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Autotraction Treatment for Low-Back Pain Syndromes

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ABSTRACT: Autotraction (AT) is a form of exercise for low back pain. The patient lies on a specially designed bench with the pelvis anchored and while grasping an overhead bar, pulls him or herself. The patient should not feel any pain. To ensure painless pulling efforts during treatment, the table allows three-dimensional adjustments to the alignment of the patient's trunk. Although the method was originally designed for patients with acute pain, it has been found that 3–6 half-hr outpatient sessions provide relief from pain in 50–60% of patients with long-lasting low back pain with or without sciatic nerve involvement. This includes patients with verified lumbar disc herniation and those who have been refractory to previous conservative or surgical treatments. The aim of passive forms of traction and of conventional exercise regimens is to decrease intervertebral disk pressure; in contrast, studies have demonstrated that autotraction is associated with sharp rises in intervertebral disc pressure. This mechanism of action still needs to be verified. It has been suggested that relief of pain with autotraction may be due to favorable microscopic changes at the disc-nerve interface or to decongestion of engorged epidural veins.

KEY WORDS: autotraction, low back pain, disc herniation, exercise

I. INTRODUCTION

In 1974 a Swedish physician, Gertrud Lind, published a doctoral dissertation[1] concerning a curious mechanical treatment of low back pain. The patient, while lying on a specially designed traction bench, had to "pull himself" as he grasped an overhead bar. Hence the name autotraction (AT). The pulling efforts lasted 3–6 sec.

During pulling efforts, or at rest periods, the therapist operated the mechanical table to tilt and rotate the two movable sections, thus providing careful three-dimensional mobilization of the spine. Lind conducted three uncontrolled studies involving more than 1,000 patients with back or lumbosacral root pain. Some had lumbar disc herniations. The reported results were that within a few 1-hr outpatient sessions, most of the subjects improved. In some cases the myelograms were reported as showing reduction of the prolapsed disc. Despite such a promising beginning, AT has not gained popularity outside of the Scandinavian countries.

Two studies designed to test the effectiveness of AT versus passive traction for lumbar disc herniation were published by the first author.[2,3] The results of using AT were that patients with chronic back pain syndromes associated with lumbar disc herniation experienced a 50–60% success rate in only 3–6 outpatient sessions. AT presents an intriguing paradox. The pulling maneuvers are effective even though there is an associated rise in the intradiscal pressure. This is in conflict with the dominant model, which ascribes low back pain to a mechanical irritation between the disc or bony prominences on one side and nerve endings on the other. Since AT has been shown to be effective, this should foster research

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into new pathophysiologic models from which rationale for treatments might be refined.

II. AUTOTRACTION

Figure 1 presents the autotraction harness and related maneuvers. The patient lies on a mechanical traction bench that has two transverse divisions, which can be tilted and rotated independently of each other. Special frames at the head and foot ends of the bench allow the patient to pull him or herself with the upper limbs while pulling or pushing with the lower limbs. The pelvis is secured to the foot end of the bench through a belt and chain in series with a spring dynamometer. The bench is inclined so that the chain is under mild tension (about 10–20% of body weight) even when the patient is relaxed.

The treatment begins with the patient lying supine. By adjusting the sections of the bench by trial and error, the therapist adjusts to the position associated with the least pain to the patient. From that optimal position, the patient is requested to pull maximally for 3–6 sec and is instructed gradually to relax and then rest for 30–60 sec. This basic maneuver can be modified to provide variations to widen the range of painfree positions. For example, the lower limbs either can be flexed, extended, relaxed, or actively pushing against the bench frame. Also, the patient can be placed in side or prone positions, and the whole bench can be inclined horizontally or vertically. Further details are in the instruction manual.[4]

Either during pulling or rest periods, the therapist gradually explores the ranges of motion toward more painful positions. The goal is to increase motion without exacerbating pain. The maneuvers entail tilting or rotating the sections of the table at about 5° per sec, no more than 45 times. A session lasts 30–60 min. Three sessions are usually performed over a 5–9-day period. If the patient reports an overall feeling of improvement, 3–6 more sessions are performed, after which no aftercare is required. If, at any time, the patient worsens, the treatment is discontinued.

This simple technique and a bench equipped with an electrohydraulic motor system were described in 1984 by Emil Natchev,[4] a pupil of Gertrud Lind. These were substantial improvements over the original version. Lind had designed a manually driven bench. After treatment, she customarily prescribed a corset and prolonged bed rest. Natchev wrote an exhaustive manual and currently runs 2–5-day training courses. Since attending a course in August 1984, the first author has treated about 1,100 outpatients using this technique. For most patients, pain had lasted for over 1 month (median about 8 months) and had been refractory to previous conservative or surgical approaches. Commonly, there were CT, MRI, or myelographic findings of lumbar disc protrusion or spinal stenosis that were consistent with the pain syndromes. On the basis of this experience,

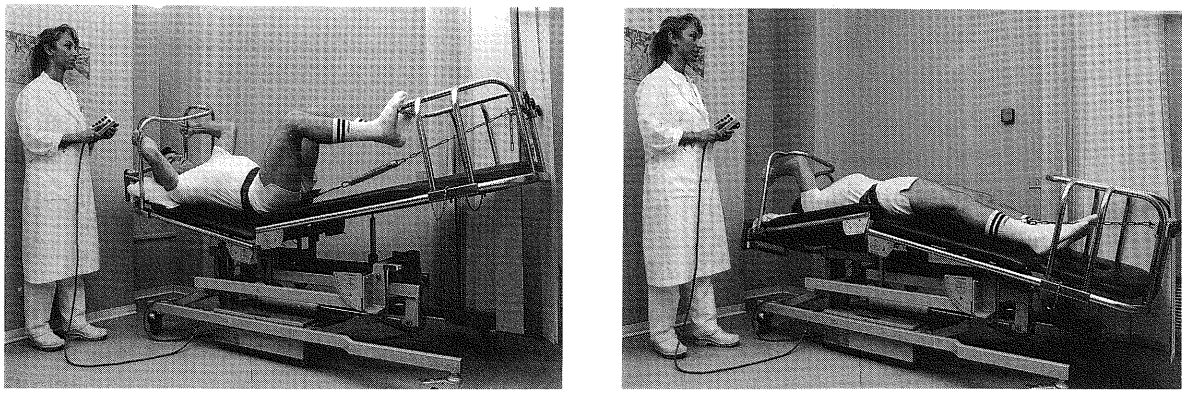

FIGURE 1. Autotraction treatment for low back pain. The patient lies on an automatically driven bench, which allows three-dimensional mobilization of the spine. He or she provides traction forces by pulling maximally for 3–6 sec with the upper limbs, then rests for 30–60 sec. The treatment begins in the least painful position. In three 40-minute sessions the patient is able to pull painlessly in the formerly troublesome positions (from Tesio L., 1993, with permission).

the first author gradually simplified Natchev's technique, using only a few of the maneuvers described in his manual. For example, the models for Natchev's manual were patients with acute pain for whom more complex positioning may be indicated. However, it appeared that patients with long-standing pain benefited less by various positions but could still respond to the treatment. In the case of long-standing pain, the treatment usually begins from the supine position with the hips and the lumbar spine flexed (Figure 1, left). As AT treatment continues, the patient is moved toward extreme extension (Figure 1, right) or is rotated or bent to the side. With this simplified routine, physical therapists can learn the basics of AT treatment in one day of intensive training.

III. INDICATIONS AND CONTRAINDICATIONS

AT is indicated for mechanical low-back pain syndromes, both acute and chronic, including those associated with lumbar disc herniation or spinal stenosis. Pain related to surgical sequelae, such as recurrent herniations or epidural scars, is also an indication. Pain must be modifiable by patient activities or positioning to anticipate a favorable response. In fact, pain or its relief in response to changes in position are clues to the maneuvers for successive treatment sessions and are indications for continuing sessions after the first three. It must be emphasized that AT is a form of active exercise, which involves strong isometric pulling and Valsalva-like maneuvers. Thus cardiovascular insufficiencies are potential and relative contraindications that should be considered by the prescribing physician. This is also true for the presence of abdominal herniations and prolapses, which might be aggravated by Valsalva-like maneuvers. Pregnancy was considered by Natchev as an absolute contraindication for AT. However, a properly modified technique, detailed later, can be safe and effective for the pregnant woman suffering from low back pain.

IV. RESULTS

A search of the literature reveals 13 published studies on the effectiveness of AT for low-back pain syndromes.[1–3,5–14] Some of these studies were designed to investigate the mechanism of action of AT, so that the entry criteria were loose and comparison groups were absent,[6–10] rendering the data on effectiveness unconvincing. Three more studies were reported in Lind's thesis, but the subjects were heterogeneous. For example, the sample sizes ranged from 41 to 1,023 subjects, and the success rate ranged from 25% to 90%.

Of the 13 studies, only three were both prospectively randomized and controlled. The first of these[11] was a well-designed multicenter investigation of back pain patients studied with conventional X-rays only. Forty-one subjects were treated with three AT sessions over a 1-week period, whereas another 41 were treated with standard lumbar corsets. Immediately after treatment and at 3-month follow-up, AT was significantly more effective than the standard treatment with 42% vs. 4% classified as responders.

In the second study,[12] patients had lumbar disc herniation verified by myelography. Twenty-six were treated with AT and 23 in the control group were treated with a special form of manual traction designed by the author of the trial. The two forms of treatment provided superimposable results. The response rate was 25% in both groups and remained stable at a 2-week follow-up.

In the third study,[3] 44 patients were enrolled. They had back or lumbar root-related pain that was unremitting for a median duration of 11 months and CT or MRI findings consistent with 1–3 lumbar disc protrusions. Previous conservative treatments were unsuccessful. Twenty-two patients were randomly assigned to either of three sessions of AT or five sessions of conventional passive traction (PT). The subjects who reported feeling improved (responders) received another cycle of treatment, whereas the nonresponders were crossed over to the other treatment modality. This design provided 40 and 27 patients having experienced AT and PT, respectively. The response rate just after completion of treatment was significantly different: 75% after AT vs. 22% (a placebo-expected rate) after PT. Figure 2 shows that the scores for both intensity and qualitative severity of pain (visual analog scale and McGill Pain Questionnaire, short form, left and center graph, respectively) decreased by one-half.

At a 3-month follow-up, 19 out of the 30 (63%) responders to AT remained improved. In-

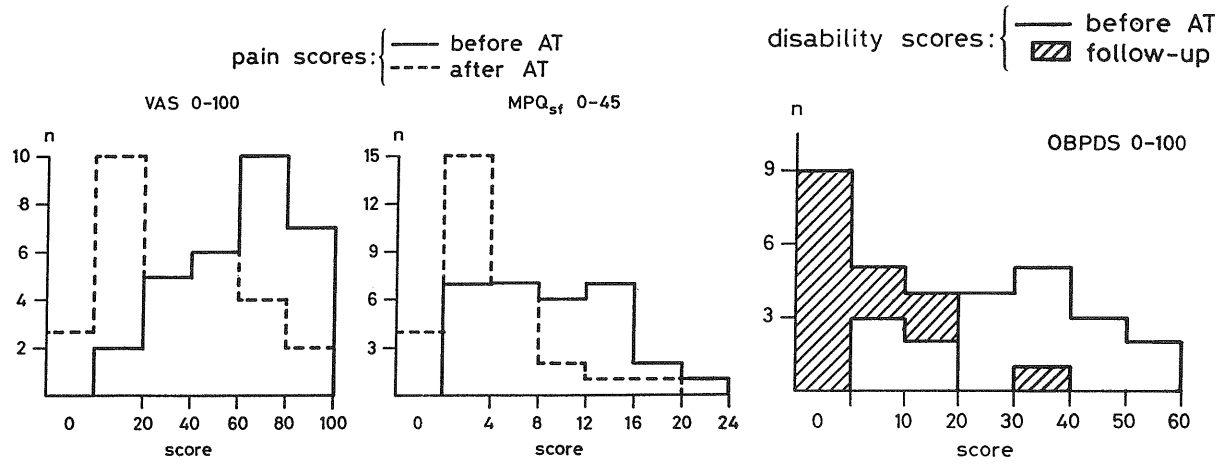

FIGURE 2. Frequency distribution of pain scores recorded after autotraction treatment. The graphs refer to 30 of 40 patients who responded to autotraction. They were all suffering from chronic pain (median 11 months) consistent with the finding of one or more lumbar disc herniations. The left and center graphs refer, respectively, to the peak intensity (visual analog scale) and to the qualitative severity of pain (McGill Pain Questionnaire, short-form, which rates on a 0–3 level the severity of 15 pain descriptors). Continuous and dashed lines refer to scores recorded before and after AT, respectively. The right graph gives the scores of back-related disability (Oswestry Low Back Pain Disability Questionnaire, which rates on a 0–5 level 10 items in the domain of pain behavior, disability, and social interaction). The scores were recorded before treatment (blank area) and at a 3-month follow-up (dashed area). Pain scores had not changed since after treatment (not shown) (modified from Tesio L., 1993, with permission).

terestingly, the median value of the scores on the back-related scale of disability (Oswestry Low Back Pain Disability Scale) were decreased to zero (Figure 2, right graph). These results validated the findings of a previous, partly controlled work.[2] In that study, 77 patients were enrolled, all of them with unremitting low-back pain syndromes plus one or more verified lumbar disc prolapses (Figure 3). Subjects served as their own controls. All had undergone conservative treatment without success. Of the subjects, 47% responded favorably at completion of the treatment and the intensity of pain had dropped by 73%. In 78% of responders, the improvement persisted at the 6-month follow-up.

In both of these studies, neither the number, size and position of the disc prolapses (Figure 3) nor the severity of pain and/or neurological deficits were individually predictive of the outcome. This negative finding may have been due to the small sample size. Thus we lack factors that are predictive of a patient's response. Response may depend upon anatomic or physiologic factors that presently cannot be detected, i.e., the compliance of the disc protrusions or of the epidural venous bed (see below). From a practical clinical standpoint, three simple outpatient sessions may suffice to identify the responders.

V. MECHANISM OF ACTION

Lind believed that AT was simply a safer and more accurate version of the conventional passive pelvic traction (PT). It soon became clear that AT is very different from PT when an *in vivo* study was performed by inserting a needle pressure gauge into the third lumbar disc of healthy volunteers.[15] During AT, the intradiscal pressure increased sharply up to five times with respect to the baseline recorded at rest. This should not have been surprising if one took into account the strong contractions of the paraspinal muscles that are concurrent with using the upper limbs to pull on the bar.

The discal pressure decreases at the end of a half-hr of PT treatment. PT is in keeping with the traditional and established treatment and prevention strategies for back pain, which recommend unloading the lumbar disc. Thus, from the very beginning the mechanism of AT conflicted with the accepted rationale for treating back pain related to disc disease.

It was hypothesized[10] that compression of the disc with the AT maneuvers might favorably remodel the disc-nerve interface. In her thesis,[1] Lind reported that in three successful cases studied with myelography, the disc protrusion regressed either during or after AT maneuvers. Four successive studies failed to support her claims. In one of them,[9] the CT equipment was modified to allow the AT bench to enter the gantry. It was shown that the profile of the disc protrusion did not change appreciably during AT maneuvers.

Changes in the disc after AT could not be demonstrated either by CT[13] or myelography[8] despite marked favorable response from patients. However, Knutsson[10] reported neurophysiological changes in a thorough investigation of patients with back pain syndromes, including those with pain radiating to the lower limb. It was shown that after successful AT, the amplitude of the somatosensory evoked potentials, the strength of the foot and the skin temperature of the affected limb recovered to normal values on the painful side. These coincided with patients' subjective reports. Gillström reported similar findings.[7] Nearly all of the published studies, including those of the first author, report that normalization of the Lasegue's sign, return of strength of the extensor of the big toe, and resolution of sensory deficits accompany relief of pain.

Thus if one allows that AT works for some patients, then, how does it work? Favorable changes at the disc-nerve interface is an attractive mechanism. Venous engorgement and inflammation within the narrow and rigid spinal canal have been invoked by the first author as possible causes of back pain, based on clinical, bioexperimental, and epidemiological grounds (for an overview, see reference 16). Current radiologic techniques cannot detect microscopic changes of the disc profile, which could be sufficient to decompress nerve endings.[10] AT allows for careful positioning of the spine so that the patient may painlessly

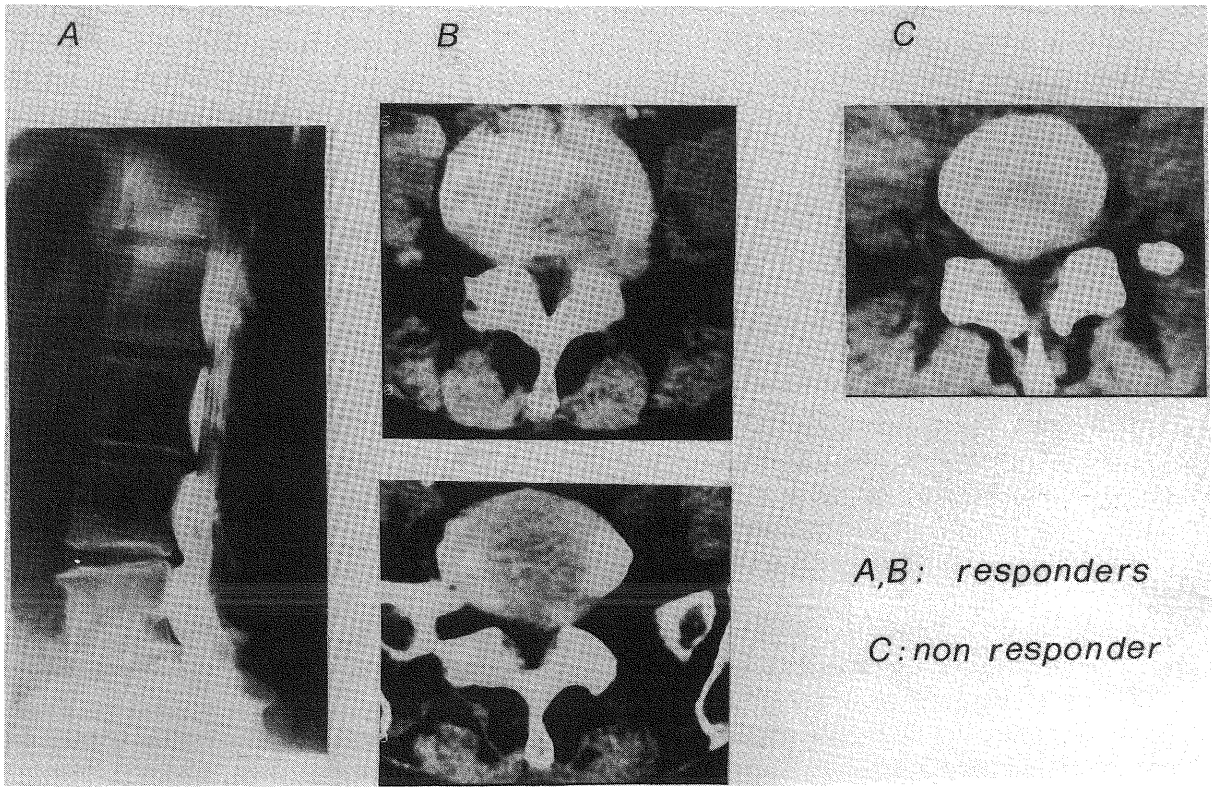

FIGURE 3. The severity of the radiological picture was not predictive of the outcome after autotraction treatment for low back pain. Subjects **A** and **B** were responders, whereas **C** was not. In A, the myelogram shows a prolapse of the first to fourth lumbar discs; in B, the CT scans show left intraforaminal herniation of the fourth lumbar disc plus spinal stenosis (upper scan), and left mediolateral prolapse of the fifth disc (lower scan). In C, the CT scan shows a mild left mediolateral protrusion of the fourth lumbar disc (from Tesio L., 1989, with permission).

perform strong contractions of the paraspinal muscles. The first author has suggested that such contractions may favor drainage of congested epidural veins.[16,17] The hypothesis is also supported by the finding that diathermy, presumably leading to venous engorgement, may occasionally exacerbate pain.[18] Decongestion of epidural veins might underlie the effectiveness of AT in nondiscal syndromes such as in patients without disc herniation but with spinal stenosis or epidural scars, and even in those with fully normal radiological findings. In such cases, the success rate of AT is nearly the same as that reported for discal syndromes (about 50–60%).

The fact that favorable results after AT may last for a year or longer is even more puzzling. With respect to disc herniations, it has been demonstrated that they can resorb over the long run.[19] Hence, if venous congestion and inflammation are the causes of low back pain, perhaps decongestion may facilitate long-lasting normalization of venous outflow. Thus, effectiveness of AT seems to be more easily demonstrated than its mechanisms of action; this, of course, is true for many other effective treatments.

VI. AUTOTRACTION AS A TOOL FOR BACK PAIN RESEARCH: MODEL OF PREGNANCY

The incidence of back pain is increased by pregnancy;[20] the prevalence of disc herniation is not increased.[21] The theory that ligamentous laxity is the main cause of disc herniation has recently been challenged on biomechanical grounds.[22] Often back pain in pregnancy has clearcut root features and is aggravated by bed rest. Both of these features argue against a purely mechanical origin of pain. Venous congestion — a physiologic correlate of pregnancy — has been argued for.[16] Treatment, however, remains a major challenge. In a pilot study involving pregnant women,[14] the first author modified the AT technique slightly. The pelvic belt was removed. The patient had to use the dorsal aspects of her feet to anchor herself to the bar at the foot of the bench. The supine position was adopted. Three autotrac-tion treatments, 20 min each, were performed on 16 women between the 13th and the 26th week of pregnancy. They all had enduring, unremitting back pain with or without sciatic pain, for over 4 weeks. In three patients, the abdominal and paraspinal muscles were monitored with surface EMG.

During AT efforts, the level of activation of the muscles of the trunk was comparable to levels recorded during trivial Valsalva maneuvers and during brief bouts of coughing. No side effects were reported. This suggested that the increases in abdominal pressure did not constitute a risk. In 13 out of the 16 patients, pain decreased significantly after three sessions both in intensity and severity (Figure 4). The deliveries were normal, and the babies were healthy. In follow-ups, 1 month after delivery, improvement had been maintained in the 13 mothers. This study was not controlled and the findings should be considered as preliminary. More interestingly, AT might be a tool for exploring the theory of venous congestion as a mechanism for low back pain. The model of pregnancy might be carried over to other low-back pain syndromes. In the case of pregnancy, we have good reason to support the hypotheses that (1) epidural venous insufficiency may underlie back pain and that (2) venous drainage may be a mechanism of action of AT.

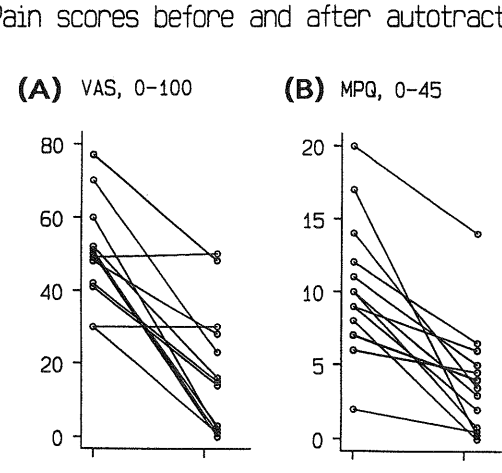

FIGURE 4. Pain scores recorded in 13 of 16 pregnant women suffering from unremitting back pain before (left column in each graph) and after (right column) three sessions of modified autotraction. Graph A and B refer to peak pain intensity (visual analog scale) and qualitative severity (McGill Pain Questionnaire-short form), respectively. Results were steady at follow-up, 1 month after the delivery (from Tesio L., 1994, with permission).

VII. MECHANICAL TREATMENTS FOR BACK PAIN: IS THERE A PLACE FOR AT?

A. Is it a Form of Traction?

Unfortunately, the name "autotraction" is misleading. In fact, it suggests a strong analogy with conventional passive pelvic traction (PT). Indeed, the AT harness (the bench, pelvic belt, and chain) and the pulling efforts exerted by the patient at first glance resemble the procedures of passive traction. It is not surprising that this misconception, originally performed by the originator herself, still persists.[23]

PT has been adopted worldwide for centuries. Does it have a stronger rationale than AT? The strongest modern rationale underlying PT is the finding, confirmed by X-ray, myelographic,[24] and CT studies,[25] that PT can enlarge the lumbar intervertebral disc spaces and "suck back," at least partly, a nonextruded prolapsed disc. Unfortunately, the transient reduction of a prolapse does not in itself prove clinical efficacy over the long run. A classic text contains the statement that "... there is a paucity of hard data about the therapeutic value of traction."[24]

PT is a passive procedure aimed at increasing the invertebral disc space, thus decreasing intervertebral pressure. By contrast, AT is an active procedure causing intermittent sharp increases in intervertebral pressure. The argument that AT and PT are not similar is supported by the report that compared AT with PT[3] showing that AT may be effective after PT had failed. Rarely did the opposite occur. In the same report, AT was successful three times more often than PT.

B. Not a Form of Manipulation

Manipulation treatments (MT) are a traditional form of brisk mobilization of the intervertebral joints. As far as back pain is concerned, the effectiveness of MT is, in the view of one group of British researchers, "probably restricted to hastening recovery in patients likely rapidly to improve spontaneously."[26] A basic principle of MT is the "rule of no pain and opposite movement." The manipulative thrust should be in the opposite direction to that which provokes pain in the involved vertebral segment."[27] The modern rationale for MT seems to have become more neurological and less mechanical. For example, during the manipulative thrust, the intersegmental spinal muscles, allegedly affected by spasm, undergo brisk shortening or lengthening, depending on their orientation. "A reflex inhibition of the spasm ... undoubtedly is the essential action of manipulation."[27] A corollary to the "rule of no pain and opposite movement" is that painful directions should exist. Cases in which pain is not sensitive to direction of movement are not ideal candidates for MT.

MT and AT, therefore, have a few similarities, which can be briefly summarized. With both MT and AT, the session begins with the least painful position. As with MT thrusts, AT efforts should never increase pain. At variance with MT, during AT the patient is actively involved, that is, he or she is intentionally guided toward (rather than away from) the formerly painful positions.

The rationale of AT (disc remodeling or venous drainage) is mechanical and does not require the presence of muscle spasm for relief of pain.

Last, the requisite of moving the patient in the direction of painless positions during treatment is crucial to MT but not to AT. In most patients with chronic pain, positioning the spine may not change the pain much. These patients may respond to AT even though they may not be candidates for MT.

C. An Original Form of Resistance Exercise

Autotraction efforts require maximal active contraction of many muscles, with special reference to those of the trunk and upper limbs. Contractions may be isometric, concentric, or even eccentric, depending on the direction of movement of the table sections. It needs to be stressed that AT is a form of resistance exercise.

The types of active exercise and of combined regimens proposed for the treatment of back pain are countless. For most, some effectiveness has been demonstrated. However, specific indications and relative superiority of any one are still under debate. The interested reader should refer to classic textbooks and reviews.[28,29]

At the risk of oversimplifying the mechanisms of action of currently proposed exercises, this discussion is limited to the following: (1) widening of the spinal canal, thus relieving compression of pain generating tissues as is the case for the classic Williams exercises,[30] and (2) strengthening of trunk (abdominal and paraspinal) muscles as is the case with McKenzie's approach,[31] with emphasis on strengthening the paraspinal muscles. The intent is to prevent damage in case of either overload or hypermobility by partitioning the trunk loads between the spine and the abdominal/pelvic axis.[32]

The action of AT appears not to fall under either of the above mechanisms because: (1) AT efforts cause intervertebral pressure to increase, which, presumably, coincides with decrease of the intervertebral space, and (2) despite progressive gains in force (during the three treatment sessions within 5 days), as registered on the spring dynamometer in series with the pelvic chain, the training period is too short for muscle hypertrophy to occur. Thus gains in strength are likely due to improved coordination of muscle contraction during the AT efforts. This does not mean that any gain in strength is transferable to the movements of daily life. The observation that pain may decrease just after the first session would discount the notion that improvement of spinal mechanics has occurred.

Possibly, the compressive forces on the intervertebral disc space associated with the efforts of AT in some way improve the nerve-disc interface or the epidural venous flow, or both. A necessary ingredient is in the favorable positioning of the patient on the traction bench. First, absence of pain allows the patient to perform very strong contractions. Second, if the disc is remodeled more favorably, pain-generating tissues at the nerve-disc interface may become decompressed, despite an increase in average intradiscal pressure. The same reasoning holds for the epidural venous flow in which a favorable combination of compression and positioning of adjacent vertebrae might provide remodeling to allow decongestion of the veins.

Whatever the exact mechanisms of action of AT may be, they seem to be rather specific to this form of exercise and should not be considered as a variant of other forms of treatment.

VIII. FINAL CONSIDERATIONS

AT is a safe, low-cost, and effective treatment for low-back pain syndromes. Within the range of available conservative approaches, AT can be used for the treatment of chronic syndromes associated with verified lumbar disc herniation and/or spinal stenosis.

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