Posture and Back Pain

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Optimization of human posture has been studied extensively through the years. The task of improving posture to improve functioning and decrease pain is an ongoing endeavor. The scientific literature reveals a robust effort to study the effects of posture on human performance and suffering. Recent technologies allow for promising new breakthroughs in delivering individualized, sensor-based biofeedback to improve posture and spinal pain.

Some have defined posture as "the average orientation of the body parts over time." (Bridger 2003), while others define it as "simply position or alignment of body parts" (Trew and Everett 2001). Perhaps more important implications of posture include more dynamic aspects of its dimensions such as length of time held in that posture or the effects on an individual who maintains that posture (Wilson and Corlett 2005).

It is known that posture affects physiology and anatomy. With sitting or flexion of the lumbar spine, intervertebral pressure increases, the gelatinous center of the disc known as the nucleus pulposus is posteriorly displaced, the diameter of the spinal canal is widened, and the load on the zygoapophoseal (facet) joints is decreased. With standing or lumbar extension, the opposite effects occur (Adams et al, 2006). With sitting or standing in neutral posture with reference to the line of gravity, muscle activity in the lumbar spine is minimal (Bogduk 1997, Mackenzie and May 2003). The more off the center of gravity the positioning, the more the trunk muscles must work in order to maintain that position.

Numerous studies have evaluated the effects of having specific postures and back discomfort (Adams et al 2002, Harrison et al 1999, Pynt et al. 2001, Pynt et al 2008, Vergara et al 2002, Shibata et al 2010). Studies have found that sitting in extreme postures, such as excessive kyphotic posture with flexion of the lumbar spine or excessive lordotic posture with extension of the lumbar spine in some people correlated with findings of low back pain (Dankaerts et al 2006). Analysis of the literature demonstrates that kyphosed seated postures when sustained are more harmful to the health of the lumbar spine than lordotic seated postures (Pynt et al 2008). Literature reviews have found that specific subclassifications of spinal posture, particularly flexion, may aggravate back pain (Lomas et al).

Multiple ergonomic studies have been performed which have revealed an association
between back pain and poor work postures (Maria et al. 2006, Burdorf et al. 1993, Nowotny et al. 2011, Keyserlinga et al. 1988, Tissot et al. 2009, Wong et al. 2009). Seating arrangements can play a role. If the backrest inclination remains between 10 and 30 degrees it is preferable for preventing low back pain (Shibata et al 2010). Changing to an optimal sitting posture results in less EMG activity and activation of the paraspinal muscles (Basler et al 1997). In addition, researchers found that control of spinal stability was significantly reduced in asymmetric postures (Granata et al 2001). A number of specific postural characteristics associated with spinal pain have been identified, including a decreased lumbar lordosis (Chaleat-Valayer et al 2011). Researchers found that subjects were much less accurate in reestablishing proper lumbar posture after 300 seconds in a slouched posture versus after 3 seconds in a slouched posture, suggesting a loss of proprioceptive control during prolonged slouching (Dolan et al 2006).

With individualized ergonomic intervention, sitting posture in computer operators can be improved along with symptoms of low back pain (Pillastrini et al 2010). Patients with chronic low back pain who received physical therapy with postural biofeedback had markedly improved pain and range of motion compared with those who received physical therapy without the postural biofeedback component (Magnusson et al 2008). Office workers can be trained to improve their sitting posture using both traditional ergonomic training methods as well as with frequent visual feedback of their posture, but those trained with frequent visual feedback had a sustained improvement over time in posture and back pain (Taieb-Maimon et al 2011).

Individualized sensor-based biofeedback devices have been studied for many years and have been shown to significantly improve spinal posture (O’Brien et al 1970). As sensor technologies have improved, more recent studies have demonstrated significant results in measuring and improving trunk and spinal posture when individuals have worn accelerometer and gyroscope sensors with real-time biofeedback (Wong et al 2008, Wong et al 2008, Breen et al 2009, and Culhane et al 2002). In one study, a sensor attached to the body recorded trunk position and movement in the participants over 3 days. When feedback signals were provided, subjects improved their posture, suggesting that a similar system could be used to monitor everyday activity (Wong et al 2008). In another study, researchers used an accelerator-based biofeedback device to determine posture of computer users. If posture was poor, they were alerted and a visual representation of their poor posture appeared on the computer monitor. Subjects' posture improved more when this visual feedback was provided than when it was not. (Culhane et al 2002). Researchers developed a garment with integrated accelerometers and gyroscopes to provide feedback on posture. The device was demonstrated to be highly accurate in measuring lumbar tilt, and, when worn, the garment significantly improved lumbar posture (Wong et al 2008). Another group studied accelerometer-based biofeedback systems for real-time correction of neck posture in computer users. All subjects had a significant decrease in the percentage of time spent in bad posture
when using visual biofeedback (Breen et al 2009). These studies have demonstrated significant advances in individualized, real time, visual and sensory biofeedback posture training using sensor-based accelerometer and gyroscope technologies.

It is clear that human dynamic and static posture is a complex issue. There are numerous scientific correlations between poor posture, spinal pain, and decreased functioning. An extensive literature search reveals a correlation between spinal pain and poor posture, most notably that prolonged, excessive flexion of the mid and lower back (i.e. a “slouched” posture), can aggravate back pain. New sensor and feedback technologies now allow for a potential revolution in improving individual posture and human performance through the use of real-time, personalized biofeedback devices.

References


