Is lumbar lordotic continuous passive motion effective for prevention of low back pain in prolonged sitting?

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Introduction: Low back pain commonly reduces tolerance for prolonged sitting required by many occupations and routine daily activities. Even people without clinical histories of low back pain report pain with prolonged static sitting (Andersson GBJ et al). Many tasks that require prolonged sitting demand a static spinal posture in order to maintain a constant distance between the seated person and the object of the desk. Previous study demonstrated that the support of the lumbar spine in seated posture is sufficient to rest the back muscle. Lumbar lordotic support during sitting decreases pressure in intervertebral discs and reduces paraspinous myoelectric activity (Andersson GBJ, et al. Floyd WF, et al. Lundervold, AJS, et al).

Reinecke et al. developed a pneumatic device to provide lumbar lordotic continuous passive motion (CPM) as an effective tool for prevention of low back pain in prolonged sitting position. They compared differences in the effects between with and without CPM, and demonstrated that CPM improved comfort for subjects with or without low back pain, just as the treatment of peripheral joint lesions has recently been improved by using CPM. Unfortunately, they did not compare differences in the effects between CPM and lumbar support.

Purposes: The purpose of this study is to compare the effects of lumbar CPM to those of lumbar support in prolonged seated position.

Materials and Methods: A pneumatic device was developed. This device includes a lumbar support bladder, which is cyclically inflated and deflated by a pump and valve system. This system is controlled by a timer and pressure feedback from the bladder. The bladder is 15 cm high, 3 cm thick when fully deflated, and 0.5 cm thick when fully deflated. Fifteen male normal volunteers with mean age of 21.4 years, height 173.1 ± 5.4 cm, and weight 610 ± 95.3 N were recruited. The seat was kept deflated, and the other period the bladder was kept inflated, and deflated by a pump and valve system. This system is controlled by a timer and pressure feedback from the bladder. The bladder is 15 cm high, 3 cm thick when fully deflated, and 0.5 cm thick when fully deflated.

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Subjects sat in a chair for a 2-hour period on each of 3 consecutive days. During one test period the CPM device was turned on, during one period the bladder was kept inflated, and the other period the bladder was kept deflated. Lasting deflation represents a state of chair without lumbar support and lasting inflation represents that with lumbar support. Each subject marked 10 cm visual analogue scales (VAS) of lumbar discomfort, stiffness, fatigue, and buttock numbness after 120 min of testing. The means of VAS scores in 3 different periods were compared with paired T tests.

Results: The mean preferred maximum pressure within the CPM bladder was 5.89 ±1.47 kPa. There is an almost linear relationship between mean preferred pressure and body mass index. Average movements of the body parts are shown in figure 1. Significant differences were noted in contact areas (p<0.005) and peak pressures in the human-seat interface (p<0.05). Contact areas were 237.2 ± 73.1 cm² with inflated bladder and 195.3 ± 68.6 cm² with deflated bladder. Peak pressures were 13.08 ± 2.09 N/cm² with inflated bladder and 11.68 ± 2.00 N/cm² with deflated bladder. Compared with deflated bladder, VAS improvements with inflated bladder were statistically significant in lumbar discomfort and fatigue. VAS improvements with CPM were statistically significant in lumbar discomfort, fatigue and buttock numbness. However, there was no significant difference in comparison between inflated bladder and CPM (Figure 2).

Discussion: On account of minimal motion in head, knee and foot, lordotic CPM is considered to be feasible for task-oriented seating and would not disturb desk work and driving. Because VAS scores improvements with CPM did not significantly surpass those with inflated bladder, effect of CPM exceeding over lumbar support in prevention of low back pain may be limited. However, VAS score in buttock numbness improves only with CPM. This effect of CPM can be explained by the results of pressure distribution of the human-seat interface. Further studies are needed to determine whether CPM can reduce occupational disability due to sitting intolerance and whether CPM is feasible in patients with low back pain.

References