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Soft Tissue Research

Clinical Investigations of Gravity Inversion Traction and Spondylolytic Anterolisthesis

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There are multiple causes and classifications of spondylolisthesis (Cox, ; Jayson, 1987; White and Panjabi, 1990; Yochum, 1987). This article pertains to a study regarding spondylolytic anterolisthesis (spondylolytic anterior spondylolisthesis), which is an adaptation of the language used by Yochum (1987). This means that there is a defect in the pars interarticularis and an anterior slippage or displacement of the vertebral body. No attempt was made here to classify the anterolisthesis by cause of the spondylolysis.

Hypotheses as to cause of spondylolytic anterolisthesis are many. A leading hypothesis indicates that the separation of the pars interarticularis is a stress fracture, meaning it is caused from a series of stresses in the region rather than by a single traumatic event (Cox, Yochim). Between 5% to 7% of the adult white population will have an anterolithesis. Approximately 90% of anterlisthesis are found at L5 (Yochum). Therefore, this study primarily evaluates the L5-sacrum articulation.

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Gravity inversion traction has been around for several decades. Its formal usage can be traced back to Dr. Robert M. Martin (1975 and 1982) who has claimed to have multiple degrees, including that of medical physician, osteopath, and chiropractor. Dr. Martin spearheaded the current trend in gravity inversion traction devices within chiropractic through his Gravity GuiderTM system. This is the traditional ankle gravity boot inversion system that has been used both with, and without, a swinging bed. In the past decade, numerous other gravity inversion traction devices have surfaced. These other gravity inversion traction devices are marketed directly to the health care provider for in-office use, as well as being marketed directly to the consumer. Each unit is different in design in terms of ease of use and patient comfort. Also, there are mechanical differences to the clinician, using different varieties of gravity inversion traction units.

The most significant mechanical differences are those attributed to the inversion traction devices in which one hangs primarily from the thighs. My intention for this article is to discuss the mechanical differences between the two basic, different varieties of gravity inversion traction units as well as discussing indications and contradictions for their usage. I will also describe a clinical protocol for the safe introduction of inversion gravity traction for patient care.

I have a particular interest in the usage of gravity inversion traction devices, as I have used them extensively in my private practice for the last ten years, and personally over the past twelve years. The following information is based upon my own clinical experiences and personal clinical research, performed in my office over the past ten years. My clinic has used inversion traction on approximately one thousand different patients in the past decade. Approximately 10% of these, or one hundred patients, eventually purchased a home gravity inversion device for home use. This study specifically relates to gravity inversion traction and spondylolytic anterolisthesis.

When one views a lateral lumbar radiograph, there is a lumbar lordosis and an angulation to the sacral base.

This sacral base angle is approximately 40 degrees in normal standing averages (Janik, 1998). When viewing the lumbosacral spine in the lateral dimension, if we were to eliminate the forces in this region created by the ligaments, muscles, discs, and pars interarticularis, etc., we would have, in simple terms, a block on an inclined plane (Fig. 1). This is not to say that the forces produced by these other tissues are negligible in comparison to the force of gravity. The force of gravity will now affect the lumbosacral spine as a block on an inclined plane. With this analysis, we will have two forces that affect the articulation (Fig. 1). These forces are:

1) Those that are parallel to the joint surface.

2) Those that are perpendicular to the joint surface.

By doing a simple force vector addition, we would have the straight vertical force of gravity. In dealing with the topic of anterolisthesis (Fig. 2), it is noted that when there is an interruption of the pars interarticularis, it is the force component that is parallel to the joint surface that will pull the L5 vertebra forward on the sacral base. The average appearance of our patient with an anterior spondylolisthesis is that there is also a narrowing of the disc spacing between L5 and S1. This narrowing is attributed to the perpendicular component of the forces that are acting over the L5-S1 interbody articulation.

When one is hanging in an inverted position, the vectors are reversed (Fig 3). The component vector, that is parallel to the joint surface, will pull the vertebrae toward posterior, or toward correction, while the component that is perpendicular to the surface, will enlarge the disc space. This simple vector analysis for the temporary reduction of spondylolytic anterolisthesis is verified with radiographic studies mentioned below. Before proceeding, however, an understanding of the principles of viscoelastic creep is necessary.

Viscoelastic creep is a characteristic of biological tissue. Discussions regarding viscoelastic creep can be found in tests by White and Panjabi, 1990, and Bogduk, 1987. An example of a typical creep curve from White and Panjabi is noted in Fig. 4. In a creep curve, deformation of the tissue is plotted as a function of time. The principle of creep is that the tissues will continue to deform over time, even though the load on the tissues will take place, creating a lasting alteration in the tissue mechanics, giving a lasting benefit to the forces that were applied to the tissues.

Over the past ten years, we have done a radiological study of 30 patients with spondylolytic anterolisthesis. Our study consisted of exposing radiographs in the upright and inverted, gravity traction positions. We carefully analyzed these radiographs for millimeters of anterior slippage, and also measured the height of the intervertebral disc. The subjects used in this study were all patients seen in the general practice of a chiropractor. Their ages ranged between 11-70 years of age. Twenty of the patients were male, ten were female. No patient had an anteriolisthesis greater than Grade II. All of these patients were suspended straight, vertically using Gravity GuiderTM boots when the inverted gravity traction radiographs were exposed. A few of these patients also were radiographed using thigh-gravity (OrthopodTM) inversion traction as well. All patients were radiographed in a least the lateral dimension. Some were also radiographed in the AP dimension. In all patients, gravity inversion radiographs were exposed at intervals of one minute. A second radiograph was exposed either at an interval of five minutes, or ten minutes of traction, depending on the tolerance of the patient. This was done in an effort to observe the phenomenon of visoelastic creep.

The average amount of reduction in anterior millimeters of displacement throughout this entire series was seven millimeters in patients

with spondylolytic anterolisthesis. The additional reduction of forward slippage, caused by creep, averaged two additional millimeters per patient, within the five to ten minute time frame used. The spacing of the intervertebral disc, on average, approximately doubled in size between L5 and S1. The smallest millimetric reduction, while under gravity inversion traction, was 4mm. The largest millimetric reduction was 12mm.

Cases I (26 year old male) and Case II (18 year old male), discussed below are representative of the study. These drawings Figs. 5, 6, 7, 8, 9, and 10 for Case I, and 11, and 12 for Case II are proportional reduction of actual tracings of the radiographs. Figure 5 is an upright, neutral lateral, lumbar radiography. Figure 6 was exposed after 60 seconds of inversion gravity traction. Figure 7 was exposed after 10 minutes of inversion gravity traction. Note the additional creep between the 60 second and 10 minute radiographs. Note that the size of the intervertebral disc has more than doubled. Note, that within 10 minutes, the anterolisthesis has completely reduced.

Figure 11 is an upright, neutral of a different patient, (Case II). Note that the 60 second vertical inversion traction radiograph is the same patient in Figure 12.

We have done one long-term follow-up study on one of the subjects involved in this study. The long-term study is the same patient as in Case I, above. The long-term benefits of inversion, noted in this single study, reveal a progressive reduction in the millimetric magnitude of the anterior displacement of L5 on the sacrum, and a gradual increase in the height of the intervertebral disc. Figure 8 and 9 are tracings of upright radiographs, exposed on the same patient as in Figures 5, 6, and 7. Figure 8 was exposed in 1983, and Figure 9 was exposed in 1991. The original radiographs (Figs. 5, 6, and 7) were exposed in 1981.

An interesting comparison is made in Case I by overlapping the original upright radiograph (Fig. 5) with the ten minute inversion radiograph (Fig. 7). This is done in Figure 10. Note the complete reduction of the anterolisthesis, and that the intervertebral disc has more than doubled in size.

Our study showed that, when doing straight vertical ankle inversion, the lumbar lordosis is increased in size. This is apparently because the sacroiliac articulation rocks forward, when one is inverted to align with the acetabulum. This forward-rocking projects as a greater curve in the lumbar lordosis. As a result, this will increase the magnitude of the vector, that is parallel with the joint surface, making it more advantageous for the reduction of the anterior slippage (Fig. 13).

The major difference between ankle inversion and thigh (OrthopodTM) inversion is that, for the most part, in the latter, there is an elimination of the component of force, that is parallel to the joint surface. Therefore, the major and, in some cases, the only vector remaining is that which is

perpendicular to the joint surface (Fig. 14).

Anterolisthesis is, however, still reduced through thigh gravity inversion traction because of the crisscross micro-mechanics of the annular disc fibers. This was clearly shown on the additional radiographs of two of the thirty people involved in this study. A comparison of the differences between OrthopodTM (thigh inversion) and ankle vertical gravity inversion follows:

Straight, vertical ankle inversion has the largest (parallel-to-joint surface) component of force for the reduction of the anterior slippage in a spondylolisthesis. This component is minimized in thigh inversion, yet there is still a positive benefit on reduction of anterolisthesis with thigh inversion because of the crisscross alignment of the annular disc fibers. However, individuals with a retrolisthesis at L5 or L4 should use vertical ankle gravity inversion with caution, as the retrolisthesis tend to be displaced more toward the posterior. This principle is clearly seen at the L-4 level on Case I, when inverted. This adverse vector component is minimized during thigh (OrthopodTM) inversion and, therefore, it is the inversion traction of choice for those with retrolisthesis.

With thigh (OrthopodTM) inversion, one is either inverted all the way or not inverted at all. An additional advantage to the ankle inversion, particularly with the addition of the swing or bed apparatus, is that the degrees of angulation can be controlled. None of us would invert an eight-month pregnant woman on a thigh (OrthopodTM) inversion unit. However, we can easily put this same woman in an ankle inversion apparatus, with the swing or bed, at approximately ten degrees of angulation, with the head being slightly lower than the feet, and achieve a traction benefit.

The protocols for inversion therapy that we have developed in our office follow:

1. Be aware of the medical contradictions to gravity-inversion therapy. These include: high blood pressure, retinopathy, diabetes, obesity, age or cardiovascular disease, etc. (This list is not all-inclusive and common sense should be used.)

2. Be aware of the mechanical contradictions to gravity inversion therapy. The most noted mechanical contradiction for ankle inversion, in the authorÕs opinion and experience, is the presence of a retrolisthesis of the lumbar or lumbossacral spine. Again, there are other mechanical contradictions, and the provider should use common sense.

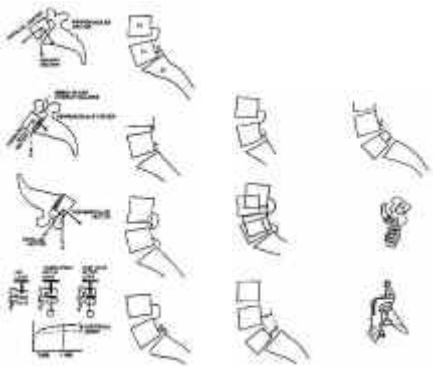
A second mechanical consideration for inversion traction is the presence of lumbar spine central canal spinal stenosis. During thigh inversion (Fig. 14), the lumbar spine is flexed, enlarging the central canal sagittal dimension by two to three millimeters (Cox). This does not adversely affect those with lumbar spine central canal spinal stenosis, and our clinical studies suggest a benefit to the patient. However, as noted

above, ankle inversion increases the lumbar lordosis, thereby narrowing the sagittal dimension of the central canal. This mechanical change could potentially adversely affect those with pre-existing absolute or relative lumbar spine central canal spinal stenosis. Therefore, we discourage the use of straight vertical ankle gravity inversion traction for those with lumbar spine central canal spinal stenosis.

If no obvious medical or mechanical contradictions to inversion traction are noted, one can proceed. The following protocols were developed by the author over the past ten years, using both ankle and thigh gravity inversion in clinical practice. It is recommended that the first time inverting, the patient be inverted for a maximum of 60 seconds. The doctor should remain with the patient the entire 60 seconds to make sure there are not problems. Questioning the patient throughout the procedure assures that he/she is getting along adequately. If, during this 60 second initial trial period of inversion, the patient complains of dizziness, nausea, headache, or significant increase in back pain, inversion should be discontinued, and possibly attempted once again on another day. The patient should arise promptly at the end of 60 seconds and, if this rising causes no immediate or subsequent increase in symptomatology, the second session of inversion therapy can be increased to two minutes, and third visit to three minutes, the fourth visit to four minutes. The ultimate goal would be achieved on the fifth visit Ñ and that would be five minutes. We do not recommend that anyone use gravity inversion traction in excess of five minutes at any given time. It is duly noted, that inversion therapy increases blood pressure, as do most forms of exercise. We discourage the use of inversion for those with systolic pressure greater than 150 mm of mercury.

It is noted in GuytonÕs physiology, that when one exercises, blood pressure increases. Part of the reason is caused by a vasodilation of the muscles that are being exercised, with a vasoconstriction in other regions of the body. Therefore, the common practice of having a patient do exercises, while inverted, does not make rational sense and in fact, could be dangerous. Recalling that blood pressure increases while inverted, if one then exercises, causing a reflex vasoconstriction in regions that are not be exercised, there could be a dramatic increase in overall systolic blood pressure, potentially dangerous consequences. Therefore, our recommendation is that inversion should be done with the greatest degree of relaxation, and no exercise should be performed during inversion. This is also how one takes best advantage of the visoelastic creep forces which are necessary when attempting to reduce spondylolytic anterolisthesis. It is this authorÕs opinion and experience that the use of gravity inversion traction is a useful and beneficial mechanical adjunct to chiropractic health care in the management of spondylolytic anterolisthesis.

It is not the intent of this paper to promote specific brands of gravity inversion devices, or to discourage the use of others not mentioned. Rather, the purpose is to share clinical investigations using inversion gravity devices.



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