

Prolonged stretching can improve range of motion in dancers who suffer from knee injuries related to iliotibial overuse.

# Dancers restore knee flexion through dynamic splinting

**K**nee flexibility is imperative to dance performance. Overuse of the iliotibial band can make the knee symptomatic and contribute to decreased range of motion.<sup>1</sup> Regaining knee flexibility is a primary goal in orthopedic rehabilitation for injuries ranging from acute anterior cruciate ligament tears<sup>2</sup> to chronic patellofemoral pain syndrome.<sup>3</sup> ITB syndrome or excessive ITB tone are considered common causes of lateral knee pain in dancers,<sup>4</sup> and require a rehabilitative focus suitable to the injury.

by Buck Willis, PhD

Knee dysfunction in dancers can best be understood by considering the biomechanics of the ITB.<sup>5-7</sup> The ITB consists of fascia from the gluteus maximus and tensor fascia lata musculature. It originates at the iliac crest and inserts between Gerdy's tubercle and the lateral femoral epicondyle. The ITB serves as a ligament connecting the femoral condyle and lateral tibia. It helps stabilize the knee and abduct the hip. It also contributes to internal rotation of the hip (when flexed to 30°) and assists in initial knee extension and flexion.

ITB syndrome, which causes pain and dysfunction, is linked to knee biomechanics and overuse. Knee flexion exerts tension on the ITB and pulls it over the lateral femoral epicondyle. Full extension then returns the ITB to its initial position. Repetitive flexion and extension can inflame the bursa, which may lead to decreased ROM as an autonomic protective measure (Figure 1).

The association between the ITB and knee pain was established by Winslow and Yoder<sup>6</sup> in a study of 41 female ballet dancers. The researchers administered a pain

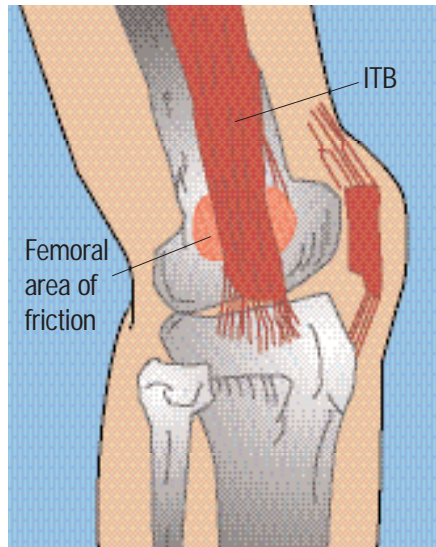


Figure 1. Iliotibial band syndrome is caused by repetitive flexion and extension of the ITB, which can inflame the bursa and lead to decreased range of motion.

survey to determine the incidence of knee pain in different ballet positions. Twenty-four subjects who affirmed that they experi-

enced pain in three of the five ballet positions were categorized as symptomatic. They were given an orthopedic physical exam, which included an Ober test to measure ITB tone (or tension) to rule out pathologies such as meniscal tears.

ITB tone was measured again after the dancers executed different dance positions. These included the turned-out position, which involves external tibial rotation, and the demi-plié, which is a half bend at the knee with external tibial rotation. Using a chi-square test for statistical analysis, Winslow and Yoder determined that a significant relationship existed between ITB tightness and patellofemoral knee pain. They concluded that a tight ITB pulls the patella laterally during flexion, which predisposes a dancer to knee pain.

The need for knee flexibility conditioning and prevention of overuse or overloading of the knee is considered integral to participation in dance.<sup>7-11</sup> Steinberg et al<sup>12</sup> examined ROM in 1320 dancers and 226 non-dancers, ages eight to 16 (mean age, 13.3 years) to find out if joint ROM among

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## Dancers' knee injuries often require increased flexibility training to regain foot flexion.

dancers increases as they get older. In order for ballet dancers to execute perfectly such movements as the plié, which involves external tibial rotation, they depend on optimal ROM.

The study examined ROM patterns by testing ankle plantar flexion and dorsiflexion; hip external rotation, internal rotation, abduction, extension, and flexion; knee flexion; and lower back and hamstring flexibility. The researchers concluded that ROM in adolescent dancers did not improve with age, and that dance programs should focus on exercises that help dancers retain the natural flexibility of their joints.<sup>12</sup>

Flexibility training and the time required to return to preinjury ROM was examined by Askling et al<sup>13</sup> in a comparison of acute hamstring strain in runners versus professional dancers. Although the initial loss of flexibility was more acute for runners, the

recovery time for dancers was substantially longer (median duration: 16 weeks for runners, 50 weeks for dancers). The researchers concluded that the difference may be attributed to the etiology of the strain: the dancers' injuries took place during slow, focused, often eccentric movements, whereas the runners' injuries occurred during high-speed concentric contractions in sprinting.

Ballet and jazz dance are considered to be among the most physically demanding activities on the musculoskeletal system, evidenced by a high preponderance of knee injuries. Professional ballet dancers have an incidence rate of 1.7 injuries per dance year. A large number of these are overuse injuries that cause knee dysfunction.<sup>9</sup> Dancers' knee injuries often require increased flexibility training to regain flexion, and such rehabilitation requires prolonged durations of stretching.<sup>9</sup> The cause of a dancer's injury is

related to the position or movement the knee was in when the injury occurred, and knee-specific flexibility training is required to improve lower extremity kinetics and kinematics and reduce stiffness.<sup>10</sup>

### Case report

A 17-year-old dancer suffered severe knee pain requiring surgery and four weeks of physical therapy for severe, chronic patellar dislocation and deficits in knee flexion. Deficits in knee extension were also present but were manageable with standard ROM therapy. The physical therapy included myofascial release, mobilization techniques, massage, and neuromuscular reeducation of movement patterns. These modalities were successful in restoring full ambulation and knee extension, but the patient still lacked the knee flexion required for performance.

To resolve the dancer's contracture, a

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Figure 2. Dancers are at heightened risk of lateral knee pain because of the added tension knee flexion places on the iliotibial band.

knee flexion Dynasplint system (Dynasplint Medical Systems) was prescribed to be worn nightly for four weeks. The Dynasplint was customized for the patient's leg length and girth. She and her mother received instruction on how to put on and take off the device and change tension calibration (based on patient tolerance).

Initially the Dynasplint was used with a tension setting of 5.2 foot pounds of force. The dancer was directed to increase flexion with a low-load prolonged-duration stretch. She wore the splint while she slept, and increased the tension biweekly, which is a common practice in the treatment of student athletes. By the end of the four-week period, the tension setting was at 11.2 foot pounds in knee flexion.

Several investigators have prescribed prolonged stretching for knee injury recuperation.<sup>1,8,9,13</sup> Also, increased time at end-range has been shown effective in lengthening the connective tissue for reduction of contracture.<sup>14,15</sup>

The patient regained 16° of flexion (126° at discharge) and re-joined her dance team, which was practicing 12 cumulative hours per day in a summer training program.

This patient's ROM therapy was injury-specific. The Dynasplint, when worn for eight hours a night, achieves an additional 56 hours per week of flexibility training, which can be an effective form of home therapy.

#### Discussion

An overuse injury resulting from repetitive action of the ITB over the knee can cause lateral knee pain that results in ROM deficits. Knee



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flexibility training is required for most dance-related knee injuries, and a sport-specific protocol of prolonged duration stretches will improve flexibility as part of rehabilitation. A protocol of increased total end-range time may also help reduce future patellofemoral injuries among dancers.

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