Decompression: A Non-Surgical Approach to Low Back and Neck Pain

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Introduction

Low back and neck pain constitute a large medical problem in many countries. In the United States alone, low back pain has been reported cost 50 to 100 billion dollars per year (Frymoyer & Cats-Baril, 1991). Cervical pain, although not as high an incidence creates a great deal of disability, with cervical myelopathy being the number one cause of neck pain in older adults. Early intervention may provide added benefit and improvement to such conditions (Wand et al 2004).

Cyriax (1984) is often quoted for earlier descriptions and benefits to spinal traction. However, prior to Cyriax, E.J. Scrip (Scrip, 1955) describes the influence of spinal traction on backache and lumbar disc herniations and the potential clinical effectiveness. The last several decades have provided us with a great deal of information, including the specific effects on the spine. We continue to see more outcomes based research, enhancing the protocols that were once archaic, simply because of the devices we were using, including our hands. In the 1990's, traction has also taken on a different role in non-surgical management of disc herniations, referred to decompression. This is not to take the place of the surgical definition, however to imply simply an unloading of the biomechanical, physiological, and day to day compressive forces the human spine encounters. Since then, we now know that there are many different components to spinal pain and continue to develop more appropriate interventions, spinal traction being one of them.

Biomechanical, Physiological and Patient Outcomes

Although the biomechanical and physiological outcomes are well established in the literature, this brief discussion will also provide and introduction for further sections. There have been investigations on internal disc pressure, separation and positioning of the vertebrae, including decompressing the component and relieving nerve root pressure, cross section, myoeletric activity, and hemodynamics of muscle tissue, and autonomic nervous response.

Although internal disc pressures and pain have been studied for decades, we will focus on the outcome of such a response, retraction of the nuclear material subsequent herniation. This has been accomplished successfully in both the cervical and lumbar spine, in both single and multiple levels (Chung et al 2002; Sari et al 2005). In the lumbar spine, Sari et al (2005) determined that static traction resulted in significant increases of both the central and lateral canals. This was a result of decreased encroachment of disc herniations, at multiple levels and retraction of soft tissue, also referred to as non-surgical decompression. It is also interesting to note that there was a decrease in the cross sectional area of the psoas major muscle. Despite patient being positioned supine with iliofemoral flexion which shortens, even the small degree of motion by applying separation forces in the spine resulted in significant changes. It is not completely clear what clinical significance this may have, but as there is soft tissue attachment to the intervertebral discs, there may be some influence and certain reason for continued investigation. Although there were significant changes in the distance of posterior elements, there were no significant change in the anterior vertebral body heights, likely a result of the "hook-lying position."

Chung et al (2002) investigated the acute in vivo effects of traction on the cervical, also indicating retraction of disc herniations at multiple levels. In addition, it was also shown to reduce to motor neuron excitability in cervical paraspinals, indicating a reduction in hypertonicity, which is not shown in asymptomatic subjects (Proulx & Gallo, 2009). Electromyography (EMG) is variable in the literature with symptomatic patients, unless indicating patients respond different to the same condition and traction will likely influence resting EMG unless elevated prior to treatment. Chung also showed an increase in blood flow to these muscles, further indicating a reduction in muscle hypertonicity, another potential cause of pain.

Other immediate outcomes reported include improvement of performance (Joghataei et al 2004). Patients receiving cervical traction in addition to the conventional therapy have improvements at 5 visits over conventional alone, however at 10 visits, they were the same. It is likely that patients experienced a further enhancement allowing them to progress more rapidly, which may indicate shorted treatment times in the long term, potentially a cost saving event for patients and heathcare. In addition, improving patient outcomes earlier may also improve disability through several mechanisms.

Although not normally consider an effect of a mechanical treatment, it may be possible to reduce sympathetic nervous system response. Proulx and Gallo (2009) studied the effect of lumbar traction on certain biomechanical parameters, but also include resting heart rate and blood pressure in asymptomatic subjects. All biomechanical mechanical parameter for lower extremity reduction in motor neuron excitability were significantly lower. Average resting heart rates following traction were also significant, with a trend in lowering systolic blood pressure. The clinical efficacy needs further research, however, there appear to be some indication of change.

In a large prospective case studies cohort, Gose (1995) evaluated the effective on chronic low back pain of 778 cases. Large cohort case studies using similar procedures
a total of 778 cases. Average time between initial onset of symptoms and treatment was 40 months, with 83% were 4 months or greater. The treatment was successful in 71% of the 778 cases, when success was defined as a reduction in pain to 0 or 1, on a 0 to 5 scale, also mobility and ADLs were correlated with pain reduction. In a progressive lumbar traction prospective case series, Beattie at al (1998) evaluated 276 patients in an
8-week course of prone lumbar traction There was significant improvement at the 8 month follow-up, supporting the long term effects. In addition to traction and decompression as a stand-alone therapy for patient outcomes, there is a growing trend to the positive events when combined with complimentary therapies (Cleland et al, 2005; Forbush et al 2011).

Treatment Options

The majority of meta-analyses on spinal traction report conflicting results. The consistent problem is the lack of randomized control studies, to indicate a high level of evidence for a specific outcome. This also includes consistency in treatment and control parameters, such as patient position, intensity and angle of pulling moment, and duration and frequency of treatments. We will attempt to provide some information and rationale to the variation in these parameters as it may provide greater guidance to understanding clinical treatment efficacy, although specific treatment protocols are beyond the scope of this review.

Keeping mind the relative differences in the spinal column, such as structure orientation, size of vertebrae, and thickness of tissue and muscles, there should be some clinical consideration for treating the cervical versus lumbar spine, however protocols are very similar with respect to treatment duration and frequency.

Patient Position and Moment of Pull Angle
Due to the amount of quantitative information, patient position and traction moments on the spine have produced a large amount of information regarding biomechanical outcomes. We can further use this information to assistant the clinical decision process in determining appropriate positions for the application of traction in the diversity of conditions that present themselves in the clinic. It also provides the clinician with opportunities to create protocols that meet the needs of a clinic setting. Therefore, we will spend more time on this area of discussion.

In lumbar traction, there is no clear evidence in the research for patient position to be more advantageous in prone or supine, it is typically the preference by the clinician and patient comfort. Many clinicians will use the similar process to determine if the patient receives flexion or extension exercises, based on bias or ability by the patient. However, there may be some rationale for choosing one position in place of the other, keeping in mind that the literature on general outcomes, including pain and disability scores, both positions have been shown to be successful. Also, to maintain consistency (homogeneity) or limitations to devices used in research that only provide one position, are other reasons for the positions chosen. Cervical traction is typically performed in the supine or seated position, again with some varied results in determining the most advantageous position.

Electrical activity or relaxation of musculature is thought to be required when attempting to create separation in vertebral structures. Weatherell (1987) compared lumbar muscle activity of normal subjects in both supine and prone positions. They determined that prone created a greater decrease in activity. I find that unusual because they should not have increased myoelectrical activity when in resting position from the beginning, especially without a spinal condition. The authors also evaluated the effect of supine position on paraspinal muscle activity did not measure any change in muscle activation following static treatment (Proulx & Gallo, 2009). Letchumen and Deusinger (1993) measured activity in patients with low back pain and determined there was no difference in position or during treatment. In fact, they also evaluated static and intermittent and determined the electrical activity in paraspinals is very inconsistent. This is also why EMG (electromyography) initiated traction never really became a popular method of treatment. The conclusion is that position has no basis for paraspinal muscle activity and should not be the consideration for treatment. Also, higher intensity traction forces actually increase muscle tension, which could be mistaken for muscle contraction in EMG analysis.

The supine position for lumbar traction allows for greater changes to structure separation and hip position, affecting psoas major. Sari et al. (2005) determined that traction in this position not only creates significant separation of poster elements, but increases the diameter of the lateral canal and soft tissue encroachment to the central canal, beyond the initial position. This also showed to create a lengthening of the psoas major. Lying in this position, sometimes referred to as the "hook lying" position, creates posterior element/vertebrae separation and muscle lengthening even before treatment is rendered. This position may be pain relieving for some patients, due to this. However, Sari et al. determined that there was no significant separation of anterior vertebral bodies. This has also been shown in the cervical spine for supine compared to seated (Fater & Kernozek, 2008). It is therefore concluded that the supine position is effective and indicated when attempting to create separation of posterior elements, lengthening of soft tissues in the posterior, and opening of lateral canal. Similar to the prone position, has been shown to create negative intradiscal pressure and retract a herniated nucleus. Also similar to prone lumbar traction, the position can allow for straight leg, or minimized hip flexion and can maintain the lordotic curve in the spine, although it is likely more comfortable in the prone position. This position actually allows for greater variation in angle of pull, which will be further discussed. In the cervical spine, supine may allow for decreased intensity, due to the unweighting of gravity, as well as a more comfortable position for relaxation of postural control muscles.

The prone position can create both an extension moment (increased or maintained lordosis) or a slightly flexed position. Although flexion may be more comfortable to perform in supine, clinicians may choose prone to put the patient into an extended position, which can have significant influence on facet joint mobility (due to beginning in the extended position). There is also contention there are applications to the form and force closure mechanism, however this is also unsubstantiated in the use of spinal traction. Because of its neutral position, this may create greater separation of anterior vertebral bodies, which can be considered an indication.

With pulley device systems, the tension cable is attached to the patient and not a table, therefore we have the option of changing the angle of pull. Most of the literature on angle of pull has been done on the cervical spine, as it is easier to produce. However, lumbar traction delivered to specific segment has been evaluated in the supine position by changing hip (iliofemoral) angle. Reilly at al. (1979) found the posterior separation increased as hip angle increased, at 0, 45, and 90 degrees, with most of the changes occurring at L4/L5/S1. The relative importance of this, I think, lies in the fact the hip flexion should be induced when attempting to create vertebral separation. Regev at al. (2011) and Yoshio et al. (2002) studied the psoas in vivo and cadevaric, respectively for passive and active influence on lumbar spine (and hip). It has been shown to have similar characteristics of the lumbar erector spinae in stability and is also therefore influenced by passive length. Due to its attachment along the lumbar vertebrae and intervertebral discs, this should be a consideration. This is very similar to the action on the cervical spine as well, where the position of the spine is the predominant influence.

Static versus Intermittent
Static traction is defined as a constant axial tension on the spine with a constant tension where as intermittent is variable, with at least two different intensities applying tension during a "treatment" time (high intensity) and a "release" time (low intensity), cycled throughout the treatment. Furthermore, intermittent traction can be applied with many different options in the sequencing, for example 60 second high intensity with a 30 second low intensity or even as low as zero seconds at each stage with certain devices.

When evaluating the in vivo effects of spinal traction on the majority of anatomical structures under imaging studies, this is typically conducted with static traction, as movement would create unclear pictures (Chung et al 2002, Sari et al 2005). There is a great deal of evidence of the acute effects of static traction on these structures, as previously discussed and may provide indication for utilizing static traction. This includes plastic deformation of tissue to create a "creep" effect in more permanent changes to soft tissue structures, for example increasing intervertebral body and posterior element separation. Although changes in motor neuron excitability is also induced with intermittent, there may be added benefit of static traction during acute phases at lower intensities without the necessity of motion, similar to traction used in emergency medicine procedures of spinal extremity conditions.

As previously discussed, intermittent may provide may similar results as static traction, including reducing disc hernations, nerve compression, motor neuron excitability, and improved function (Browder et al 2004, Letchuman & Deusinger, 1993, Nanno 1994). This may provide an option that could be more comfortable to patients at higher intensities, over a given treatment time. Also, with improvements in device technology, it is possible to deliver manual therapy-like treatments than are performed on the extremities, as in Maitland's Mobilization Classification.

Intensity
Specific applied forces with significant biomechanical effects to human lumbar spines range from 9kg to 45kg (Twomey, 1985,) Although 9kg created significant increases in spinal stature, these were cadaveric spine specimens with no muscle activation that could cause resistance to treatment. Mezaros et al, (2000) reported the use of percentages (10, 40, 60) of body weight in patients with a positive straight leg raise (SLR) for radiculopathy. All percentages increase range of motion prior to eliciting a positive SLR, however 40 and 60 percent were significant.

With today's newer technology, especially when considering patient comfort, lower intensities then previously mentioned may provide improved outcomes. This also includes the development of split table designs that use a lower coefficient of friction to create axial distraction, as well as variable angles in moment of pull, further reducing the effect of the patient's body mass in the horizontal plane, the direction of axial distraction when a patient is lying down on a table. As a result, it is more possible to obviate body mass in treatment protocols (and hopefully research variation) and derive more standardization. To induce reductions in muscle activation, such as a reduction in muscle spasm, intensities as low as 10-14kg may be applied. To create separation in vertebral elements, keep in mind certain positions induce a positive change even prior to the application of an axial force and therefore intensities to begin motion may range from 18kg to 23kg.

In the cervical spine, the applied intensity tends to deal less with body mass and more with standard forces, although as low as 2.73kg based on body mass has been reported on the cervical spine (Klaber Moffett & Hughes, 1990). Although Cyriax's (1984) recommendation in the cervical spine is as high as 136.4kg for manual traction, this is rarely reported in the research, although may provide some insight to the relative strength of the spine in traction and indicate a low likelihood of injury.

As with the lumbar spine, cervical spine neurological decreases require less intensity than biomechanical, beginning at 3kg and 5kg, respectively.

Treatment Duration and Frequency

Typical treatment times for spinal traction range from 5-30 minutes (Beattie et al 2008, Meszaros et al 2000). In cadavers, Twomey (1985) reported the separation of vertebrae to occure immediately after the application of force, however as previously pointed out, there is no muscle activation in these specimens. The decision to use intermittent versus static may also influence the amount of time required for treatment. When using intermittent to make more permanent changes, the cycle time increases treatment times as there is a rest between "treatment" cycles, hence the need to 30 minutes total treatment time. Static however, may only require as little as 5-6 minutes treatment during the acute phase to reach complete muscle relaxation and induce a elongated decrease in motor neuron excitability. In higher intensity static treatments to create plastic deformation, typically 3 minutes may be required for muscle relaxation to reach soft tissue deformation, followed by and additional 4-6 minutes to maximize the stress-strain relationship.

As patients often feel immediate relief of signs and symptoms, there is a large variability in both frequency and total number of treatments. Gose et al. (1998) reported treatment totals as low as six and higher than 15. From a clinical perspective, this at least provides us with some insight as to how diverse the patient response may be and require the clinical reasoning to be applied in order to determine the exact number of total treatments. This decision making process is further enhanced with performance based outcomes measures, reducing the subjectivity of such reason. Unfortunately treatment frequency is as variable as other parameters, however has been shown to be effective in less than one treatment per week. However, this is less likely with patient that required more continuous treatments to make permanent tissue changes and if clinician make the assumption this is very similar to other mobilization and stretching protocols, based on evidence, it will likely require 3-5 treatments per week.

Conclusion and Future Directions

We are some new potential uses, such treatment in idiopathic and adult scoliosis, resetting of motor control dysfunction following injury, reducing motor neuron excitability in extremities, and affecting the autonomic nervous system. There continue to be advancements in classifying patients that will respond positively from such treatment, at least for specific conditions, as well as advancements in technology that provide traction as a greater platform to provide varying levels of traction.

Although complete guidelines are not established, there are several references which to draw some clinical conclusions. There are many positive aspects of traction and decompression therapy, and despite the disagreement on complete efficacy in review studies clinicians continue to utilize such a procedure, possibly based on “practice-based” evidence. After being around for some 3,000, it likely will not go away and as we improve technology and research, we will only further establish its place in physical medicine and rehabilitation.

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