The effects of inversion chair therapy on intraocular pressure and systemic blood pressure

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The effects of inversion chair therapy on intraocular pressure and systemic blood pressure

Abstract
Intraocular pressure (IOP) was recorded before, during, and after the use of an inversion chair by 11 young, healthy, male subjects. Systolic and diastolic blood pressures (BP) were also measured. Subjects were seated on the chair while baseline IOP and BP measurements were taken. The subjects were then rotated 1800 to e head-down (inverted) position. The hips and knees remained flexed and the subjects were supported at the hips by the chair. IOP and BP were measured after the subjects had been inverted for 2 1/2 minutes and again after 5 minutes. Subjects were returned to e sitting position and IOP and BP were recorded after 2 1/2, 5, 7 1/2, and 10 minutes. Subjects remained at rest during the test. Mean upright right eye IOP increased from 12.5 mmHg to 25.1 mmHg end mean upright BP increased from 117.3/178.9 to 140.2/106.7 mmHg after 2 1/2 minutes of inversion. Both IOP and BP remained elevated during inversion and returned to near normal values after the subjects were once again placed in the sitting position. Since IOP rose significantly during inversion, use of this chair or other types of inversion devices may be contraindicated for patients with high blood pressure, glaucoma, and ocular hypertension.

One subject developed a subconjunctival hemorrhage es a result of the inversion. This indicates that inversion therapy should not be undertaken by persons with vascular changes, such as those which occur in diabetes.

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The Effects of Inversion Chair Therapy on Intraocular Pressure and Systemic Blood Pressure.

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Pacific University College of Optometry

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We wish to thank Bobbie Dirks for all her help and support on this project. We would also like to thank the Tuality Hospital Physical Therapy Department and Jan Severson for allowing us use of the Orthopod Inversion Chair. Final thanks to our subjects who were willing to hang upside-down for five minutes.
Intraocular pressure (IOP) was recorded before, during, and after the use of an inversion chair by 11 young, healthy, male subjects. Systolic and diastolic blood pressures (BP) were also measured. Subjects were seated on the chair while baseline IOP and BP measurements were taken. The subjects were then rotated 180° to a head-down (inverted) position. The hips and knees remained flexed and the subjects were supported at the hips by the chair. IOP and BP were measured after the subjects had been inverted for 2 1/2 minutes and again after 5 minutes. Subjects were returned to a sitting position and IOP and BP were recorded after 2 1/2, 5, 7 1/2, and 10 minutes. Subjects remained at rest during the test. Mean upright right eye IOP increased from 12.5 mmHg to 25.1 mmHg and mean upright BP increased from 117.3/78.9 to 140.2/106.7 mmHg after 2 1/2 minutes of inversion. Both IOP and BP remained elevated during inversion and returned to near normal values after the subjects were once again placed in the sitting position. Since IOP rose significantly during inversion, use of this chair or other types of inversion devices may be contraindicated for patients with high blood pressure, glaucoma, and ocular hypertension.

One subject developed a subconjunctival hemorrhage as a result of the inversion. This indicates that inversion therapy should not be undertaken by persons with vascular changes, such as those which occur in diabetes.
INTRODUCTION

An inversion chair is a gravity traction device in which an individual hangs from the thighs in a 90° head-down position with the hips and knees bent. The chair is often used in therapy for patients who suffer from lower back pain. The inversion chair allows for "correct anatomic alignment of the vertebrae during traction" due to the bending of the knees and hips which allow the lower back to be straight. This alignment of the vertebrae "relieve(s) disc and nerve root pressure, as well as relieving associated muscle tension and spasms." 6

Another popular method of inversion which is often used in the home is gravity boots. The boots are specially designed with hooks to allow the user to hang from a horizontal bar in a completely vertical head-down position. In a study done by Klatz and associates, a significant increase in intraocular pressure (IOP) and blood pressure (BP) was found when subjects went from a seated position to an inverted position using gravity boots.1,4 Subsequent studies involving gravity boots have confirmed these results.1,2,4,5 One could hypothesize that the use of the inversion chair could result in BP and IOP increases similar to those shown in the gravity boot studies. However, the literature search did not reveal any studies of this nature utilizing the inversion chair.

Since a wide age range of patients are involved in inversion chair therapy, it is natural to assume that some of these patients may have general health problems which could be aggravated by a significant increase in BP or IOP. Due to the lack of research in the area and the potential hazards to certain patient populations, this study was undertaken to determine the effects of inversion chair therapy on BP and IOP.
METHODS

The eleven subjects who took part in the study were all male, ages ranging from 19 to 35. The volunteers had no medical history of diabetes, hypertension, glaucoma, or any known allergies to anesthetics. Ocular health was normal in all subjects. All but one subject were students of Pacific University College of Optometry. Any volunteers with systolic blood pressures over 130 mmHg, diastolic blood pressures over 90 mmHg, or intraocular pressures over 20 mmHg were eliminated from the study.

Subjects were initially given a biomicroscopic examination to check for any apparent conjunctival petechiae. Subjects were then seated on the Orthopod inversion chair in the pre-inversion position and baseline BP and IOP were taken. One drop of 0.5% proparacaine HCl was instilled in each conjunctival sac to anesthetize the eyes for the tonometry procedures. Pre-inversion IOP was taken on both eyes, while the remaining IOP measurements were taken on the right eye only. IOP was measured using the Digilab Model 30R Pneuma-tonometer. Blood pressure was measured using a standard stethoscope and a Tyco spymometer attached to the right arm. The arm was hanging down at the subject’s side.

The subjects were then inverted in a 90° head-down position hanging from the thighs with the hips and knees bent. BP and IOP measurements were taken at 2 1/2 and 5 minutes. The right arm was hanging down toward the floor in a slightly bent position for the BP measurements. After 5 minutes, the subjects were returned to the upright position. BP and IOP measurements were taken again at 2 1/2, 5, 7 1/2, and 10 minutes. Right arm again hanging down at the subject’s side. Finally, the subjects were given a final biomicroscopic examination to check for any ocular changes which may have occurred as a result of the inversion.
RESULTS

Systolic blood pressure, diastolic blood pressure and intraocular pressure were all shown to increase during inversion. Mean upright systolic BP increased from 117.3 mmHg to 140.2 mmHg and mean upright diastolic BP increased from 78.9 mmHg to 108.7 mmHg after 2 1/2 minutes of inversion. Mean upright right eye IOP increased from 12.5 mmHg to 25.1 mmHg after 2 1/2 minutes of inversion. Using analysis of variance, these increases were found to be significant (p<.001). The decrease in systolic and diastolic blood pressure and IOP when returning to the upright position after 5 minutes of inversion also proved significant (p<.001) by the analysis of variance method. Mean BP decreased from 140.2/108.7 mmHg to 114.9/77.9 mmHg and mean right eye IOP decreased from 25.5 mmHg to 13.6 mmHg. (See Appendices 1 & 2.)

DISCUSSION

The results of this study indicate that both systolic and diastolic blood pressures increase significantly during head-down inversion. The effects of gravity on hemodynamics are such that the blood vessels experience variable responses in pressure and flow. Guyton states that in an adult who is standing perfectly still the pressure in the veins of the feet is approximately (+)90 mmHg when compared to the pressure in the right atrium. This difference is caused by the weight of the blood between the heart and the feet. Conversely, the venous pressure in the sagittal sinus is approximately (-)10mmHg. Because of this effect, it has been estimated that when a shift is made from the supine to the standing position, approximately 500 ml. of blood pool in the legs. This pooling "can result in a decreased cardiac output of 2 liters/minute and a 40% reduction in stroke volume." One could assume that in the fully inverted
position the right atria of the heart would receive venous blood that is normally pooled in the legs and cardiac output would increase, thereby raising systemic blood pressure.\textsuperscript{1} The inversion chair allows some pooling of blood in the legs but the basic hydrostatic laws still apply. An increase in systemic blood pressure would be expected, although it might be argued that the increase would not be as dramatic as that found with the use of gravity boots.

It was also found that a significant increase in intraocular pressure occurred during the inversion chair procedure. The previous studies using gravity boots for complete inversion have shown similar results.\textsuperscript{1,2,4,5} Even a mild postural change from a sitting to a lying position has an average rise in IOP of 2 to 3 mmHg in normal eyes.\textsuperscript{2,3,6} It can be presumed that the significant increase in IOP during inversion is due mostly to an increased episcleral venous pressure which causes an increased resistance to aqueous outflow.\textsuperscript{1,2} In a previous study by Weinreb, Cook, and Friberg, it was speculated that "compressive forces placed upon the globe by congested orbital contents and an increase in ocular blood volume with congestion of the uvea" may also contribute to the increase in IOP during inversion.\textsuperscript{2}

One subject in this study developed a subconjunctival hemorrhage during the inversion procedure. One can assume that the increase in blood pressure during inversion caused the blood vessel to break, however, a specific cause-and-effect relationship cannot be determined. The subject did note that the vessel which broke was a weak vessel and that a subconjunctival hemorrhage involving that vessel was not an uncommon occurrence. With that in mind, one must consider that persons with diabetes or other vascular changes may be at risk during the inversion procedure.

In view of the evidence found in this study, it seems necessary to outline certain groups of people who may be at risk when using the
inversion chair. Due to the increase in blood pressure, those people with a history of hypertension, strokes, or cardiovascular disease should refrain from using the inversion chair. The significant increase in intraocular pressure during inversion would obviously put those patients having glaucoma at risk. The glaucomatous eyes may be susceptible to a decrease in retinal sensitivity and vision loss if unable to withstand the significant increases in IOP. Repeated or prolonged inversion may compound these effects. Similarly, this increase in IOP may be equated to ocular hypertension and "may put some patients with impaired aqueous outflow at a greater risk of developing visual field loss and optic nerve atrophy."  

The Orthopod Inversion Chair comes with the following manufacturers' warning: "If any medical condition exists which might preclude the use of this device (such as, but not limited to: high blood pressure, middle ear infection, eye disorders, etc.) please consult with your doctor. This is especially important for individuals over 35 or those persons with pre-existing poor health. Do not let children use the Orthopod unattended." It is felt that the manufacturer should specify the "eye disorders" of glaucoma and ocular hypertension in their warning. In addition, a screening procedure by the practitioner is necessary before use of the inversion chair to eliminate patients who would be at risk. Included in the screening should be IOP measurements, visual field findings, optic nerve observations, and BP measurements.

It would be interesting to see a further study done on the effects of IOP and BP when using therapy exercises with the inversion chair. Additionally, another possible study would be to compare the differences of IOP and BP increases between the inversion chair and gravity boots.
FIG. 1 - Mean blood pressure versus time with the zero, seven and one half, and ten minute values being measured in the upright position, two and one half and five minute values being measured in the inverted position.

FIG. 2 - Mean intraocular pressure versus time with the zero, seven and one half, and ten minute values being measured in the upright position, two and one half and five minute values being measured in the inverted position.

Appendix 1
Mean BP IOP Measurements Over Time

<table>
<thead>
<tr>
<th></th>
<th>Systolic BP (mmHg)</th>
<th>Diastolic BP (mmHg)</th>
<th>IOP (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upright (Baseline)</td>
<td>117.3</td>
<td>78.9</td>
<td>12.5</td>
</tr>
<tr>
<td>Inversion (2.1/2 min.)</td>
<td>137.9</td>
<td>106</td>
<td>25.1</td>
</tr>
<tr>
<td>Inversion (5 min.)</td>
<td>140.2</td>
<td>102.7</td>
<td>25.5</td>
</tr>
<tr>
<td>Upright (2.1/2 min.)</td>
<td>114.9</td>
<td>77.9</td>
<td>13.6</td>
</tr>
<tr>
<td>Upright (5 min.)</td>
<td>114.1</td>
<td>80.3</td>
<td>13.5</td>
</tr>
<tr>
<td>Upright (7.1/2 min.)</td>
<td>113.8</td>
<td>79.5</td>
<td>12.5</td>
</tr>
<tr>
<td>Upright (10 min.)</td>
<td>113.4</td>
<td>79.1</td>
<td>12.2</td>
</tr>
</tbody>
</table>

Appendix 2
REFERENCES


