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THE BALLET DANCER

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"... the first all-important dictate of ballet dancing never to miss the daily practice, hell or high water, sickness or health, never to miss the barre practice; to miss meals, sleep, rehearsals even but not the practice, not for one day ever under any circumstances, except on Sundays and during childbirth."

Agnes de Mille⁵

Our experience within the ballet community has shaped the way we rehabilitate ballet dancers' back injuries. The dance class, the focus of the elite dancer's life, provides continual honing of psychomotor skills through rigorous training, while it develops and maintains the dancers' high fitness levels. Our back rehabilitation program, which applies principles of motor skill acquisition in a progressive manner, has been modified for the young ballet dancer to incorporate aspects of dance class.

FACTORS INFLUENCING INJURY

Physical, psychological, and environmental factors mold the young novice dancer into the elite professional. Many of these factors, while necessary for the formation of the classical ballet dancer's body and style, may predispose the dancer to back injuries.

Physical Factors

Hypermobility. Hypermobility in dancers is both an asset and a liability. While it allows the dancer to achieve the necessary postures required in ballet, it may also predispose the dancer to greater injuries when it is not accompanied by balanced muscular strength and control. Dancers display wider ranges of spinal

flexion and extension as well as generalized joint hypermobility compared with the general population.^{2,9}

Patterns of Tightness and Weakness. Much of the dance literature discusses hyperlordosis as a significant predisposing factor for back injuries in dancers. Patterns of weakness and tightness in certain muscle groups that contribute to hyperlordotic posture can be identified. Tightness of the lumbodorsal fascia and hamstrings can occur during the *growth spurt phase* of development, resulting in a hyperlordotic posture.^{1,17} Weakness of the abdominal muscles in dancers has also been reported and been linked with tight lumbodorsal fascia and hyperlordosis.^{7,15,16}

Dancers attempt to mold their bodies to fit a certain aesthetic ideal. In classical technique, there is a strong emphasis on patterns of hip abduction and external rotation with an exclusion of hip internal rotation.²⁰ If dancers are not endowed with sufficient natural *turnout*, or hip external rotation (minimum of 45°)⁸ to meet the demand of aesthetic form, then they may try to compensate with increased lumbar lordosis.^{5,11}

Spondylolysis and Spondylolisthesis. The prevalence of spondylolysis and spondylolisthesis may be as great as four times that found in the general population.^{2,10} Many physicians who treat professional dancers feel that it may be a relatively common cause of low back pain.^{11,14} Hamilton, the physician for the New York City Ballet, contends that Grade 0-1 spondylolisthesis is not a contraindication for continuation of a dancer's career.¹¹

Diet. Although no studies have yet shown a direct correlation between poor diet and back injuries, poor nutrition has been linked to increased osteopenia, stress fractures, and scoliosis.^{3,12,23}

Psychological Factors

Young elite dancers live in a special environment. The selection process of dancers begins early in their lives as teachers begin to assess a student's potential talent and body type. Young female dancers who have higher average age of menarche have the competitive edge over those with earlier maturation because of their low body fat, thin torsos, and long limbs. Vincent proposes that the rigors of early dance training may be as much a factor as genetics in the formation of the classic ballerina's physique (Fig. 1).²²

The world of the young elite dancer is very competitive. Only 5% of all dancers who enter the national ballet schools at the age of 8 years old will graduate.⁶ Many dancers try to minimize the extent of injuries and return to dancing too early after an injury because they fear losing a part in a dance production or losing their technical edge.

ENVIRONMENTAL CONCERNS

The forces incurred in dance generally arise from impact or contact with the floor. The ballet dancer's shoes are not shock absorbent. Shoe fit is vital to the dancer's success and is generally the chief concern. A safe dance surface should have the proper blend of resilience, friction, and spring.²¹ The American Guild of Musical Artists has published specific recommendations for dance surfaces.²

Dance Class

Dance class is the common thread that runs through the stages of a dancer's life, from novice to elite, and can be used as a fundamental tool for rehabilitation of the injured dancer. The training that occurs within ballet class is very effective

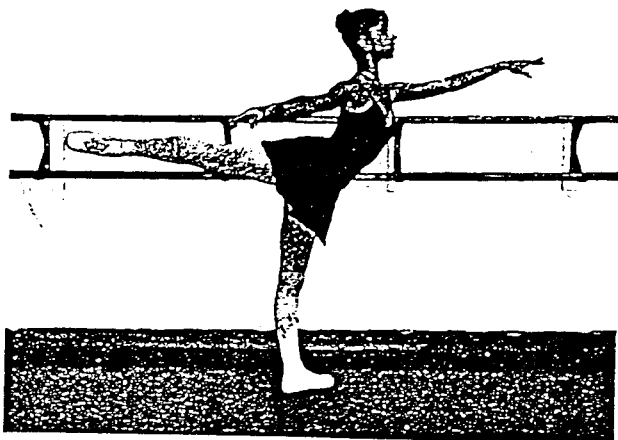


FIGURE 1. The classical ballet dancer's physique. Jenna McClintock of the Oakland Ballet in arabesque position.

in building the skills that the dancer needs for rehearsals and performances. Dance class teaches strength, endurance, flexibility, coordination, and balance, as well as musicality, expression, and timing.

Elements of Dance Class. Dance class progresses from more stable to less stable positions. Many classes begin with floor barre, in which the dancer performs dance techniques in non-weightbearing positions, either prone, supine, or sidelying.

After floor barre, the dancer progresses to barre work with exercises performed standing while holding onto a supporting bar. Technique is built at the barre. It is here that the dancer has the time to concentrate on proper alignment, and to focus on and correct poor habits under the guidance of the teacher's trained eye. There is progression in the difficulty of the exercises at the barre.

In the next phase of class, the support of the barre is removed. The dancer is challenged with more difficult balance and coordination activities, and the focus shifts from technique to the aesthetics of dancing. The dancer repeats many of the barre exercises without support and in more complex patterns. Proper alignment must be automatic so that the dancer's mind can be free to learn the complex dance patterns quickly.

THE DANCE INSTRUCTOR AS TRAINER

The dance instructor is a very important person in the young dancer's life. Dancers depend on their teachers to catch their mistakes or misalignment. Good dance teachers understand proper placement and alignment and are able to convey these concepts to their students. They are able to assess students' areas of weakness and suggest supplemental work outside class. Conflicts sometimes arise between the dance and medical community about safe dance practice. For example, many reputable dance instructors in our area feel that it is safe to begin pointe work by the age of nine, whereas most doctors recommend postponing training on pointe until the age of 12.¹¹ It is imperative that the clinician form an alliance with the dance instructor to facilitate the rehabilitation process with consideration of their complementary roles.

BACK INJURIES IN DANCERS

The risk of back injury increases as greater demands are placed on the young elite dancer through rehearsals, performances, and diverse choreography.

Frequency

Our experience with California's Oakland Ballet has shown that dancers experience an increase in the frequency of all types of injuries during periods of increased performance demand. An example is the *Nutcracker* season, when they average six performances per week, compared with the regular fall season's average of three performances over two weeks.

Back injuries have been ranked by Bowling as the number one chronic injury incurred by dancers.⁴ Micheli ranks back injuries as fourth in frequency and notes that they are generally more serious and remove the dancer from activities for a longer period of time than other types of injuries.¹⁷

Injury Categories

Back injuries can be attributed to a single traumatic event, macrotrauma, or to repeated microtrauma, termed an overuse injury. The common factor in overuse injuries is when microtrauma occurs in a particular anatomic structure that is subjected to repetitive frictional, tractional, or loading forces.¹³

Treatment of Acute Injuries

Although the treatment of acute injuries is well established in the medical practice and literature, it has yet to be fully implemented in the dance community. In our experience many dance teachers still recommend heat and stretching for acute injuries, whereas the use of rest, ice, compression, and elevation (RICE) is the recognized protocol in the general medical community. Educating dance teachers about the advantages of this latter approach will greatly facilitate recovery from injury.

Many elite and pre-elite dancers find it difficult to rest after being injured. This can often be attributed to pressures of performance and to the keen competition in the dance companies for roles in productions. Physical therapists and physicians need to assist company directors and instructors in determining the legitimate time frame for tissue healing and proper neuromuscular rehabilitation before a dancer returns to work. In small companies, there are few or no understudies, so that injury to a primary dancer puts an inordinate strain on the other dancers who have to learn multiple roles.

Rehabilitation of Subacute and Chronic Injuries

Training is the primary focus in the rehabilitation of dancers with subacute and chronic injuries, and is augmented by soft tissue and joint mobilization, manual muscle stretching, and modalities, as appropriate. The following training principles used in our clinic were developed by Dennis Morgan, DC, PT and Eileen Vollowitz, PT.^{18,19}

1. **Assessing the patient's weightbearing and postural tolerances.** Patients must be assessed and reassessed for factors that aggravate and alleviate pain. The exercise program is modified to reflect weightbearing, static posture, and movement sensitivity, which are common aggravating factors.

2. **Limiting movement to the least painful ranges of motion.** Patients are made aware of the range of pain-free lumbopelvic motion that is available in

different positions, e.g., prone, supine, kneeling, or standing. If the patient has a very small pain-free range, is too weak, or lacks coordination to control pelvic motion properly, often we passively pre-position the patient in an overcorrected spinal position. Use of hip flexion or placement of a wedge under the buttocks can be used to reduce lumbar lordosis, whereas hip extension or use of a towel under the lumbar spine can be used to maintain lordosis.

When sufficient trunk control is achieved, the patient is asked to control the trunk actively through muscular activity, i.e., active pre-positioning. The patient may exercise in more mid-range, functional positions as pain allows. This may include exercises that move through lumbar flexion and extension. Patients are cautioned not to exercise at the end of their physiologic range.

3. Assisting lumbopelvic control by use of neurological reflexes. We use primitive neurologic reflexes to help the patient develop control of trunk motion and posture. For instance, with the mass flexion synergy, flexion of the neck and of the hips will facilitate contraction of the abdominal muscles. Conversely, with the mass extension synergy, extension of the neck and hips facilitates the recruitment of the back extensors. When the patient demonstrates consistent control of the trunk in mass patterns, we remove the reinforcement of head and limb positioning. This might involve having the patient flex the neck while performing a trunk extension exercise. The patient is also challenged to use transitional control, in which first agonist and then antagonist muscle activity is required. Dennis Morgan, DC, PT, gives the example that "when reaching from overhead to below the waist, a shift from flexion stabilizers to extension stabilizers may be required in order to protect the low back."¹⁹

4. Allowing the patient to progress from most stable to least stable positions. Patients begin exercising in stable positions with a large base of support. When they demonstrate control of the trunk and tolerance of stable positions, we begin to incorporate weight shifting and then movement of the body through space. We decrease the base of support or the stability of the exercise surface with the use of balance boards, balance rollers, and therapeutic balls.

5. Progressing from large, gross, and simple movements to smaller, isolated, and complex movements and increasing the speed of the movement. The rehabilitation program culminates in exercises that reflect the functional demands of patients' work and recreational activities.

These principles of back rehabilitation have been very successful in the treatment of dancers at our clinics. Throughout the training process, nondance exercises must be applied functionally, that is, with consideration for application to dance. Dancers with back injuries often have decreased tolerances of weight-bearing positions, prolonged postures, or motion of the spine. Equipment such as the Pilates reformer, which resembles the Shuttle 2000, can provide resisted exercise in stable non-weightbearing positions.* Many of the Pilates-based exercises incorporate dance-like movement. This benefits dancers psychologically and physiologically as they can still experience dancing without strain.

Dancers have better balance and coordination than our average patients. This means that we must find novel ways to challenge their extraordinary skill

* The Pilates reformer was designed by Joseph Pilates and has been used by dancers for rehabilitation and conditioning since the 1930s. There are various manufacturers throughout the country. For further information contact: Institute for the Pilates Method, 824 Camino Del Monte Sol, Santa Fe, NM 87501.

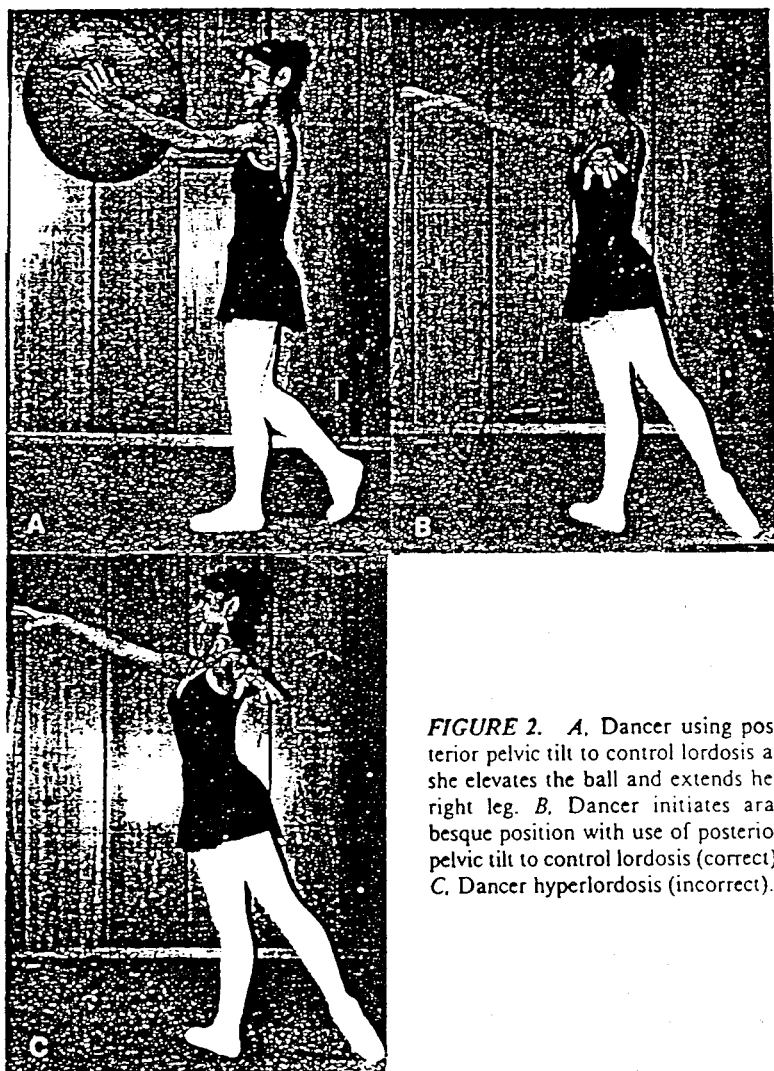


FIGURE 2. *A.* Dancer using posterior pelvic tilt to control lordosis as she elevates the ball and extends her right leg. *B.* Dancer initiates arabesque position with use of posterior pelvic tilt to control lordosis (correct). *C.* Dancer hyperlordosis (incorrect).

levels. Balance boards and gymnastic balls have proved to be valuable tools for dynamic challenges. Conversely, many dancers display deficits in strength of certain muscle groups, specifically the abdominals. Classical ballet training requires sustained lumbar extension postures, which naturally recruit the back extensors. Dancers need consciously to recruit their abdominals during the execution of dance movements, and especially to avoid hyperlordotic postures (Fig. 2*B* and *C*).

At each phase of rehabilitation, the dancer is shown that nondance exercises are similar to floor barre and barre exercises when executed with modifications, such as the addition of hip external rotation. These exercises are then performed as floor barre and barre exercises by the dancer in the clinic in preparation for return to class (Figs. 2*A* and *B*).

Dancers are allowed to return to class, usually with some restrictions, as soon as they demonstrate proper strength and control in the clinic. They are given a home exercise program to supplement dance class activity. We respect that dancers are eager to return to class and try to get them back to the barre as soon as is safely possible. The dance instructor is consulted about modifications the dancer might need to make in class and about monitoring the supplemental exercise program. The physician, in consultation with the physical therapist, decides when the dancer returns to rehearsals and performances. Young elite dancers need education, training, and guidance to bring them successfully through the rehabilitation process. This is best achieved by an alliance of the physician, the physical therapist, the dance instructor, and the company director.

CASE STUDY

One week prior to beginning physical therapy, an 18-year-old male dancer with the Oakland Ballet injured his back during rehearsal. The injury occurred when he performed a Russian folk dance during the carnival scene from *Petrushka*. The dance required him to jump from a squat to mid-air, moving from a forward-bent to a back-bent position. He felt pain during the execution of the movement and had experienced an intermittent achiness. He indicated that the pain was in the left low back and occasionally in the left buttock. Activities that aggravated his pain included: dance movements requiring back-bending, overhead lifts, and the arabesque position. Ice and rest had helped to alleviate the pain over the week prior to beginning therapy.

The patient had a past history of one episode of left low back pain when he was 16 years old. The episode began when he was performing arabesques in class. He noted that he usually performs arabesques with his left leg. The pain completely resolved without treatment in 3 weeks.

The patient presented with increased lumbar lordosis and thickening of the soft tissues of the lumbosacral region. He had no pain upon standing. His active ranges of motion were: flexion 50% of normal with pain across the low back; extension 75% of normal with pain with 10 repetitions, and sidebending bilaterally equal and pain-free. Combined movement testing was painful with left sidebending, right rotation, and extension of the lumbar spine. Manual muscle tests, deep tension reflexes, and straight-leg raising were within normal limits. Palpation revealed increased muscle tone in the left lumbosacral region, with tenderness in the left L4-5 and L5-S1 segments. Passive movement testing increased his pain with right rotation and eased it with left rotation and right sidebending.

We initiated therapy with local mobilization techniques followed by electrical stimulation and ice. We found that the patient had poor recruitment of his right paraspinal muscles with right leg lifts, and relatively weak abdominals. The patient's rehabilitation program was established based on the principles previously discussed:

1. The patient tolerated weightbearing and static positions. He did have movement sensitivities of flexion, extension, and combined movements into extension.
2. The patient was instructed to explore his range of lumbopelvic motion in different positions in order to demonstrate the safe and pain-free boundaries of movement. With his exercise program he was allowed to move through flexion and extension within the pain-free range.
3. The patient was placed in a semi-reclined position, supine on the therapeutic ball. Neck flexion and hip flexion assisted the patient in recruitment of his abdominal muscles (Fig. 3A). The patient progressed by using arm elevation while maintaining abdominal control of his trunk (Fig. 3B). This was compared functionally to the dancer's position with overhead lifts.

The patient was also placed prone on the ball. Neck and hip extension were also used to facilitate the back extensor (Fig. 4A). Specific recruitment of the right paraspinal muscle was achieved through flexion of the left hip while the right hip was extended (Fig. 4B). The

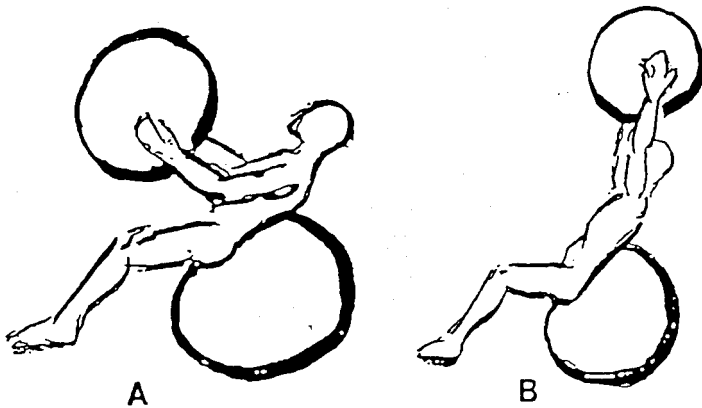


FIGURE 3. *A.* Semi-reclined position, supine on therapeutic ball with neck and hip flexion. *B.* Semi-reclined position on therapeutic ball with arm elevation.

patient was instructed to use abdominal contraction to control hyperlordosis in this position, i.e., using flexors with an extensor synergy pattern.

4. After the patient gained trunk control with these exercises, he progressed to similar exercises in standing—functionally related dance movements (Figs. 2*A* and *B*). A balance board was incorporated at this point to challenge his control with these movements. Emphasis was placed on arabesque and overhead lifting.

5. The Pilates-based shuttle was used throughout rehabilitation to maintain basic strength in noninvolved areas, such as the lower and upper extremities. Pilates exercises reinforced the ball training program.

Discussion

The dancer was allowed to return to barre after three treatment sessions, and to full class after five sessions. He was pain-free with full active range of lumbar motion after six sessions, and returned to a full schedule of classes, rehearsals, and performances. We discussed the dancer's problems with the balletmaster so that rehabilitation would continue in the dance studio.

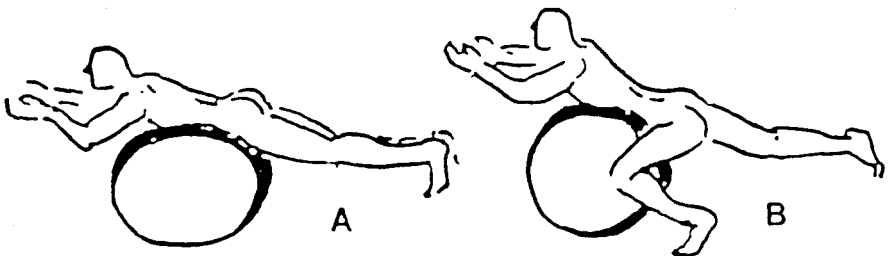


FIGURE 4. *A.* Prone on therapeutic ball with neck and hip extension. *B.* Prone on therapeutic ball with flexion on the left hip with extended right hip.

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