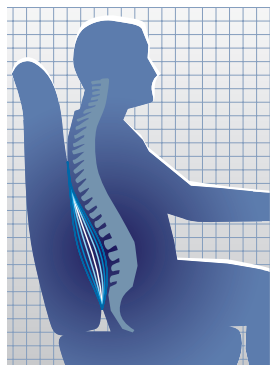


CONTINUOUS PASSIVE MOTION LUMBAR SUPPORT: THE BACKCYCLER® SEATING METHOD FOR PREVENTING LOW BACK DISCOMFORT, STIFFNESS AND FATIGUE

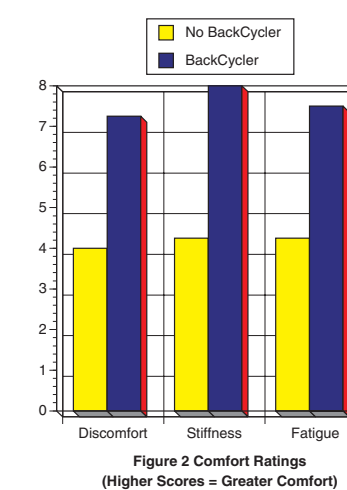
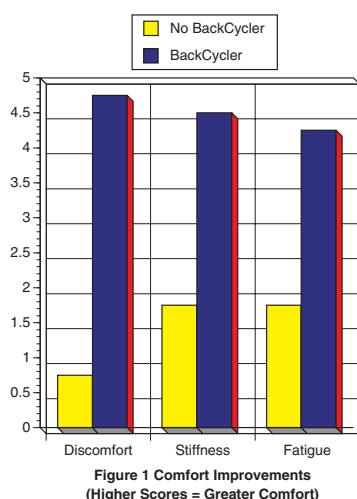
INTRODUCTION

Low back pain strikes over 70% of adults during their lifetime and 30% each month. This modern epidemic costs Americans alone over \$50 billion annually. Back pain is also by far the most common physical complaint of people who sit for prolonged periods. This is because sitting rotates the pelvis and spine into a position that magnifies the upper body's static loading of the lumbar muscles, ligaments, and discs. While seat back reclining and lumbar support reduce spinal strain, many different seating contours and postures have been promoted over the years. No single contour or posture works for everyone or for very long. In the past decade a series of experiments has shown that gradually shifting the lower spine's position by inflating and deflating a lumbar support bladder with a pump and valve system known as the BackCycler® can dramatically reduce the discomfort, stiffness, fatigue and drowsiness associated with sitting.



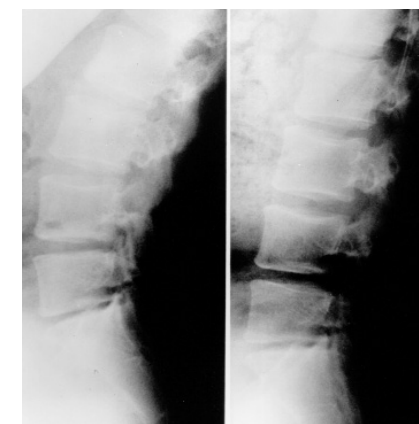
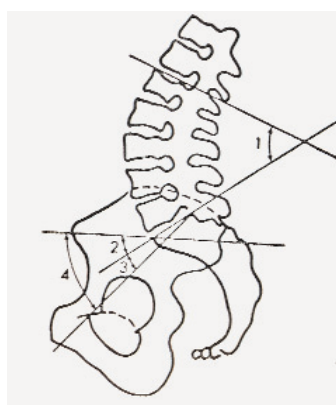
THE BACKCYCLER® REDUCES DISCOMFORT, STIFFNESS AND FATIGUE OF SITTING

Spine specialist Dr. Rowland Hazard invented pneumatic continuous passive spinal motion when he found he could relieve his own backache by removing and replacing a lumbar cushion on a long car ride. The next step was to create this cyclic spinal motion with air, the lightest and softest support medium, and to customize the motion and support for each body size, posture and spinal stiffness through pressure control. Initial studies at the University of Vermont showed that people chose a variety of inflation pressures averaging 1.5 psi, and cycle times averaging over 1 minute, suggesting that the BackCycler® was not just massaging soft tissues. Strictly controlled laboratory studies of people without back problems involved two-hour sitting sessions on consecutive days. During sessions with the BackCycler® improvements in discomfort, stiffness and fatigue were at least twice as great. (Figure 1) Twenty-eight people with chronic stable back pain drove motor vehicles with and without the BackCycler® for an average of 5 hours on consecutive days. Mean self-assessment scores with the BackCycler® were at least 3 points better on a 10-point scale for each comfort variable. (Figure 2) Funded by the National Institute for Disability and Rehabilitation Research, this research won a first prize from the International Society for the Study of the Lumbar Spine and was published in The Journal of Spinal Disorders, Volume 7, pages 29-34, 1994.



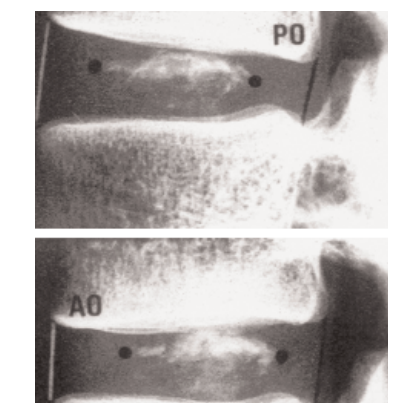
X-RAYS DEMONSTRATE BACKCYCLER®'S EFFECTIVE AND SAFE SPINAL MOTION

Once it was clear that the BackCycler® made people more comfortable while sitting, many spine physicians and researchers asked how far it moved the spine in order to be so effective, yet safe. Therefore, two veteran users underwent lateral spinal fluoroscopic x-ray analysis while applying the BackCycler® at customary, maximally comfortable inflation pressures. The change in spinal positions between inflation and deflation are shown in the x-rays on the right. Cobb angle changes from L1 to the sacrum as seen in the diagram on the left were 21 and 41 degrees, similar to the movement that occurs when one rises from unsupported sitting to standing. These changes clearly showed that the BackCycler® works through cyclic spinal repositioning rather than through some superficial massage effect. The spinal motion is well within the safe limits of usual daily activities. This study was presented at the Chiropractic Centennial Foundation and published in the Journal of the Neuromusculoskeletal System, Volume 3, pages 192-196, 1995.



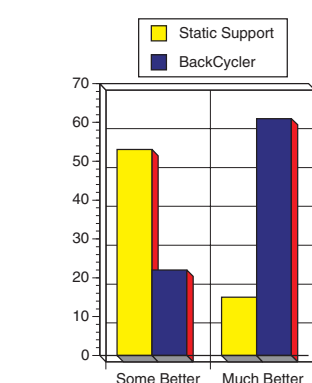
THE BACKCYCLER® AFFECTS INTERVERTEBRAL DISC FLUID DYNAMICS

The intervertebral disc is the most notorious source of serious back pain. Long-term disc degeneration contributes to painful conditions and the static loading of sitting has been blamed for accelerating this process. The disc has no blood supply and relies on spinal positional changes to create a pumping effect to drive in fluid and nutrients and expel metabolic wastes. These fluid dynamics can be studied by measuring a person's height over time, since fluid-filled discs are taller than "dry" ones. Researchers at the University of Waterloo compared subjects' heights before and after sessions of five sitting conditions: unsupported flexion, unsupported extension, unsupported alternating flexion/extension, static lumbar support, and the BackCycler®. There was significantly less spinal shrinkage and perceived discomfort with the BackCycler® than with the static postures. This study was presented and published in the Proceedings of the Human Factors Association of Canada, pages 91-95, 1995.



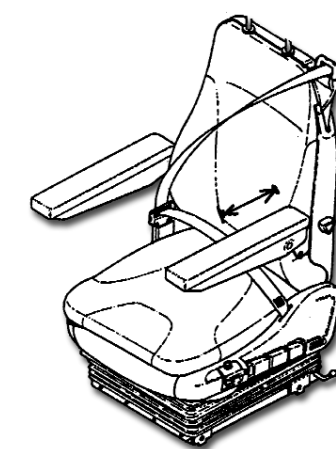
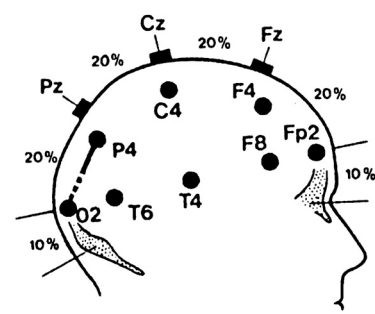
TRUCK DRIVERS PREFER BACKCYCLER® TO STATIC LUMBAR SUPPORT

Beyond the common association between sitting and back pain, people who drive motor vehicles 4 or more hours per day triple their risk for disc herniation, and truck drivers have a particularly high rate of low back pain. Some researchers have speculated that the spinal ligaments and disc linings may stretch or "creep" under the constant load that occurs with the prolonged confined sitting and vibration in motor vehicles. The resulting deformation may be painful and may lead to injury when the driver gets out and strains the back while bending or lifting. At the University of Vermont, 49 truck drivers used the BackCycler® and a static support for 6 months each in random order. Both devices improved overall and driving related self-assessments of back pain and discomfort. However, as seen in the graph on the right, at the end of the year 61% of the drivers stated the BackCycler® made their back feel much better compared to only 15% for the static support.



THE BACKCYCLER® IMPROVES ALERTNESS DURING SIMULATED MOTOR VEHICLE OPERATION

As proof of the BackCycler®'s comfort effects mounted in multiple academic and commercial studies, there was some concern that motor vehicle operators might be made too comfortable and drowsy. Since up to 10% of the most serious motor vehicle accidents may be due to driver somnolence, Sweden's Arbetslivsinstitutet investigated the effect of the BackCycler® on the alertness of ten people in a motor vehicle seating laboratory. Using brain wave analysis (ElectroEncephaloGraphy) and repeated questioning, they tested ten people during a carefully controlled series of 30-minute sessions with and without the BackCycler®. While oral reports confirmed the expected comfort effects, EEG and subjective ratings showed driver alertness was significantly greater with the BackCycler®. This study has been published as Arbetslivsrapport NR2000:9, ISSN 1400-8211. A discussion of these findings at the Society of Automotive Engineers' 2001 World Congress concluded that the BackCycler®'s reduction of spinal strain may reduce the mental and physical fatigue associated with motor vehicle operation.



FROM THE LABORATORY TO THE REAL WORLD

Beyond the academic and institutional research foundation for the BackCycler® outlined above, commercial testing and surveys have produced broad support for its effectiveness in multiple real world settings. United Airlines has installed 10,000 BackCycler® seats, tripling their low back support comfort ratings. In the automotive industry, both Lear and Johnson Controls have had very positive results with controlled ride testing. In 2000 the BackCycler® consumer model was rated by the Good Housekeeping Institute in consultation with the American Academy of Orthopedic Surgeons as the #1 product for people with back pain. From its proving grounds in academic laboratories the BackCycler® has emerged into diverse global applications including commercial and private aircraft, automobiles, buses, home furniture, and heavy trucks.

