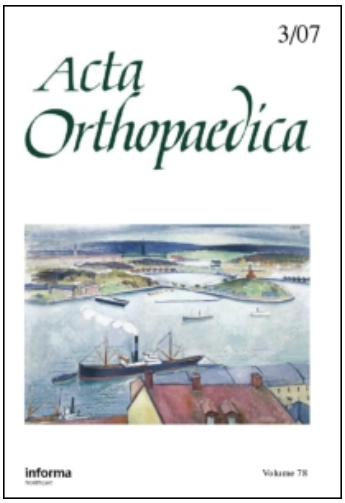

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Anterior cruciate ligament injury in professional dancers

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Background **Anterior cruciate ligament injury (ACL) is a common sport injury; however, there are no data concerning dance and ACL injury. We report the incidence, injury mechanism, and clinical follow-up of ACL injury in professional dancers.**

Patients and methods **In a retrospective cohort study involving the three major dance companies in the Netherlands, by interviewing all 253 dancers who had had a full-time contract during 1991–2002, dancers with symptomatic ACL injury or past ACL reconstruction were identified and examined.**

Results **6 dancers (2 of whom were women) had had a symptomatic ACL rupture and reconstruction. Interestingly, all had been on the left side and had had a similar trauma mechanism: while dancing a classical variation they landed, after a jump, on their left leg, in the turned out position with a valgus force on their knee. There was a higher risk of ACL injury in the classical company than in the two contemporary companies. The risk of dancers having a rupture of the left ACL during a 10-year career in this classical company was 7%.**

Interpretation **ACL injuries are not an infrequently seen type of injury in professional classical dancers, with a very specific mechanism of injury—a landing on the left leg in exorotation. More attention and prophylactic measures should be given to this specific injury mechanism.**

Rupture of the ACL occurs frequently in pivoting sports such as soccer, American football, basketball and handball. The annual prevalence of ACL injuries in the general population has been estimated to be 1 injury for every 3,500 people (Miyasaka et al. 1991). In activities with more rotational forces, such as skiing, the incidence of ACL injury lies between 4.2 injuries per 100,000 skier days for men and 4.4 for women (Viola et al. 1999). The classical trauma mechanism in ACL rupture is a valgus exorotation trauma. In ballet dancing, jumping and landing in exorotation often occurs. To our knowledge, however, there have been no previous studies on the frequency of ACL injury in dancing.

Patients and methods

This study is based on the three major dance companies in the Netherlands: the Dutch National Ballet (HNB), the Netherlands Dance Theatre 1, 2, 3 (NDT), and Scapino Ballet Rotterdam. By interviewing all 253 dancers who had had a full-time contract in the period 1991–2002, 6 dancers were identified who had had a symptomatic ACL injury or reconstruction during this 10-year period.

A questionnaire was filled in by these dancers concerning mechanism of injury, past treatment, and outcome and dance-related complaints. Scoring was done using the IKDC 2000 questionnaire (Hefti et al. 1993, Irrgang et al. 2001). A physical examination was performed with KT 1000 measurements (MEDmetric, San Diego, California).

Statistics

Chi-square tests were used to compare the proportion of symptomatic ACL ruptures between the two contemporary dance companies and the classical dance company. Because of the small proportion

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Figure 1. A grand jeté.

Figure 2. A female dancer performing a cabriole.

of symptomatic ACL ruptures, we used Fisher's exact test. Differences were considered significant at the 0.05 level (one-sided). We used SPSS version 12.1.

Results

From 1991 to 2002, the Scapino Ballet and NDT, both of which are contemporary dance companies with an average of 81 dancers per season, had no dancers with symptomatic ACL injuries. HNB, a classical company, however, had 6 dancers with symptomatic ACL injuries. This company has an average of 82 professional dancers a year. The risk of dancers having a rupture of the left ACL during a 10-year career in this classical company was 7%. The classical company showed a significantly increased risk of having symptomatic ACL injuries compared to the two contemporary companies ($p = 0.02$, power 55%).

With an average working year of 230 dancing days for all 3 companies, these dancers occupy 374,900 dancing days. This gives a risk of 1.6 injuries per 100,000 dancing days. The risk increases to 3.2 injuries per 100,000 dancing days if we only consider the higher-risk classical company.

Figure 3. Landing in a turned-out position with the knee in valgus.

All injuries happened while landing on the left leg in the classical position of exorotation in the hip. The women had both performed a grand jeté (Figure 1). The 4 men landed on their left leg after a cabriole (Figure 2). In 50% of cases, these jumps were during performances.

The 6 dancers, all of who had had a complete ACL tear of the left leg, underwent either auto- or allograft (bone-patella-tendon-bone) or a hamstring graft reconstruction. The dancers were examined by us on average 5 (2–10) years after surgery. 3 had nearly normal IKDC scores and 3 had abnormal scores (with an average subjective IKDC score of 85 (68–97)). Instrumented laxity testing at maximum showed 4 knees with less than 3 mm of side-to-side difference and the others with 4 mm and 5 mm of side-to-side difference.

After the injury, all 6 dancers had some persistent feeling of insecurity when landing on jumps. After returning to dancing, 3 of the 6 dancers subsequently stopped dancing because of this handicap.

Discussion

6 dancers in the classical company had had ACL injuries, but no such injuries had occurred in the 2 contemporary dance companies. This difference cannot be explained by the schedules, the dancing hours, or the stage floor, as these are very similar (Versteeg 2000). All three companies have a similar full-time dance load. On average, they give more than 100 performances a year and the dancers normally work 5–6 days per week. One possible explanation is the difference in repertoire (Versteeg 2000). In a classical dance company, the number of jumps is far greater than in a more modern company and these landings will be in en dehors, the classical turned-out position of the leg. Landing in this turned position is probably the most important risk factor behind such ACL injuries in dancers.

The injury mechanism was similar for all dancers. They landed from a jump with the hip and foot turned out, with a valgus stress on the knee (Figure 3). The mechanism that most often accounts for ACL injury is adduction/internal rotation of the hip, valgus and external rotation of the knee, and pronation of the foot (Ireland et al. 2002, Hewett et al. 2005,). The only difference here is that, instead of an internal rotation of the hip, there is external rotation with a relatively more pronounced external rotation of the lower leg and foot.

One striking finding was that all injured cruciate ligaments were on the left side. This may not be coincidence. In ballet, all turns and jumps are performed left and right in training; however, on stage and during rehearsal the majority of the turns are performed to the right, where the left leg is the supporting and landing leg. With a grand jeté, however, one pushes off with one leg and lands on the other. The 2 female dancers pushed off with their right leg and landed on their left. In a solo, a dancer makes his/her own choice. The majority choose the left leg as the supporting leg.

Limitations of this study were the small numbers in this elite group, and the fact that the follow-up was retrospective. However, the number of actual dancing years is high. It is possible that some ACL injuries were missed, or were asymptomatic. This could give an underestimation of the number of true ACL ruptures. However, this group of athletes is watched continuously during training and performance, and a trauma on stage would be difficult to miss.

Because of the small numbers, the different reconstructive techniques used, and the different rehabilitation programmes, it is difficult to comment on the clinical outcome of the ACL treatment. However, 3 out of 6 had to stop dancing at this high level. An ACL rupture appears to be a real threat to a dancing career.

The incidence rate of 3.2 symptomatic ACL ruptures per 100,000 working days is nearly as high as the well-recognized high risk of ACL injury in professional skiers (Viola et al. 1999). A soccer or basketball player—especially a female—does, however, have a 3–5 times greater chance of ACL tear in an athletic event than a professional dancer (Agel et al. 2005, Mihata et al. 2006). There should be better awareness of this kind of injury in dancers, especially as it can end one's career. There should also be more preventive measures, focusing on dance technique, neuromuscular training, and avoidance of an excessive knee abduction moment—with landing in a less exorotated, pronated foot position (Hewett et al. 2005).

Contributions of authors

DM designed the study, examined all patients, collected and analyzed the data, and wrote the manuscript. JV supervised the analysis and proofread the manuscript.

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