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Original Article

Altered lumbopelvic movement control but not generalized joint hypermobility is associated with increased injury in dancers. A prospective study☆

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ABSTRACT

Dancers experience significant more low back pain (LBP) than non-dancers and are at increased risk of developing musculoskeletal injuries. Literature concerning the relationship between joint hypermobility and injury in dancers remains controversial. The purpose of this study was therefore to examine whether lumbopelvic movement control and/or generalized joint hypermobility would predict injuries in dancers. Four clinical tests examining the control of lumbopelvic movement during active hip movements were used in combination with joint hypermobility assessment in 32 dancers. Occurrence of musculoskeletal injuries, requiring time away from dancing, was recorded during a 6-month prospective study. Logistic regression analysis was used to predict the probability of developing lower limb and/or lumbar spine injuries. Twenty-six injuries were registered in 32 dancers. Forty-four percent of the dancers were hypermobile. A logistic regression model using two movement control tests, correctly allocated 78% of the dancers. The results suggest that the outcome of two lumbopelvic movement control tests is associated with an increased risk of developing lower extremities or lumbar spine injuries in dancers. Neither generalized joint hypermobility, evaluated with the Beigthon score, nor a history of LBP was predictive of injuries. Further study of these interactions is required.

1. Introduction

Dancers are at increased risk of developing Low Back Pain (LBP) (McMeeken et al., 2001), as they regularly perform repetitive extensions, high velocity twisting and bending movements. Given the exceptionally high flexibility required for dance, it is not surprising that repetitive movements to extreme positions can contribute to pain. Several studies have revealed increased flexibility and hypermobility in dancers (Klemp et al., 1984; Gannon and Bird, 1999; McCormack et al., 2004). While hypermobile (non-dancing) individuals may be asymptomatic, hypermobility is a predisposing factor of musculoskeletal pain/injury (Kirk et al., 1967; Simmonds and Keer, 2007). It has been suggested recently that evaluating the quality of movement could be more important than measuring the quantity of movement in hypermobile individuals (Simmonds and Keer, 2007). Impaired proprioception has been found in hypermobile individuals (Mallik et al., 1994; Hall et al., 1995). It has been suggested that this could lead to recurrent joint trauma and consequently musculoskeletal pain (Fitzcharles, 2000). Hence, proprioceptive and motor control training have been used in the treatment of hypermobile individuals (Russek, 2000; Ferrell et al., 2004).

The literature concerning the relationship between joint hypermobility and injury in dancers remains controversial (Klemp and Learmonth, 1984; Klemp et al., 1984; McCormack et al., 2004). An extremely high prevalence of injuries has been described in dancers (Garrick and Requa, 1993). Of all professional dancers in Australia, 89% sustain injuries which affect their career and

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approximately 50% of professional dancers have persistent/recurrent injuries (Crookshanks, 1999; Negus et al., 2005). However, it is not clear whether this high prevalence of injuries is related to hypermobility. One hypothesis is that the high prevalence of injuries including LBP is due to repetitive movements in the hypermobile range of movement, which is typical for dancing (McCormack et al., 2004). Another hypothesis is that impaired motor control of the lumbopelvic region leads to compensatory movements of the spine and lower limbs, which results in injuries (Zazulak et al. 2007a, b). However, motor control has not been examined in dancers, despite the high prevalence of LBP in this young population. Therefore, we undertook a study to examine the relationship between motor control, hypermobility and injuries (including LBP) in dancers.

Generalized joint hypermobility can be easily screened according to the Beighton modification of the Carter and Wilkinson criteria. Hypermobility is generally defined as a score higher or equal to 4/9 on the Beighton scale (Beighton et al., 1999). Less consensus exists for defining motor control impairments in clinical settings. A typical feature of impaired motor control is a reduced control of active movements (Luomajoki et al., 2007). An important part of the rehabilitation process, therefore, consists of training of specific lumbopelvic stabilization, independent of any trunk, lower or upper limb movement (Richardson et al., 1992; Sahrmann, 2002). The ability to activate muscles to isometrically hold a position or prevent motion at one joint, while concurrently producing an active movement at another joint, is a movement control test (Mottram and Comerford, 2008). Several authors voice the need for a clinical assessment of active movement control in LBP-patients (Maluf et al., 2000; O'Sullivan, 2005; Luomajoki et al., 2007), but information regarding the clinimetric properties of simple clinical movement control tests is lacking.

1.1. Study aims

The purpose of this study was to examine whether altered lumbopelvic movement control and/or generalized joint hypermobility would predict musculoskeletal injuries to the spine and lower extremities in dancers. In addition, the inter-observer reliability and internal consistency of the four clinical tests examining lumbopelvic movement control were evaluated in patients with chronic LBP and healthy subjects.

2. Methods

2.1. Subjects and research design

All students following a full-time professional Dance Program in Belgium ($n = 32$) were recruited for the prospective part of the study. Twenty-six female (81%) and 6 male (19%) students, aged 20 ± 2 years (range[17–25]) participated in the study. Baseline assessment included medical history, examination of lumbopelvic movement control and generalized joint hypermobility. Movement control and hypermobility were examined by an assessor blinded to the medical history of the dancer.

The occurrence of injuries of the dancers was recorded every 2 weeks during a 6-month follow-up period, by assessors blinded to the outcome of the baseline assessment. Injuries were defined as any musculoskeletal condition requiring time away from dancing and were registered using a standardized questionnaire and subjective evaluation.

Prior to participation, all subjects received verbal and written information addressing the nature of the study. Demographic information was recorded by the time of testing. The Human Research Ethics Committee of the University Hospital approved the study and written informed consent was obtained from all participants prior to testing.

2.2. Instrumentation

The Pressure Biofeedback (PBU) has been developed to monitor lumbopelvic movement by recording pressure changes during assessment and exercise (Richardson et al., 1992; Jull et al., 1993). Calibration studies demonstrated that pressure recordings resulted from lumbopelvic movement and positional changes and were independent of the individual body weight (Jull et al., 1993). The PBU is sensitive to small movements associated with deep muscle recruitment within 2 mm Hg of pressure change (Falla et al., 2003). A high level of agreement has been found between the results of the prone abdominal drawing-in test, recorded with the PBU and converted to categories and a delayed contraction of transversus abdominis (Hodges et al., 1996). Furthermore, a blinded observer was able to detect the presence or absence of LBP with the use of the prone abdominal drawing-in test, recorded with the PBU (Cairns et al., 2000).

The visual analogue scale (VAS – 100 mm) was used for the assessment of lumbar pain severity. The VAS score is believed to be reliable, valid, and sensitive to change (Jensen et al., 1986; Ogon et al., 1996).

An international long-arms goniometer[1] was used for the evaluation of elbow and knee joint angles (assessment of generalized joint hypermobility).

A standardized questionnaire was used to collect demographic information at baseline, and an injury registration form was used for the assessment of musculoskeletal symptoms and injuries (Cumps et al., 2007). With this injury registration form information about the symptoms and injury occurrence, the time loss and the medical diagnosis were gathered. This injury registration form has already been used in prospective epidemiology research in sportsmen (Cumps et al., 2007).

2.3. Procedure

Generalized joint hypermobility was assessed according to the description provided by Beighton et al. (1999). The clinimetric properties of the Beighton score have been summarized elsewhere (Nijs, 2005). Three subgroups were defined based on the individual Beighton scores: tight (0–3); hypermobile (4–6); extremely hypermobile (7–9) (Stewart and Burden, 2004).

Lumbopelvic movement control was assessed by evaluating the subjects' ability to control movement of lumbopelvic region while performing simple movements in the hips. Four commonly used clinical tests, i.e. the Active Straight Leg Raising (ASLR), Bent Knee Fall Out (BKFO), Knee Lift Abdominal Test (KLAT) and Standing Bow (SB), were used in the present study for the evaluation of lumbopelvic movement control. ASLR, BKFO and KLAT were performed in supine position and monitored with a PBU. The pressure was inflated to 40 mm Hg (baseline pressure) (Richardson et al., 1992). Prior to the test, the subjects performed two inspirations and expirations. The pressure was then readjusted to 40 mm Hg. The participants were instructed to maintain neutral spine position (i.e. preventing spinal movement) during lower extremity movement. The other leg was extended (ASLR, BKFO) or flexed (KLAT), and rested on the table. A pre-testing trial was organized to familiarize the subjects with the PBU and the clinical tests. Maximal pressure deviation from baseline was recorded during each test and these scores were used for further analyses.

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