Knee Surg, Sports Traumatol, Arthroscopy (1993) 1:206–208

Knee Surgery
Sports Traumatology
Arthroscopy

Spinal sagittal mobility and joint laxity in young ballet dancers

A comparative study between first-year students at the Swedish Ballet School and a control group

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Abstract. The present study compares spinal configuration, spinal range of motion and joint mobility in first-year students of the Swedish Ballet School and in non-dancing students of corresponding age and sex in a state school. The study comprises all the first-year (fourth grade) students ($n = 23$) at the Swedish Ballet School: 11 boys and 12 girls. Their dance practice time was 10 h per week. Thirty-six children in the fourth grade at a state school comprised the control group. None of the controls took ballet classes or participated in organised gymnastics out of school. The neutral spine configuration in standing and the sagittal spine mobility were measured using Debrunner's kyphometer and Myrin's inclinometer. Joint laxity was measured by employing a modified form of the Contompasis method. Compared with the controls, the dancers showed a higher incidence of joint hypermobility, greater mobility of the thoracic spine, a less prominent lordosis of the lumbar spine and a less prominent kyphosis in the thoracic spine in the neutral standing position. The dancers had done little or no ballet training before entering the ballet school at the age of ten. The results agree with those of earlier studies and suggest that increased flexibility is an asset for those being selected as future ballet dancers.

Key words: Joint laxity – Spinal sagittal mobility – Young ballet dancers

Introduction

Many studies have consistently found ligamentous laxity in athletes and dancers [10, 13, 14]. Ligamentous laxity has been associated with different clinical syndromes, e.g. Marfan's syndrome, Ehlers-Dunlos disease, osteogenesis imperfecta, various pathological conditions such as subluxation of the shoulder and the patella, and injuries to the ligaments of the knee [13, 14]. It has also been argued that ligamentous laxity may be acquired from overuse of the joint [4, 13]. In a study by Hamilton et al. [5], ballet dancers were found to be flexible but not hypermobile, and to have a range of motion in the hip and ankle joints different from those of the general population.

A professional ballet dancer is a combined artist and elite athlete. Studies have demonstrated that the physical demands of athletic performance in classical ballet are similar to those of traditional sports [12, 15]. Injuries in classical ballet resemble injuries in sports in regard to frequency and localisation [3, 6]. The study by Hamilton and coworkers [5] found that male dancers who had suffered four or more injuries had greater elbow extension and increased straight-leg raising ability than male dancers with fewer than four injuries. The same study demonstrated that female dancers with a limited hip turnout were more frequently injured. However, there are other studies that show no relationship between joint mobility and injury frequence [8, 9].

A study by Öhlen suggests that young female gymnasts with abnormal spinal mobility, increased lumbar lordosis, and generalised joint laxity represent a subset of axial hypermobility that may constitute a specific aetiology for low back pain [17]. It has also been suggested that generalised joint laxity is an aetiological factor in the development of early-onset arthrosis, a condition often seen in professional dancers [1].

The purpose of this study was to analyse spinal sagittal mobility and joint laxity in a group of young ballet dancers.

Subjects and methods

The study included all the first-year (fourth grade) students (11 boys and 12 girls) at the Swedish Ballet School. All were 10 years old. Informed consent was obtained from their parents. Their practice time was 10 h per week. The Swedish Ballet School works closely with the Royal Swedish Ballet. Members of the School often take part in performances given by the Royal Swedish Ballet, and many of the present members of the Ballet were recruited from the School.

Thirty-six children in the fourth grade at a Swedish state school made up the control group (11 boys and 25 girls). All were

This study was orally presented at the First World Congress on Arts and Medicine, New York, February 1992

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10 years old. Informed consent was obtained from their parents. None of the controls took ballet classes or participated in organised gymnastic training during their leisure time. Each child was examined clinically to detect any evidence of scoliosis.

The neutral spine configuration at standing was registered and sagittal spine mobility was measured with Debrunner's kyphometer. This instrument comprises a protractor with a 1° scale at the junction of two double parallel arms connected to blocks large enough to span two spinous processes. The angles of kyphosis and lordosis are read directly from the scale of the kyphometer. The kyphosis was measured between spinous processes C7–T1 and T11–12. The lordosis was measured between T11–12 and S1–S2.

The neutral spine configuration was defined as the spinal posture in the relaxed erect standing position. The child was asked to look straight ahead and stand relaxed with arms hanging. Sagittal ranges of motion were studied in the thoracic and lumbar spine. Total backward bending in the lumbar spine could not be recorded on the Debrunner's kyphometer because many of the children bent beyond its range; instead, for this we used Myrin's inclinometer [11].

Generalized joint laxity was measured by one observer employing a modified form of the Contompasis method as described by McNerney et al. [10]; it comprises six different tests:

1. Passive opposition of the thumb to the flexor aspect of the forearm
2. Passive dorsiflexion of the fifth metacarpophalangeal joint
3. Passive hyperextension of the elbow
4. Passive hyperextension of the knee
5. Calcaneal stance position
6. Hyperflexibility of the spinal column

For the first five tests, a numerical value for each side was determined. For test 6, one value was obtained. Generalized joint laxity was defined as present if the total score was 40 points or more. Values for each side should be equal; a difference in symmetry suggests an acquired type of laxity in the joint concerned. For statistical treatments of results, student's *t*-test was used.

Results

Spinal configuration

Mean thoracic kyphosis was 11.8° (4°–23°) in the ballet group and 29.4° (16°–44°) in the control group ($P < 0.01$). Mean lumbar lordosis was 22.1° (6°–35°) in the ballet group, and 30.7° (15°–53°) in the controls ($P < 0.01$). No differences were found between boys and girls.

Range of motion

The mean sagittal range of motion in the thoracic spine was 71.1° (25°–101°) in the ballet group and 55.0° (20°–103°) in the controls ($P < 0.01$). In the lumbar spine, the mean sagittal range of motion was 95.6° (56°–123°) in the ballet group and 94° (56°–116°) in the control group. No differences were found between boys and girls.

Joint hypermobility

The mean laxity score was 34.3° (22°–55°) in the ballet group and 29.1° (22°–42°) in the control group ($P < 0.01$). Five of the 23 children in the ballet group, as against only 2 of the 36 controls, scored over 40 points. No difference was found between boys and girls.

Discussion

The present study compares spinal configurations, spinal ranges of motion, and joint mobility, in a group of first-year students at the Swedish Ballet School and in a group of non-dancing students of corresponding age and sex in a state school. For all variables except total range of motion in the lumbar spine, statistically significant differences were found between the two groups. Spinal kyphosis and lordosis were less prominent in the ballet dancers than in the controls, while their range of motion in the thoracic spine and joint hypermobility were more pronounced. No differences were found between boys and girls regarding the variables measured.

Of the 23 ballet students, 10 girls had been dancing irregularly before entering the school. There was no difference in spinal sagittal mobility or generalised joint laxity between them and the other ballet students. At their age (10 years) the musculoskeletal system is subjected to various degrees of development and the internal and external design of the bones are modifiable by extrinsic factors [2, 7, 16]. To achieve the qualities of a professional ballet dancer, much is demanded of these children [1, 12]. Repetitive movements at full turnout of the hips and the lower extremities, excessive forward bending of the lumbar spine and, for girls, dancing en pointe, introduced at the age of 11, are examples of activities requiring a large range of motion, correct technique and adequate strength.

Our findings support earlier investigations indicating that axial hypermobility is more likely to be hereditary than a result of excessive ballet training. The results agree with those published by Hamilton et al. [5] suggesting that increased flexibility is an asset in the selection process for ballet dancers. In the same study, hypermobility appeared to contribute to an increased incidence of injuries in male dancers.

We are continuing to examine the ballet and the control groups. The variables investigated in the present study are being used to analyse the relationship between any of our present findings and any future development of joint and/or back problems.

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