told things by their doctors that lead to inactivity and depression."

- ⌚ Mathews, J.A. (1968), Dynamic discography: A Study of Lumbar Traction. *Annals of Physical Medicine*. IX(7) 265-279

These authors describe the radiographic findings in three patients with sciatica and used visualization with epidural contrast injections while the lumbar spine was injected to track. In two patients with multiple disc protrusion, protrusion was lessened by the traction, created by "vertebral distraction." Traction was applied with the patient prone on a conventional "couch.," with a thoracic corset and pelvic harness. They used traction of up to 120 pounds for 38 minutes, with the improvement as noted.

- ⌚ McElhannon, J.E (1984) *Physio-therapeutic treatment of myofascial disorders*. Anaheim Hills, CA: James E. McElhannon

McElhannon considers the contraindications to traction to be primary metastatic malignancy, cord compression, infections disease of the spine, cardiovascular disease, arthritis, old age, pregnancy, active peptic ulcers, hernia, aortic aneurysm, or gross hemorrhoids. But traction is indicated in conditions where you want to achieve "distraction of the vertebral bodies with enlargement of the intervertebral space producing an inward suction effect on the disk; stretching of muscles and ligaments with a tautening of the posterior longitudinal ligament exerting a centripetal effect on the adjacent annulus fibrosis; separation of the apophysial joints; and enlargement of intervertebral foramina." He recommends mechanical massage of the lumbar spine prior to traction.

He states that the angle of pull in cervical traction will vary from 5 to 50 degrees. In the upper three vertebrae, the angle will be 5-15 degrees. For cervical vertebrae 4 through 7 and dorsal vertebrae 1, 2, and 3, the angle would be 30-50 degrees. "The lower you treat in the cervico-

thoraco spine, a greater angle of pull is required, up to 50 degrees, for maximum and consistent results." Proper angle pull for thoracic-lumbar conditions is 15-50 degrees. To affect low thoracic and lumbar vertebrae 1 through 3, the angle of pull must be 15-30 degrees. To affect L3 through L5 and S1, the angle of pull must be 30-50 degrees. "The lower in the spine you treat, the greater angle of pull required." He believes that mechanical massage should not be done after traction. He also believes that static traction for 20 minutes is preferable to intermittent traction for patients with acute discogenic disease, severe radiculitis, or severe muscle spasms and that a patient with severe muscle spasm should never have intermittent traction. For more chronic problems, intermittent traction (pulling for 30 seconds, followed by release of 10 seconds) is best and gives the greatest results. In the cervical area, he states that traction of the cervical spine should never start with less than 15 pounds, and never less than 50 pounds in the lumbar, as this poundage is necessary to overcome muscle tension, and less pounds will actually aggravate the patient by introducing reflex spasm. He recommends 3 days of steady traction and then three times a week for 6-8 weeks, with considerable improvement expected after three to five treatments. If the patient does not improve after three treatments, the poundage is increased by 10 pounds. Cervical traction goes up to 60 pounds, and even higher in large male patients, and lumbar traction goes up to 125 pounds. He states that some type of bolster should always be placed under the patient's knees to flatten the lordotic curve while traction is being given.

⌚ Nachemson, A. (1966) The load on lumbar discs in different positions of the body. *Clinical Orthopedics and Related Research*, 45, 107-122

"The load on the lumbar discs is related both to the body weight of the subject and the position of the body...For a subject weighing 70 kg, the load on the L3 disc in the sitting position is approximately 140

kg. Approximate loads in the other positions are as follows: standing, 100kg; sitting and forward tilting of 20 degrees, 190 kg. With an additional kg in hands, 270 kg; reclining, lateral decubitus, 70kg; relaxed supine, anesthetized reclining, 20 kg. If such a subject tilts forward 20 degrees in the standing position and lifts 50 kg by his hands, the total load on the L3 disc will be about 300 kg." In moderate degenerative discs, the pressures are approximately 30% lower than in comparable normal discs.

- ⌚ Nachemson, A.L.(1981) Disc pressure measurements. *Spine*, 6, 93-97

Intradiscal pressure was measured in over 100 individuals, and it was found that reclining reduces the pressure by 50%-80%, but unsupported sitting increases the load by 40%. Forward lifting and weight lifting increased the pressure by more than 100%, and upward flexion and rotation by 400%. "Large augmentations in pressure were also observed in subjects performing various commonly prescribed strengthening exercises."

- ⌚ Nachemson, A., & Elfstrom, G. (1970) Intravital dynamic pressure measurements in lumbar discs. A study of common movements, maneuvers, and exercises. *Scandinavian Journal of Rehabilitation Medicine, Suppl. 1*, 1-49

This publication refers back to the original material much of which has already been presented in other papers by Nachemson, but it is a much more comprehensive review.

- ⌚ Neuwirth, E., Hilde, W., & Campbell, R (1952) Tables of vertebral elongation in the treatment of sciatica. *Archives of Physical Medicine*, 33, 455-460

The authors state that the intervertebral discs constitute about one-fourth of the entire length of the vertebral column. They record data referring to vertebral traction as early as the fifth century B.C. in the writings of Hippocrates. He described various procedures to

redress kyphosis and in particular recommended the use of a ladder to which the patient was bound, head up or down, and then lifted by a rope, which ran over a pulley attached to the roof of a house. Then the ladder with the patient was dropped onto a hard pavement.

They describe a table, which can be tilted in either direction, head up or head down, using a hand wheel on a worm gear. They mount pulleys at either end of the table to pass straps to the head or the chest or the pelvis.

They always provide preliminary use of heat and sedative massage to the area of the vertebral segment to be elongated and then apply traction, with the intensity gradually increased. At the end of a few minutes, the traction is slowly and gradually reduced to the starting point. Then, after a short pause, traction is reapplied and increased to a higher level, with progressive stages to maximum traction, with 30-60 minutes of rest at the completion of the complete treatment. They gave treatment daily or every other day, and they report that "vertebral elongation" relieves muscle spasm, promotes the return of the protruded disc and the slightly displaced vertebrae to their original lodging, and facilitates reduction of subluxated apophysial joints, with reduction of pressure upon nerve root blood vessels and lymphatic and consequent relief of pain.

They report that in a cadaver stripped of muscles, 9 kg of traction force was necessary to separate two lumbar vertebrae by one and a half mm. In the living, 100 kg of traction force must be employed to obtain the same results.

They report overall, from their work and that of others, 68% good results in some 400 patients, 69% in another 240 patients, and 58% in another 156 patients. They state that vertebral traction has been found to exert significant beneficial effect in patients with sciatica.

④ Pal, B., Mangion, P., Hossain, M.A., & Diffey, B.L
(1986). A controlled trial of continuous lumbar

traction in the treatment of back pain and sciatica.

British Journal of Rheumatology, 25, 181-183

These authors compare a controlled trial of continuous lumbar traction in the hospital in patients with back pain and sciatica with a similar group treated with sham traction. However, they used only a maximum of 8.2 kg, which obviously would be of no value.

⌚ Ramos, G., & Martin, W. (1994) Effects of vertebral axial decompression on intradiscal pressure. *Journal of Neurosurgery*, 81, 350-353

A cannula was connected to the patient's L4-5 space with a pressure transducer. The patient was placed in a prone position on a VAX-D therapeutic table. Changes in intradiscal pressure were recorded. At a resting state, controlled tension was applied to the pelvic harness. Tension in the upper range was observed to decompress the nucleus pulposus, to below -100 mm Hg. This was only done in three patients.

⌚ Snook, S., (1987). The costs of back pain in industry. Occupational back pain, state-of-the-art review. *Spine*, 2(1), 1-5

In 1987, the average direct healthcare and compensation cost for an individual with back sprain was \$5,739. The estimated cost of industrial low back pain in the United States in 1983 was \$25.25 billion.

The author quotes an estimate of \$14 billion expended on the treatment and compensation of low back pain sufferers in 1976, with an estimate of \$25.25 billion in 1983. Lost wages alone were estimated at \$11 billion per year in 1975-78. In 1985, it was estimated that 33% of the cost of managing compensatable back pain due to medical care and 67% to "indemnity costs." It appears that we could conservatively estimate that compensable back pain, both in medical costs and lost wages, in 1996 would be around \$100 billion. If we include non-compensable back pain, which is at least another similar amount, the total cost of significant back

pain in the United States in 1996 would be somewhere between \$200-300 billion, counting wages lost or paid out, as well as medical costs, with approximately one-third of that total amount being total medical costs.

An ad from Spinal Designs International (2400 Chicago Avenue, S., Minneapolis, MN 55407) states that the LTX 3000 Lumbar Rehabilitation System (a chair in which the patient sits with a belt around the chest and the bottom of the chair drops out) leads to "lumbar stabilization, intradiscal pressure unloading, free movement and exercise, gentle musculature stretching, and neutral spine positioning."

⌚ Wall, P.D.(1996) Editorial comment: Back pain in the workplace. 1. *Pain*, 65(1),5

Commenting on a task force on "Pain in the Workplace," Dr. Wall states that the "report is an uncritical lurch back 150 years when chronic pain without lesions was already a major problems." He mentions that Charcot considered angina and Parkinsonism to be neuroses because of unknown causative lesion. He further quotes Tate describing back pain without lesion as hysteria, but could be caused by "irritation of the upper dorsal portion of the spinal marrow." Wall goes on to state that the authors of the task force "display no caution in their uncertainty that there is no lesion" and that "there is nothing left to study." He criticizes the task force's consideration of low back pain as "a problem of activity intolerance, not a medical problem." Dr. Wall advises that surgeons should not operate under such circumstances and not prescribe drugs, and he particularly criticizes the fact that the task force recommends abruptly at 6 weeks that "those still complaining of non-specific low back pain should be labeled activity intolerant and unemployed with a removal of medical and wage benefits." His conclusion is that "Back pain in the Workplace" is at the best an idiosyncratic, largely untested series of recommendations on how to treat the first six weeks of low back pain, after which advice ends abruptly with the re-assignment of the

patient to the diagnosis of 'activity intolerance' which is "not a medical problem."

- ⌚ Weisfeldt S.C. (1971) Ambulatory approach to the treatment of low back pain. *Journal of Occupational Medicine*, 13, 384-387

Ice packs and traction were used for acute back pain. The use of ice and later moist heat with intermittent traction plus ambulation and exercise afforded excellent relief of pain and earlier return to work, even in industrial accidents. Patients received an average of 8.3 treatments Of 316 industrial accident patients treated by intermittent traction and ice, 76.6% lost an average of 5.9 days of work.

- ⌚ Unpublished study. An acute low back distress study from the University Hospital, London, Ontario, 1987-1988 This unpublished study reports that 66% of patients had a positive outcome from VAX-D therapy. The criterion for success was a reduction to 50% of the baseline aggregate score for pain and disability.

APPENDIX B: BACK PAIN PROTOCOL

I. Inclusion Criteria

- A. Pain present for 1 week or more due to ruptured intervertebral disc
- B. Pain present for 1 month or more for other causes of back pain
- C. Patient will be available for 4 weeks of continuous therapy
- D. Patient has adequate financial resources to cover therapy
- E. Patient is at least 18 years old or has parental consent if at least 15 years

II. Exclusion Criteria

- A. Pregnancy
- B. Prior lumbar fusion
- C. Metastatic cancer

- D. Severe osteoporosis, with estimates by radiological interpretation of lumbar plain x-rays showing greater than 45% bone loss
- E. Bilateral spondylolisthesis of spondylolysis
- F. Compression fracture of lumbar spine below L1
- G. Aortic aneurysm by physical examination or x-ray
- H. Pelvic or abdominal cancer
- I. Rheumatoid spondylitis
- J. Disc space infection
- K. Significant cognitive dysfunction
- L. Psychosis
- M. Significant opioid, alcohol, or tranquilizer dependency
- N. Weight greater than 290 pounds (possible exclusion at 250 pounds depending upon weight distribution)
- O. Significant uncontrolled intercurrent medical disorder
- P. Hemiplegia or significant Para paresis
- Q. Severe peripheral neuropathy

III. Negative influences

- A. Smoking-Patients need to know that results will be 50% less effective
- B. Consumption of greater than 20 mg/day equivalent of diazepam or four Percodan/Percocet/Tylox (oxycodone/aspirin or acetaminophen), which will require a detoxification plan
- C. Consumption of greater than two cups of coffee, three cups or glasses of tea, or two cans of soda pop per day
- D. Obesity of greater than 20% above ideal body

- E. Consumption of prednisone or steroids than DHEA
- F. Overall poor nutrition
- G. Serious language barrier preventing effective communication
- H. Significant negative attitude on the part of the patient

IV. Evaluation

A. History

1. Comprehensive general medical assessment
2. Spinal-specific questions/ issues
 - a. Details concerning the onset of the pain complaint
 - b. Factors which decrease or increase pain
 - c. Location of center of pain, spread, and/or radiation
 - d. Intensity (average, high, and low, with estimate of percent of time being high or low)
 - e. Physical limitations due to the pain
 - f. Mattress (type, quality, and condition)
 - g. Sensory symptoms (tingling, numbness)
 - h. Known muscle weakness
 - i. Bowel, bladder, and sexual dysfunctions
 - j. Recent or remote spinal injuries
 - k. Recent or remote spinal surgery
 - l. Recent or remote diagnostic spinal studies (lumbar puncture, discogram myelogram ,CT, MRI, plain spinal x-rays)
 - m. Any spinal anesthetic or epidural or steroid injections
 - n. Trigger point injections or nerve blocks in the past 6 months
 - o. Acupuncture therapy in the past 6 months

- p. Any physical therapy in the past 6 months
- q. Any use of a back brace (other than work-required lifting belt) in the past 6 months
- r. Family history of significant spinal problems
- s. Any personal history of cancer
- t. Any personal history of collagen disease (rheumatoid arthritis, systemic lupus erythematosus, scleroderma, mixed collagen vascular disease)
- u. Any chiropractor or osteopathic adjustments initially determined dosage or manipulation in the past 6 months 2. All patients will start Bromasea 2 t.i.d. ½ hour

B. Physical Examination

1. General exam

- a. .Vital signs (height, weight, blood pressure, pulse, respiration, temperature)
- b. HEENT
- c. Neck
- d. Chest (heart, lungs, and breasts)
- e. Abdomen

- f. Pelvic (within past 6 months for women)
- g. Rectal (essential for all patients)
- h. Skin (lesions, thickness/coarseness, redness)
- i. Extremities (pedal pulses, cyanosis, clubbing, edema)
- j. Neurological
- k. Funduscopic CN II-XII
- l. Muscle Strength
- m. Tandem gait with Romberg screen
- n. Posture
- o. Sensory vibration at patella versus malleoli, light touch versus pin-prick for arm compared to leg dermatomes

2. Spinal

- a. Lumbar flexion, extension, side bending and lateral rotation
- b. Straight leg raising (lying supine and sitting upright)
- c. Hip abduction ("Fraser")
- d. Palpation of sacrum for sacral shear or torsion
- e. Palpation for rotation focal tenderness of the spine

3. Diagnostic Testing

- a. Plain x-rays of the lumbar spine, including oblique and flexion/extension laterals done within the past 6 months of after most recent injury or spinal surgery

- b. If there is a clinical suggestion of nerve root impairment, then obtain MRI from T12 to L1 to L5-S1
- c. CBC and differential, chemistry panel 20, ESR with 200-mm column, urine analysis, TSH, intracellular Mg (Spectral Diagnostics)
- d. If MRI is negative for nerve root compression in a patient with severe nerve root signs, then get EMG, NCV to rule in/out a neuropathy

4. Treatment

- a. Initial management of all currently consumed analgesic medications and substances (caffeine, alcohol, tobacco, and street drugs)
 - a. Patient will decrease by 10% per day from initially determined dosage.
 - b. All patients will start Bromase 2 t.i.d half hour a.c
- b. Patients will be taught to use the visual analog scale for pain measurement at the first appointment with the physician, and then will continue to complete visual analog scales at all subsequent appointments.
- c. Patients will be issued a TENS unit to be used during all waking hours
 - a. Electrode placement will be taught to patient by facility MD or RN.
- d. Patients will receive a daily pre-DRS vibratory massage or myofascial release using vacuum/ inferential current treatment for 30 minutes with heat application to the lower back for 20 sessions.
- e. Patients will be positioned on the DRS and receive distraction/decompression for

30 minutes using one-half of the body weight plus 10 pound for 20 sessions.

- f. After DRS, patients will have a Polar Pack placed on the lower back for 30 minutes.
- g. After 1 week (five DRS sessions) if patients with clinical and diagnostic imaging findings of ruptured or ruptured intervertebral disc are not 50% improved, add 1 mg/day intravenous colchicines and 2 g magnesium/ B6 intravenous for 5 days, then orally maintain patients on 0.6 mg/day for 6 months.
- h. After the second week of the program (ten DRS sessions), if improved 50%, instruct the patients in the Shealy exercise program. For those not yet improved 50%, then reassess patients with repeat physical examination
- i. For those patients who are *not* 50% better after ten DRS sessions, consider:
- j. Percutaneous electrical nerve stimulation to be done by the facility physician
- k. Referral to anesthesiologist of neurosurgeon for facet nerve blocks
- l. Trigger point injections with Sarapin by facility physician
- m. Enroll patient in laser study protocol and administer laser therapy 2 minutes/day for up to 5 days
- n. After 20 DRS sessions or significant improvement of patients symptoms from multimodality approaches, patient will have an exit physical examination with the facility physician. An aftercare plan will be established calling for the use of the Polar Packs, TENS, exercise, relaxation training, use of any substances, pacing techniques, and proper

utilization of body mechanics and posture for daily activities.

- o. Patients return 1 month after treatment for evaluation by the facility physician.

APPENDIX C: REFERENCES REGARDING COLCHICINE

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Topic Simple pelvic traction gives inconsistent relief to herniated lumbar disc sufferers.

A new decompression table system applying fifteen 60 second tractions of just over one half body weight in twenty 1/2 hour sessions was reported to give good or excellent relief of sciatic and back pain in 86% of 14 patients with herniated discs and 75% of 8 with facet joint arthrosis. (Shealy, C.N., Borgmeyer, V., AMJ. Pain Management 1997, 7: 63-65).

Herniated and degenerated discs can be shown at discography-disco-manometry to have elevated intradiscal pressures made even worse by sitting and standing, thus preventing proper disc nutrition. Therefore decompressing the over pressurized disc should allow for healing and repair of disc prolapse, herniation and annulus tears.

Serial MRI imaging of 20 patients treated with the decompression table shows in our study up to 90% reduction of subligamentous nucleus herniation in 10 of 14. Some rehydration occurs detected by T2 and proton density signal increase. Torn annulus repair is seen in all. Transligamentous ruptures show lesser repair. Facet arthrosis can be shown to improve chiefly by pain relief. Follow up studies for permanency or relapses are in progress.

The DRS Mechanical Decompression-Distraction System was described by Shealy and Borgmeyer (1) to give relief of lumbar herniated disc and facet joint arthrosis superior by 50% to conventional pelvic traction. Twenty DRS treatments produced on midsagittal MRI a 50% reduction in one case, and a 7mm distraction of L5 on SI was shown on lateral x-ray. (2) Clinical improvement in 75 to 85% of subjects was reported.

Does clinical betterment correlate directly to improvement in MRI image and can MRI shed any light on the mechanism of improvement?

That the abnormal disc has an elevated pressure can be appreciated at discogram. It is postulated that this elevated pressure interferes both with diffusion of nutrients from surrounding vessels into the nucleus and with adequate patching or repair of the torn annulus.

Nachemson's group has emphasized lowering intradiscal pressure for 30 years. (3) & (4) Neurosurgeons Ramos and Martin (5) at operation on a similar decompression table measured in an L4-5 herniated disc a lowering of intradiscal pressure from 30 to 50 mm above the normal 90 to 100 mmHg into the negative range of minus 100 to 150 mmHg during 90 to 95 LB traction. Will such negative pressures heal the annulus, rehydrate the nucleus?

The aim of the present study was to do before and after MRI to correlate clinical improvement with any MRI evidence of disc repair in annulus, nucleus, facet joint or foramen as a result of DRS treatment.

A course of 20 DRS Lumbar De-compression treatments were given in 4 to 5 weeks to 18 patients, and a double course of 40 in 10 weeks to 2 more. Pull of distraction was adjusted to one half-body weight plus 10 lbs. Each session consisted of 20 repetitions in 30 minutes of full distraction for 60seconds and 30 seconds of relaxation to 50 lbs. Distraction angle on pelvic harness was varied from 10% for L5-S I to 20 to 25% for L4-5 herniations and above.

Subjects comprised 12 males and 8 females from age 26 to 74. Radiculopathy in 14 patients was from herniated discs of varying sizes. (L5-S I level in 6, L4-5 in 6, and 1 each at L3-4 and L2-3).

Radiculopathy without disc herniation was present in 6 patients from foraminal stenosis facet arthropathy and lateral spinal stenosis.

EMGs confirmed radiculopathy in all.

MRI's before and after were obtained on high and mid field units.

Clinical status was assessed before, during, and after treatment with standard analog pain rating scale of 0- 10 and neuro exam.

Range of motion for spinal mobility (initially impaired in all), myotoma I weakness reflex and dermatomal sensory loss were tested.

A) MRI OUTCOMES

Disc Herniation: 10 of 14 improved significantly, some globally, some at least local at the site of the nerve root compression. Measured improvement in local or general disc herniation size varied in range of 0% in 2 patients, 20% in 4 patients, 30 to 50% in 4 patients and a remarkable 90 % in 2 patients who had the number of treatments at 40 sessions in 8 weeks. Fig. 1 shows an example of a local left lateral recess disc herniation reduced over 40% completely relieving root compression when the midline portion was a little changed.

Fig. 2 shows on axial view at L5/S1 retraction of a far left lateral herniated disc pulling it away from impingement on the S1 and probably L5 roots with complete relief of radicular signs and symptoms. Mid sagittal components was unchanged. Figs. 3 A & B & Fig. 4 show remarkable effects of 90% global disc reduction, perhaps due to extended course of treatments. Note the unique "empty pouches" left by the persistently bowed-out ligament at L4-5. Also some early rehydration of the degenerated nucleus is shown in Figs. 3, A & B and 4 by T2 and proton signals.

Facet joint arthropathy and foraminal compression cases showed no demonstrable change save 2 cases with slight increase in height but not in hydration.

B) CLINICAL OUTCOMES

Irrespective of MRI status all but 3 patients had very significant pain relief, complete relief of weakness when present, and of immobility and of all numbness (save in 1 patient with herniation and 2 with foraminal stenosis without herniation). With disc herniation, 10 patients of 14 had 10 to 90% improvement in pain and disability. Two had 40 to 50%, one had only 20% with foraminal syndrome without herniation, 4 had 70 to 100 % improvement, one had 40 to 50 %, one with severe spinal stenosis had only 25% and was sent for surgery. Degree of clinical im

Improvement from DRS treatment clinical outcome of radiculopathy whether from disc herniation or foraminal syndromes is more impressive than most improvement shown consistently by MRI, at least with today's techniques and short time of follow-up.

Relief of pain and disability by reduction of disc size is easy to argue in a small majority of this series. A few patients have dramatic anatomic improvement. The others with minimal or no significant MRI improvements are harder to explain. Also, many patients improved very early in treatment, probably before MRI change could be seen.

Nutrient diffusion increase and torn annulus healing resulting from lowering intradiscal pressures are likely causes of clinical improvement when MRI anatomy is not much altered by distraction. Leaking of important sulfates and carboxylates from the nucleus and posterior annulus have been shown in recent studies (6) and (7) lowering of intradiscal pressure by DRS treatment likely can start to reverse these processes by allowing fibroblast repair of the annulus outer layers and some nutrition to the nucleus.

Also penetration of nerves into inner annulus and nucleus of degenerated prolapsed discs has been recently demonstrated and could play a role in pain production. (8) Mechanical intradiscal pressure relief may help this feature as well as giving structural stability.

(1) DRS distraction treatments afforded good or excellent relief of pain and disability whether from herniated disc or foraminal or lateral spinal stenosis.

(2) MRI showed imperfect correlation with degree of clinical improvement but 10 to 90% reduction in disc herniation size could be seen at least at the critical point of nerve root impingement in 10 of 14 patients.

(3) Two patients with extended courses of treatment showed 90% disc reduction and one of these had early rehydration of the degenerated disc at L4-5. An "empty pouch" sign on MRI at the site of previous herniation was seen in these 2 patients.

(4) Foraminal and lateral spinal or facet arthrosis cases causing radiculopathy without herniation also improved but without MRI change.

(5) Annulus healing or patching in the herniated disc can be shown by MRI and is postulated to be a primary factor in clinical and MRI improvement.

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Ultrastructural changes of compressed lumbar ventral nerve roots following decompression. [El-Barrany WG](#), [Hamdy RM](#), [Al-Hayani AA](#), [Jalalah SM](#), [Al-Sayyad MJ](#).

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OBJECTIVE: To study whether there will be a permanent lumbar nerve root scarring or degeneration secondary to continuous compression followed by decompression on the nerve roots, which can account for postlaminectomy leg weakness or back pain. **METHODS:** The study was performed at the Department of Anatomy, Faculty of Medicine, King Abdul-Aziz University, Jeddah, Kingdom of Saudi Arabia during 2003-2005. Twenty-six adult male New Zealand rabbits were used in the present study. The ventral roots of the left fourth lumbar nerve were clamped for 2 weeks then decompression was allowed by removal of the clips. The left ventral roots of the fourth lumbar nerve were excised for electron microscopic study. **RESULTS:** One week after nerve root decompression, the ventral root peripheral to the site of compression showed signs of Wallerian degeneration together with signs of regeneration. Schwann cells and myelinated nerve fibers showed severe degenerative changes. Two weeks after decompression, the endoneurium of the ventral root showed extensive edema with an increase in the regenerating myelinated and unmyelinated nerve fibers, and fibroblasts proliferation. Three weeks after decompression, the endoneurium showed an increase in the regenerating myelinated and unmyelinated nerve fibers with diminution of the endoneurial edema, and number of macrophages and an increase in collagen fibrils. Five and 6 weeks after decompression, the endoneurium showed marked diminution of the edema, macrophages, mast cells and fibroblasts. The endoneurium was filled of myelinated and unmyelinated nerve fibers and collagen fibrils. **CONCLUSION:** Decompression of the compressed roots of a spinal nerve is followed by regeneration of the nerve fibers and nerve recovery without endoneurial scarring.

Interspinous Process Decompression With the X-STOP Device for Lumbar Spinal Stenosis: A 4-Year Follow-Up Study. [Kondrashov DG](#), [Hannibal M](#), [Hsu KY](#), [Zucherman JF](#). St. Mary's Spine Center, One Shrader Street, Suite 450, San Francisco, CA 94117.

X-STOP is the first interspinous process decompression device that was shown to be superior to nonoperative therapy in patients with neurogenic intermittent claudication secondary to spinal stenosis in the multicenter randomized study at 1 and 2 years. We present 4-year follow-up data on the X-STOP patients. Patient records were screened to identify potentially eligible subjects who underwent X-STOP implantation as part of the FDA clinical trial. The inclusion criteria for the trial were age of at least 50 years, leg, buttock, or groin pain with or without back pain relieved during flexion, being able to walk at least 50 feet and sit for at least 50 minutes. The exclusion criteria were fixed motor deficit, cauda equina syndrome, previous lumbar surgery or spondylolisthesis greater than grade I at the affected level. Eighteen X-STOP subjects participated in the study. The average follow-up was 51 months and the average age was 67 years. Twelve patients had the X-STOP implanted at either L3-4 or L4-5 levels. Six patients had the X-STOP implanted at both L3-4 and L4-5 levels. Six patients had a grade I spondylolisthesis. The mean preoperative Oswestry score was 45. The mean postoperative Oswestry score was 15. The mean improvement score was 29. Using a 15-point improvement from baseline Oswestry Disability Index score as a success criterion, 14 out of 18 patients (78%) had successful outcomes. Our results have demonstrated that the success rate in the X-STOP interspinous process decompression group was 78% at an average of 4.2 years postoperatively and are consistent with 2-year results reported by Zucherman et al previously and those reported by Lee et al. Our results suggest that intermediate-term outcomes of X-STOP surgery are stable over time as measured by the Oswestry Disability Index.

Vertebral Axial Decompression Therapy For Pain Associated With Herniated Or Degenerated Discs Or Facet Syndrome: An Outcome Study.

The Effects Of Vertebral Axial Decompression On Sensory Nerve Dysfunction In Patients With Low Back Pain And Radiculopathy.

Canadian Journal of Clinical Medicine (pressure to a negative 150Mm Hg., allowing
Effects Of Vertebral Axial Decompression On Intradiscal Pressure.

- Journal of Neurosurgery

Vax-D stands for **V**ertebral **A**xial **D**ecompression. It is a non-invasive treatment for patients suffering from the painful and disabling effects of bulging discs, herniated discs and degenerative disc disease. Vax-D is designed to relieve pressure on structures that cause low back pain. Vax-D is safe and effective without any of the risks associated with surgery, anesthesia, injections or drugs.

The Vax-D unit creates a vacuum affect in the disc.

This accomplishes 3 tasks:

- draws the jelly nucleus back to its proper place
- repair of the fibrous outer layer
- bringing nutrients to the disc to allow it to rehydrate

CBS news estimated that out of 500,000 spinal surgeries performed each year in the United States, over 80,000 are unnecessary.

Spinal surgery ranks 3rd among all surgical procedures, yet statistics show the majority to be less than 31% successful.

**50 ADDITIONAL DECOMPRESSION RESEARCH ARTICLES
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