



**PASIG MONTHLY CITATION BLAST: No.36**

**November-December 2008**

Dear PASIG members:

By now you have received the PASIG electronic survey. Please assist your board by filling it out. If you haven't received it, please contact Board Secretary, Karen Hamill at [dancingkaren@hotmail.com](mailto:dancingkaren@hotmail.com). Finally, check out the PASIG programming for CSM in Las Vegas (February 9 – 12) on the APTA website and plan to attend! Watch for the January Blast, which will include a CSM programming schedule of PA-related platforms and posters.

**The Foot and Ankle in Performing Artists:  
From Show Girls in Heels and Skaters in Boots to  
Barefoot Dancers and Gymnasts  
Measuring, Manual Therapy and Rehabilitation, and Footwear Modifications**

**Thursday, February 12**

8:00 AM - 11:00 AM

(Course Level - Multiple Level) - 0.30 CEUs

The Foot and Ankle is a site of disability and dysfunction for many performing artists. The demand of the activities varies greatly; less motion and stability are seen in figure skaters compared to dancers and gymnasts. Footwear, props, and performance schedules often compound challenges to the artist's recovery after injury. This programming will review the major obstacles and evidence in measuring and rehabilitating this vital region. Performing arts specific examples of successful modifications, taping, and rehabilitation progressions will be reviewed. Upon completion of this course, you'll be able to: 1) Understand and apply self-report instruments in the management of foot and ankle injury. 2) Understand the limitations of foot and ankle measurement in the performing arts population. 3) Understand the rehabilitation principle for tendinopathies. 4) Identify manual therapy techniques that can be useful in the rehabilitation of the foot and ankle. 5) Describe clinical guidelines for common injuries in the foot and ankle in performing artists. 6) Identify modifications to assist the performing artist to return to performance.

Speakers: Shaw Bronner, PT, PhD, OCS - Brooklyn, NY; Rob Roy L Martin, PT, PhD, CSCS - Pittsburgh, PA; Sheyi Ojofeitimi, MPT - Brooklyn, NY; Jason Chad Tonley, PT, DPT, OCS - Los Angeles, CA.

The PASIG is proud to announce the winner of this year's student research scholarship: Brooke Windor DPT. Her study is titled: "Lower Extremity Joint Kinetics During the Takeoff Phase of a Grand Jete Performed by Elite Dancers". Brooke is a student from the University of Southern California. Congratulations, Brooke! We look forward to hearing you present your research.

The November – December Citation BLAST continues our special topic series: "*Injury Prevention and Screening Programs for Dancers*, contributed by Nardi Ashley SPT and Sarah Wenger PT, MSPT, DPT from Drexel University. The format is an annotated bibliography of articles on the selected topic from 1996 – 2008. As always, each month's citations will be added to EndNote libraries available on the PASIG webpage for our members to access and download. (Information about EndNote referencing software can be found at <http://www.endnote.com>, including a 30-day free trial). If you'd like to suggest a topic or create one, please let me know.

Please write to me with your comments and suggestions. If you're seeking a research mentor, looking for a sounding board about a research idea, want some editorial suggestions on a manuscript, let me know and I'll try to connect you with the right researcher. Entry contributions to these Citation Blasts or other PA research ideas are always welcome.

As always, please drop me an e-mail anytime.

Regards,  
Shaw

Shaw Bronner PT, PhD, OCS  
Chair, PASIG Research Committee  
[sbronner@liu.edu](mailto:sbronner@liu.edu)

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## **Injury Prevention and Screening Programs for Dancers**

Injury prevention is an essential aspect of a dancer's professional career and longevity. Currently the addition of injury prevention programs in professional dance companies is rising. However, it is still necessary to determine standardized injury prevention programs and reliable and valid screening tools that can be utilized at both the amateur and professional level. While treating a dancer, it is important for the physical therapist to understand the biomechanics of dance technique, the role that aesthetics play into dance performance, and the demanding nature of dance. The following papers report the rate of occurrence of the most common dance injuries and explain factors that contribute to these injuries. In addition, the papers have examples of evaluation tools and outcome measurement tools that may be useful for the physical therapist. The effectiveness of orthopedic screening tools is also addressed.

Nardi Ashley SPT and Sarah Wenger PT, MSPT, DPT  
Drexel University

Bronner S, Ojofeitimi S, Rose D. (2003). Injuries in a modern dance company: Effect of comprehensive management on injury incidence and time loss. *Am J Sports Med*: 31 (3), 365-373.

**BACKGROUND:** Professional dancers experience high rates of musculoskeletal injuries. **OBJECTIVE:** To analyze the effect of comprehensive management (case management and intervention) on injury incidence, time loss, and patterns of musculoskeletal injury in a modern dance organization. **STUDY DESIGN:** Retrospective/prospective cohort study. **METHODS:** Injury data were analyzed over a 5-year period, 2 years without intervention and 3 years with intervention, in a modern dance organization (42 dancers). The number of workers' compensation cases and number of dance days missed because of injury were compared across a 5-year period in a factorial design. **RESULTS:** Comprehensive management significantly reduced the annual number of new workers' compensation cases from a high of 81% to a low of 17% and decreased the number of days lost from work by 60%. The majority of new injuries occurred in younger dancers before the implementation of this program. Most injuries involved overuse of the lower extremity, similar to patterns reported in ballet companies. Benefits of comprehensive management included early and effective management of overuse problems before they became serious injuries and triage to prevent overutilization of medical services. **CONCLUSIONS:** This comprehensive management program effectively decreased the incidence of new cases and lost time. Both dancers and management strongly support its continuance.

Bronner S, Turner R. The Dance Functional Outcome System: A new measurement tool. *J Orthop Sports Phys Ther* 29(1):A-20 (Abstract), 1999.

The Dance Functional Outcome System (DFOS) has been undergoing study for the past five years. To date, this instrument has demonstrated excellent test-retest reliability ( $r= 0.91$ ) on healthy adult dancers of intermediate to professional levels of training. Study of the instrument across time on dancers following musculoskeletal injury (healthy baseline, at physical therapy intake, at physical therapy discharge, and 3 month post discharge) demonstrates sensitivity to functional change ( $p<0.01$ ). In conjunction with the use of the SF-36, the DFOS has demonstrated responsiveness to musculoskeletal injury and recovery in the adult dance population.

The DFOS can be found at: [www.bodydynamicsinc.com/pdf/DFOS.pdf](http://www.bodydynamicsinc.com/pdf/DFOS.pdf)

Gamboa JM, Roberts LA, Maring J, Fergus A (2008). Injury patterns in elite preprofessional ballet dancers and the utility of screening programs to identify risk characteristics. *J Orthop Sports Phys Ther*: 38 (3), 126-136.

**STUDY DESIGN:** Retrospective descriptive cohort study. **OBJECTIVES:** To describe the distribution and rate of injuries in elite adolescent ballet dancers, and to examine the utility of screening data to distinguish between injured and noninjured dancers. **BACKGROUND:** Adolescent dancers account for most ballet injuries. Limited information exists, however, regarding the distribution of, rate of, and risk factors for, adolescent dance injuries. **METHODS AND MEASURES:** Two hundred four dancers (age, 9-20 years) were screened over 5 years. Screening data were collected at the beginning and injury data were collected at the end of each training year. Descriptive statistics were used to characterize distribution and rate of injuries. Inference statistics were used to examine differences between injured and noninjured dancers. **RESULTS:** Fifty-three percent of injuries occurred in the foot/ankle, 21.6% in the hip, 16.1% in the knee, and 9.4% in the back. Thirty-two to fifty-one percent of the dancers were injured each year, and, over the 5 years, there were 1.09 injuries per 1000 athletic exposures, and 0.77 injuries per 1000 hours of dance. Significant differences between injured and noninjured dancers were limited to current disability scores ( $P = .007$ ),

history of low back pain ( $P = .017$ ), right foot pronation ( $P = .005$ ), insufficient right-ankle plantar flexion ( $P = .037$ ), and lower extremity strength ( $P = .045$ ). **CONCLUSION:** Distribution of injuries was similar to that of other studies. Injury rates were lower than most reported rates, except when expressed per 1000 hours of dance. Few differences were found between injured and noninjured dancers. These findings should be considered when designing and implementing screening programs.

Garrick, JG (2004). Preparticipation orthopedic screening evaluation. *Clin J Sport Med*: 14(3), 123-126.

**OBJECTIVE:** To review evidence-based support for the preparticipation orthopedic evaluation. **DATA SOURCES/METHODS:** Articles were reviewed that dealt with the sensitivity, specificity, and predictive value of the components of the standardized preparticipation orthopedic evaluation. In addition, studies describing musculoskeletal conditions/findings predictive of future injuries were sought through a PubMed search. **RESULTS:** The sensitivity of the evaluation questionnaire appears to be adequate, exceeding 90% in some studies. There is little or no published information documenting that the physical examination (1) approaches the questionnaire in either sensitivity or specificity or (2) identifies elements of value based on their association with future injuries or reinjuries. There are no readily discernible elements even in an expanded examination that are documented as being predictive of future problems. **CONCLUSIONS:** The current questionnaire and examination appear to fulfill adequately both legal and institutional requirements. Practitioners should be aware of the absence of data linking virtually any of the findings on the examination to either an increase or a decrease in the likelihood of future injuries. There is no evidence that increasing the scope of the examination would enhance its predictive value.

Hamilton LH, Hamilton WG, Warren MP, Keller K, Molnar M. (1997). Factors contributing to the attrition rate in elite ballet students. *J Dance Med & Sci*; 1 (4), 131-140.

Forty elite female dance students (mean age: 14.92 years) were followed at the School of American Ballet to distinguish the physical and mental factors associated with dropping out of the profession. The dancers were evaluated for injury patterns, eating behavior (EAT 26; food diary), personality (OSIQ-R), menstrual functioning, pubertal development (Tanner stages), and orthopaedic parameters. During the four-year period of this study 55% of the sample stopped dancing. Those in this 55% had a higher rate of injuries and eating problems. Furthermore, deficits on an orthopaedic screening exam accurately predicted dancers who dropped out of training at the advanced level from those who became professionals ( $p < 0.009$ ). As a group, dancers with an eating disorder profile had more anatomical deviations that compromise dance technique. These results suggest that classical ballet weeds out students without the right bodies, similar to Darwin's "selection of the fittest." In addition, ballet dancers may develop eating problems to compensate for a suboptimal technique. The orthopaedic exam is recommended as a useful screening tool in diagnosing potential problems in dancers but is not intended to exclude students from training.

Hincapie CA, Morton EJ, Cassidy JD. (2008) Musculoskeletal injuries and pain in dancers: a systematic review: 89 (9), 1819-1829.

**OBJECTIVE:** To assemble and synthesize the best evidence on the epidemiology, diagnosis, prognosis, treatment, and prevention of musculoskeletal injuries and pain in dancers. **DATA SOURCES:** Medline, CINAHL, PsycINFO, Embase, and other electronic databases were searched from 1966 to 2004 using key words such as dance, dancer, dancing, athletic injuries, occupational injuries, sprains and strains, and musculoskeletal diseases. In addition, the reference lists of relevant studies were examined, specialized

journals were hand-searched, and the websites of major dance associations were scanned for relevant information. **STUDY SELECTION:** Citations were screened for relevance using a priori criteria, and relevant studies were critically reviewed for scientific merit by the best evidence synthesis method. After 1865 abstracts were screened, 103 articles were reviewed, and 32 (31%) of these were accepted as scientifically admissible (representing 29 unique studies). **DATA EXTRACTION:** Data from accepted studies were abstracted into evidence tables relating to the prevalence and associated factors, incidence and risk factors, diagnosis, treatment, economic costs, and prevention of musculoskeletal injuries and pain in dancers. **DATA SYNTHESIS:** The scientifically admissible studies consisted of 15 (52%) cohort studies, 13 (45%) cross-sectional studies, and 1 (3%) validation study of a diagnostic assessment tool. There is a high prevalence and incidence of lower extremity and back injuries, with soft tissue and overuse injuries predominating. For example, lifetime prevalence estimates for injury in professional ballet dancers ranged between 40% and 84%, while the point prevalence of minor injury in a diverse group of university and professional ballet and modern dancers was 74%. Several potential risk factors for injury are suggested by the literature, but conclusive evidence for any of these is lacking. There is preliminary evidence that comprehensive injury prevention and management strategies may help decrease the incidence of future injury. **CONCLUSIONS:** The dance medicine literature is young and heterogeneous, limiting our ability to draw consistent conclusions. Nonetheless, the best available evidence suggests that musculoskeletal injury is an important health issue for dancers at all skill levels. Better quality research is needed in this specialized area. Future research would benefit from clear and relevant research questions being addressed with appropriate study designs, use of conceptually valid and clinically meaningful case definitions of injury and pain, and better reporting of studies in line with current scientific standards.

Liederbach M. (1997). Screening for functional capacity in dancers: Designing standardized, dance-specific injury prevention screening tools. *J Dance Med Sci*: 1 (3), 93-106.

Well-designed screening tools that measure functional capacity in dancers can yield powerful objective data for the dance educator and clinician. Integrating concepts from the broader disciplines of epidemiology, outcomes, and ergonomics, dance science professionals can develop specific tests to establish normative values for their group in order to set injury-prevention, training adaptation, and skill-acquisition goals with individual dancers. Suggestions for standardization procedures to enhance comparisons within and between dance populations are presented along with examples of traditional and dance-specific screening tests.

Luke AC, Kinney SA, D'Hemecourt PA, Baum J, Owen M, Micheli LJ (2002). Determinants of injuries in young dancers. *Med Probl Perform Art*: 17, 105-112.

The epidemiology of dance injuries requires further study, in order to properly implement effective health interventions. This study aimed to pilot injury surveillance tools to assess the incidence of injuries in adolescent pre-professional dancers and identify the intrinsic and extrinsic risk factors associated with dance injuries. The study involved a prospective, cohort design. A population of adolescent dancers at a liberal arts high school dance program in Natick, Massachusetts, was studied over the nine-month school year in 2000/2001. Intrinsic risk factors, including anatomical characteristics, past medical history, menstrual history, and dance experience, were assessed with a pre-participation history and orthopedic physical exam. The extrinsic risk factors, including training, fatigue, stress, shoes, and calcium intake, were assessed with surveys completed every two weeks by the dancers. Study outcomes were: 1) self-reported injuries (SRIs), 2) reported injuries (RIs) assessed by a physical therapist in the school clinic, 3) duration of injuries, and 4) severity of injuries. Descriptive

statistics and univariate analyses were performed on each risk factor. Thirty-nine of 55 dancers participated in the study. The average age was 15.3 years, and 85% of the dancers were female. The return rate for the biweekly surveys was 90%. Over one school year, there were 112 self-reported injuries, averaging 2.8 SRIs per dancer, and 71 reported injuries assessed by the physical therapist, averaging 1.4 RIs per dancer. Consistent with other studies, the most common locations for injuries were ankles, lower leg/calf, and back, usually caused by overuse, muscle strains, and sprains. Although the female dancers reported dancing significantly more hours (3.3 hours per day) than the males (2.7 hours/day), the males had a higher injury rate of SRIs (8.4 injuries/1,000 exposure hours of dancing vs. 4.1 injuries/1,000 hours) as well as RIs (5.5 injuries/1,000 hours vs. 2.6 injuries/1,000 hours). Older age and male sex were risk factors associated with SRIs and RIs. Most risk factors were found not to be statistically associated with the number of SRIs or RIs. Self-reported injuries occur frequently in pre-professional student dancers, who seek medical care in more than half the cases. Health professionals involved with dancers should be familiar with posterior ankle and low back problems. The rates of injuries appear almost twice as high in male dancers than female dancers. The main limitations to this study were small sample size and misclassification, recall, and reporting biases. With the information and tools of this pilot study, a multi-center study can be carried out to better assess risk factors on a larger dance population. Further research should aim to standardize injury definitions and classifications.

Schoene LM (2007). Biomechanical evaluation of dancers and assessment of their risk of injury. *J Am Podiatric Med Assoc*; 97 (1), 75-80.

Professional dancers have a 90% risk of injury during their career. The lower extremity is involved in approximately 75% of the injuries sustained by dancers. Proper biomechanical evaluation, risk assessment, and prevention-oriented treatment are necessary to minimize future problems and promote a full and lasting recovery when an injury is sustained. This article outlines the in-office evaluation process and discusses backstage care.

Solomon, R (1997). A pro-active screening program for addressing injury prevention in a professional ballet company. *J Dance Med Sci*; 1(3), 113-118.

The Boston Ballet implemented a pre- and post- season screening program for all the members of the company to reduce injuries. The screening form that was utilized includes personal data, medical history (including menstrual history), injury history, and an anatomical evaluation (alignment, range of motion, strength assessment, body composition). As the dancers became familiar to the screening program, they responded well and followed the recommendations given to them in writing. The screening form continues to change depending on clinical experience.

Southwick H, Cassella M (2002) Boston Ballet student screening clinic: An aid to Injury prevention. *Ortho Phys Ther Prac*; 14(2), 14-17.

Most dance training is dictated by artistic habits, which does not include the current conditioning techniques or account for biomechanical principles. Therefore, dancers continue to be prone to injuries throughout their training and career. A screening clinic was developed specifically for adolescents of the Boston Ballet student ensemble. The clinic was held on 1<sup>st</sup> Saturday of every month and included a questionnaire regarding past injuries and a physical examination. The dancers were provided a home exercise program of 3-5 exercises that targeted their impairments. The results reported that the most common postural deviation was an increased lumbar lordosis and anterior pelvic tilt (96%). In addition 66% forced turnout, and 60% forced turnout while increasing lumbar lordosis, causing iliopsoas tightness. Surprisingly, 87% of the dancers had a SLR of less than 90 degrees. Following their home exercise program, 64% had increased iliopsoas flexibility and

61% had increased hamstring flexibility. Abdominal muscle weakness was also improved after the home exercise program. The results of this study show the importance of screening ballet students at various stages of their training and demonstrate a physical therapist's role in identifying and treating weak or tight areas.

Weigert BJ, Erickson M. (2007). Incidence of injuries in female university-level modern dancers and the effectiveness of a screening program in altering injury patterns. *Med Probl Perform Art*: 22, 52-57.

Little information is available about the frequency and type of injuries that occur in modern dancers at a university level. Modern techniques present varied physical demands to dancers, and injuries within the academic setting can be particularly detrimental, both academically and artistically. Screening programs are widely promoted throughout the sports and dance medicine literature as a means for preventing these injuries. The goal of this study was to determine the incidence and types of injuries that occur in a university modern dance program. Subsequently, as deficits in strength, flexibility, and balance may be identified as risk factors for these injuries and addressed in a routine screening process, the second goal was to determine if dancers who participated in the screening process were at lower risk for injury. Injury characteristics in dance majors ( $n = 30$ ) were examined over two semesters by looking at on-site clinic data, as well as subjects' self-reports of injuries, the number of days they had to miss or modify class due to injury, and the degree to which pain limited their participation. At the beginning of the second semester, half of the subjects were randomly selected to participate in a screening program. The injury rate for all subjects was over 30% for each semester by clinic visits and 67% for the first semester and 77% for the second semester by self-report. At the end of the second semester, there was no difference between the screened and unscreened groups with respect to clinic visits, days of class missed or modified due to injury, or pain scores. This study therefore suggests that modern dancers at a university level do have a high incidence of injury, but this rate was not decreased by a screening program.

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