

Original Article

Lumbar spine reposition sense: The effect of a ‘slouched’ posture

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Received 27 October 2005; received in revised form 14 February 2006; accepted 2 March 2006

Abstract

Proprioceptive control is considered important for spinal stability and prevention of injury. However there is evidence that proprioceptive structures, that are reflexive and viscoelastic, are challenged by commonly adopted ‘slouched’ postures. The aim of this study was to investigate the effect of such postures on proprioceptive control. The reliability of a flexible electrogoniometer was established ($ICC = 0.89$). Using a repeated measures design ($n = 32$, 80% power detecting 0.5° difference at 95% significance) subjects repositioned their lumbar spine immediately (3 s) and following 300 s in a ‘slouched’ posture, with a 15-min interval in between. Results showed a significantly reduced lumbar spine reposition sense following 300 s in a ‘slouched’ posture as compared with 3 s in a ‘slouched’ posture ($P < 0.001$), mean difference 3.92° (SD 4.35). Based on this sample, there was evidence that a ‘slouched’ posture, of 5 min duration, would increase reposition error by more than 2.35° and less than 5.48° ($n = 32$, CI 95%). These findings support the practice of postural education to reduce potential to proprioceptive loss and injury. The electrogoniometer shows potential for use in clinical practice.

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Keywords: Reposition sense; Lumbar spine; Proprioception; Posture**1. Introduction**

Low back pain is considered to be a major clinical and public health problem in the UK (CSAG, 1994; Waddell, 1998). It is described as having reached epidemic proportions in most western industrialized countries with 60–80% of all adults suffering from low back pain at some point during their lives (Waddell, 1998). A survey by CSAG in 1993 reported that 52 million working days were lost due to back pain in the UK (CSAG, 1994). It has been suggested that a slouched posture is one factor that may contribute to low back pain (Dolan et al., 1988; Kendall et al., 1993). A slouched or flexed posture commonly occurs in day-to-day sitting activities and is defined as a relaxed sitting posture with a flexed lumbar spine (Dolan et al., 1988; Kendall et al., 1993). In this posture, the neutral

position is lost and the spine is potentially exposed to injury (Panjabi, 1992a, b).

Panjabi (1992a, b) has identified a ‘neutral zone’ described as a few degrees of spinal movement that is controlled by proprioceptive neuromuscular reflexes. A possible link between slouched postures and predisposition to low back pain is the loss of neutral zone control due to loss of proprioceptive reflexes. Loss of neutral zone control has been associated with degenerative changes (Panjabi and Goel, 1982) and linked with pain symptoms (Panjabi, 2003) and loss of proprioceptive control has been associated with low back pain populations (Gill and Callaghan, 1998; Koumantakis et al., 2002; O’Sullivan et al., 2003). There is evidence that reflexive activity of proprioceptive structures and viscoelastic properties of spinal tissues are challenged by stretch or by flexed postures (McGill and Brown, 1992; Adams and Dolan, 1996; Solomonow et al., 2001). Reflexive muscle activity has been found to be reduced by application of a stretch to spinal ligaments (Solomonow et al., 2001), and in looking at in vivo cat spines

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they found that a 10 s stretch applied to the supraspinous ligament reduced multifidus activity by 50%. In humans there is evidence of a direct link between lumbar muscle activity and proprioceptive control (Brumagne et al., 1999b) and evidence of rapid viscoelastic changes in ligaments and other spinal tissues in response to stretch (McGill and Brown, 1992; Adams and Dolan, 1996). Examining cadaveric spines, Adams and Dolan (1996) found a 42% change in ligament tension in response to a 5-min stretch and McGill and Brown (1992) identified a creep response of a 5° increase in flexion when maintaining a slouched posture for 20 min.

If individuals spend time in flexed postures, the implication is that their spinal proprioceptive neuromuscular reflexes will be affected. Physiotherapy advocates postural awareness and re-education, and for a modern lifestyle where there is a tendency towards flexed postures, the ability to reposition after a period of time in flexion is important for prevention of low back pain and injury. The aim of this study was to evaluate the effect of prolonged 'slouched' posture on lumbar spine reposition sense compared to immediate reposition sense in asymptomatic subjects. It was hypothesized that the accuracy of lumbar spine repositioning would be reduced in those subjects that sat in a prolonged 'slouched' posture compared to those that did not.

2. Methods

2.1. Design

A repeated measures design was used to determine the effect of 'slouched' posture on reposition sense. The order of testing was randomly allocated to either repositioning after 3 s slouch or after 300 s slouch. Lumbar spine position was measured with an electrogoniometer that stored the data. The researcher was blind to the results since the data was not displayed during data collection. All measurements were taken on one occasion to reduce error. The outcome measure was reposition error as a measure of proprioception (McCloskey, 1978).

2.2. Sample

A convenience sample of 32 was selected based upon a power calculation ($P > 0.05$, 80% power, Sim and Wright, 2000) for clinical significance with a detectable difference of 0.5°. The sample included 12 males and 20 females with a mean age of 22.66 (SD 5.16) and body mass index 25.68 (SD 3.23).

2.3. Inclusion and exclusion criteria

The inclusion criterion was an age range of 18–40 years (Kaplan et al., 1985; Parkhurst and Burnett, 1994). Exclusion criteria was a previous history of low back pain and/or back surgery (Brumagne et al., 1999a), current or recent ear infection or vestibular disorder (McCloskey, 1978; Brumagne et al., 1999a) and previous hip pain or injury (Brumagne et al., 1999a; O'Sullivan et al., 2003). Ethical approval was obtained and participants received information sheets and gave informed consent.

2.4. Measurement

Lumbar spine reposition sense was measured using a flexible M180B electrogoniometer (Biometrics Ltd., UK) connected to a dual channel data logger (Biometrics DL1001). Results were uploaded onto an IBM-compatible computer using Biometrics DL1001 Version 3.2 software. Subjects sat on the end of the plinth, hips and knees at approximately 90°, facing a blank wall 1 m away. Two electrodes were placed at L1 and S1, as recommended by Biometrics (2002). The 'upright' starting posture was aligned, by the researcher, as the anterior and posterior superior iliac spines being level in the horizontal plane (Maffrey-Ward et al., 1996).

2.5. Procedure

The subject was requested to 'sit in an upright posture' by the researcher. Prior to each test, ten practice repetitions of repositioning to 'upright' posture were performed with the researcher providing manual facilitation and verbal feedback. For each reposition test the subject was asked firstly either to 'slouch and return immediately to your upright posture' (3 s, test 1) or requested to 'slouch and return to your upright posture when instructed' (300 s, test 2) depending on randomized order of testing (Figs. 1 and 2). A rest period of 15 min between tests allowed for tissue recovery (McGill and Brown, 1992).

2.6. Reliability

The reliability study was to determine the extent that the measures were repeatable for serial measurements. The time period or placing of the electrogoniometer were not considered to be a potential source of error as the electrogoniometer remained in position throughout. Stability was determined for a single investigator collecting data from the same individuals. Intra-rater reliability of reposition measurement was calculated from the first 18 subjects (80% power to detect intraclass correlation coefficient (ICC) 0.7–0.9 at 95% significance, Walter et al., 1998) from the planned study

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