Inversion Devices: Their Role in Producing Lumbar Distraction

George Gianakopoulos, BS, George W. Waylonis, MD, Peter A. Grant, MD, Donald O. Tottle, LPT, James V. Blazek, MD
Riverside Methodist Hospital and The Ohio State University, Columbus, OH 43214

ABSTRACT. Gianakopoulos G, Waylonis GW, Grant PA, Tottle DO, Blazek JV: Inversion devices: role in producing lumbar distraction. Arch Phys Med Rehabil 66:100–102, 1985.

• **Twenty persons with chronic low back pain participated in a clinical study to evaluate the effects of gravity traction. Each subject was instructed in the use of three devices, two for inversion and one for upright suspension traction. Baseline pulse and rate blood pressure were recorded before and after traction. Periods of traction did not exceed 20 minutes. The order of use of the devices was randomized. Each participant was monitored for significant side effects and was questioned to determine which device was best tolerated, easiest to use, or caused changes in back symptoms. Lateral lumbar spine radiographs were taken with the subject in the standing position and after varying periods of inversion. Observations included the following: (1) An average increase in blood pressure of 17.2 systolic (range 4–34) and 16.4 diastolic (range 2–50) while in the inverted position. (2) An average decrease in heart rate of 16.4 beats per minute (range, 4–32). No significant physiologic changes of blood pressure or pulse were observed in patients using GLR suspension traction; (3) distraction of the lower lumbar intervertebral spaces (range, 0.3 to 4.0 mm) with inverted traction in all cases; (4) side effects including periorbital and pharyngeal petechiae (one patient), persistent headaches (three patients), persistent blurred vision (three patients), and contact lense discomfort (one patient); and (5) improvement of low back symptoms in 13 of the 16 symptomatic patients. Although these devices make lumbar traction practical in a home setting, their use should be under medical supervision because of possible side effects.**

KEY WORDS: Backache; Body weight; Equipment and supplies; Lumbar vertebrae; Traction

Recently, devices which suspend the user in the inverted position have received much publicity and are being aggressively marketed for use by patients with low back pain. The manufacturers claim that the lumbar vertebrae can be distracted with inversion but to date this claim has not been substantiated experimentally. Few side effects or contraindications to inversion have been described.[2,4]

To achieve effective vertebral distraction, one third to one half of the body weight must be applied.[1] In the home the application of this amount of weight has so far proved impractical despite the availability of the GLR suspension type of traction—for which we have found little enthusiasm in our practice. It seemed to us that the use of the patient's own body weight in inversion might offer a solution to the problem. Several types of inversion devices are being marketed and sold independent of the health profession (no approval, prescription, or supervision required). The purpose of this study was to determine the efficacy of, side effects of, and contraindications to the use of inversion by persons with chronic low back pain.

MATERIALS AND METHODS

The 20 volunteers (12 men and 8 women) were members of our hospital staff or selected outpatients. Their ages ranged from 23 to 66 years. All had chronic low back pain of various etiologies. The group was screened for medical problems using a written questionnaire and a personal interview. To ensure that subjects received the same orientation to the program, introduction to the study and instruction in the use of the equipment were provided by videotape.

Sixteen subjects were symptomatic at the time of the study and two had undergone lumbar laminectomy. Twelve symptomatic subjects had radicular symptoms while four had pain localized to the lumbar region.

Three types of gravity traction devices were used in the study. With the Backtrac, an inversion device which suspends the user by the ankles, the user can control the increase in the angle of the device and the amount of traction. A full 180° of inversion can be achieved by gradual acclimation. With the second inversion device, Back-On-Trac,[b] a large padded roller bears the body's weight on the anterior thighs, while the hips are held in 90° of flexion and the knees are flexed at about 120°. The third device, the Gravitational Lumbar Traction System developed by the Sister Kenny Institute,[c] does not involve inversion. The user is suspended in the upright position by a corset-like vest worn around the rib cage. The lower half of the body supplies the distracting force through the action of gravity.

The subjects were initially monitored until they were comfortable and demonstrated sufficient confidence to use each unit without assistance. The order of use of the devices was randomized. Baseline blood pressure and pulse measurements were recorded. Blood pressure measurements were done on the left arm with the arm outstretched so that all readings were recorded with the cuff at the level of the heart.

Participants used each device in the hospital physical therapy department once each day for five days. On the fifth day, blood pressure and pulse readings were taken before and during traction. At the subject's signal for termination, blood

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pressure and pulse were recorded and the person was returned to the starting position.

The amount of time an individual could remain inverted or suspended varied greatly. We set no time goals for the duration of traction. To minimize the effects of mechanical discomfort of the inversion and suspension devices on blood pressure/pulse readings, we elected to permit the subjects to end the traction period at their discretion. If any traction unit was not tolerated, the participant was permitted to discontinue its use.

Lateral radiographs of the lumbar spine were obtained before and after 5 to 15 minutes of inversion (but not suspension) in the five subjects who agreed to undergo these x-ray studies. Standing and inverted lateral radiographs were obtained with a standard upright x-ray table, but for the inverted films the patient was suspended in the inverted position from the top of the table. All radiographs utilized Buckey technique at 40-inch film-target distance so as to minimize technical variation between the two films. Magnification factors would be the same in both situations and were, therefore, ignored for purposes of this presentation. Measurements at the anterior and posterior aspects of the intervertebral space and at the center of the interspace were averaged.

RESULTS

We estimated the efficacy of inversion traction using two basic parameters: the participants' subjective evaluation of pain relief and radiologic evidence of lumbosacral vertebral distraction. Since we did not x-ray subjects in the GLR, our evaluation of the device was limited only to pain relief. Thirteen of the 16 symptomatic subjects felt improved after inversion, and 2 of the 13 described relief as "dramatic." One of these two patients, a 40-year-old auto mechanic, had a herniated disc documented by high resolution CAT scan. He was nearly incapacitated by paresthesias and radicular pain, had previously failed to respond to conventional physical therapy measures and did not want surgical intervention. He found that ten minutes of inversion at work using inversion boots connected to an automotive hoist, resulted in an initial three hours of symptomatic relief. The pain relief gradually increased in duration as he used inversion regularly so that after three months he was able to remain painfree by using inversion once or twice a week. The second subject who had chronic pain and stiffness in the morning reported being painfree for four months after inversion therapy. Four of the 20 subjects were asymptomatic at the time of our study but wanted to participate to determine their potential for future use of inversion or suspension therapy. These four subjects and one other symptomatic subject noted no change in their status. One subject experienced marked increase in discomfort after inversion. No significant preference for either of the two inversion devices was expressed by our subjects.

As a more objective means of evaluation of vertebral distraction than the subjective reactions of our subjects, lateral lumbosacral spine radiographs were obtained in five subjects (table). Distraction of lower lumbar intervertebral spaces occurred in all five cases. Distraction at the L3-4 level averaged 1.5mm (range 0.3-4.0mm); at the L4-5 level, 1.6mm (range 0.7-2.1mm); and at the L5-S1 level, 2.0mm (range 1.0-3.9mm). Generally the degree of distraction seemed to be greater in those interspaces that showed other radiographic signs of disc degeneration such as narrowing, marginal osteophytes, sclerosis of end plates and "vacuum" phenomena. Vertebral distraction was noted to be greater posteriorly than anteriorly.

Radiographic Measurements of Lumbar Distraction (mm) During Inversion

	Standing				Inversion			
*Subject	Fr	Bk	Ct	Avg	Fr	Bk	Ct	Avg
				L3-4 Interspace				
A	6	4.5	5.2	5.2	11	6	10.5	9.2
B	14	8	12	11.3	14	8	13.5	11.8
C	12	4	7	7.7	11.5	5	9	8.5
D	10.5	10.5	14	11.7	14	12	15.5	13.8
E	15	8.5	12.5	12	15	9	13	12.3
Avg				9.6				11.1
				L4-5 Interspace				
A	11	5	11	9	12	6	11	9.7
B	11	5.5	8	8.2	13	7	11	10.3
C	12.5	5	8	8.5	14.5	7	10	10.5
D	16	5	12.5	11.2	18	6	14	12.7
E	14	5.5	10	9.8	15	7.5	11	11.2
Avg				9.3				10.9
				L5-S1 Interspace				
A	10	3	6	6.3	15	4.5	11	10.2
B	15	7	10	10.7	18	7	11.5	12.2
C	17	3	11.5	10.5	19	5.5	12	12.2
D	22.5	4.5	11.5	12.8	24.5	6.5	13	14.7
E	16.6	5	10.5	10.7	18	6	11	11.7
Avg				10.2				12.2

*Fr, front; Bk, back; Ctr, center; Avg, average.

The side effects encountered with the two inversion devices affected numerous body systems. The only side effects with the GLR system were complaints of chest discomfort from the harness. The changes observed with the inversion devices involved the cardiovascular system. All 20 participants demonstrated elevation of both systolic and diastolic blood pressures. The average of the systolic elevations was 17.2mmHg with a range of 4 to 34mmHg, while the average of the diastolic elevations was 16.4mmHg with a range of 2 to 50mmHg. A significant drop in heart rate averaging 16.4 beats per minute (range 4 to 32) was also observed. These cardiovascular effects reverted to normal soon after the upright position was regained.

Some side effects persisted (ie, longer than five minutes) including headache (three patients), blurred vision (two patients), and conjunctival injection (one patient). One patient developed periorbital and pharyngeal petechiae the morning after inversion. She previously had been diagnosed as having Von Willebrand's disease (factor VIII deficiency). Numerous patients complained of nasal stuffiness during and for varying periods after inversion. One patient who wore contact lenses noted dryness of the eyes with rather severe discomfort requiring discontinuation of inversion. Numerous musculoskeletal complaints were thought to be directly related to the use of the mechanical devices including ankle discomfort with the Back-Swing, calf and thigh pain with the Back-On-Trac, and chest discomfort with the GLR upright traction device.

DISCUSSION

From our findings inversion and gravity traction devices appear to offer a means of conservative therapy for low back pain that is practical in the home setting. In our group of 20

patients, use of these devices produced symptomatic relief in 13, two of whom described relief as "dramatic."

We recognize that two successful cases do not constitute a strong scientific justification for recommending a technique. However, traction has been used in the treatments of chronic low back pain for centuries and we conclude only that inversion and upright suspension therapy offer promise as an effective means of achieving pelvic traction at home.

These reports of good results must be balanced against the possibility of significant side effects. Both Sheffield[5] and Martin,[1] Martin and Ging[3] describe no substantial side effects during or after inversion therapy. Our results are similar to those of Klatz (quoted by Mara[2], who noted significant changes in the cardiovascular system during inversion. We strongly recommend that hypertensive individuals should certainly try other forms of treatment before resorting to inversion and then should be carefully monitored during inversion. Any medical problems potentially exacerbated by an elevation of blood pressure, intracranial pressure or the mechanical stress of the inverted position, should be considered contraindications to inversion therapy. Plocher[4] recently described two patients who developed petechiae after short periods of inversion therapy.

Other possible contraindications to inversion therapy[2,3] include cardiopulmonary disease, glaucoma, chronic headache, gastro-esophagat reflux, artificial hip replacements, motion sickness and chronic sinusitis. Hypocoaguability states due to disease or secondary to medication, are also probable contraindications. Although some of these contraindications would result in only minor discomfort during inversion, the potential for serious side effects must be considered.

Although there is definite evidence that inversion can produce demonstrable lumbar distraction and a subjective decrease in patient's symptoms of low back discomfort, its use should be under the supervision of a physician because of the potential for side effects.

ADDRESS REPRINT REQUESTS TO:
George W. Waylonis, MD
3535 Olentangy River Road
Columbus, OH 43214

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Suppliers

a. Backtrac Model Pro-2, Backtrac Corporation, Pasadena, CA
b. Back-on-Trac, Lossing Orthopedics, Minneapolis, MN 55404
c. Gravity Lumbar Reduction, Ada Corporation, Miami, FL

ABSTRACTS of selected literature

Murray MA, Robbins N: Cell proliferation in denervated muscle: time course, distribution and relation to disuse. Neuroscience 7:1817-1822, 1982.

• The effects of denervation on skeletal muscle fibers have been intensively investigated, but the effects on other cell types within muscle tissue are not well understood. In the present experiments, cell proliferation was analyzed in mouse extensor digitorum longus muscles denervated for periods of one day to six weeks. Incorporation of tritiated thymidine into DNA increased 36 h after denervation, reached a maximum at a level twenty times control at 4 days, and returned towards control values by 7 days. Incorporation first increased in the endplate area, but 12 h later involved the entire muscle. Six weeks after denervation, muscles labeled at 4 days had lost 90% of the total label. Muscle disuse, produced by tetrodotoxin block of the nerve for up to 4 days, did not result in a proliferative response.

Thus, cell proliferation after denervation is not a response to simple disuse, but rather to a nerve- or muscle-related mitogen. Since the response is mostly distributed throughout the entire muscle, the mitogen probably emanates from muscle fibers.

Kelly S, Zin WA, Decramer M, De Troyer A: Salutary effect of fall in abdominal pressure during diaphragm paralysis. J Appl Physiol 56: 1320-1324, 1984.

• To examine the mechanical effects of the fall in abdominal pressure (Pab) that occurs during inspiration in diaphragmatic paralysis, we studied lung inflation and rib cage expansion before and after the abdomen was opened in nine spontaneously breathing dogs with bilateral phrenicotomy. We measured Pab, tidal volume, and parasternal electromyographic (EMG) activity during quiet breathing and CO_2-induced hyperpnea. In six dogs, we also measured changes in anteroposterior and transverse rib cage diameters, the resting length of the parasternal intercostal muscles, and the amount of shortening of these muscles during inspiration. Opening the abdomen caused a marked reduction in the fall in Pab during inspiration and invariably resulted in a decrease in tidal volume (mean decrease, 13%), which contrasted with marked increases in inspiratory rib cage expansion and in the amount of parasternal intercostal shortening. The procedure, however, did not affect the resting length or inspiratory EMG activity of the parasternals. These findings indicate that although the fall in Pab, which occurs during inspiration in diaphragmatic paralysis, causes paradoxical inward displacement of the ventral abdominal wall, it has a salutary effect on tidal volume. This phenomenon is probably due to the fact that the diaphragm is part of the abdominal wall.