



PASIG **PERFORMING ARTS**
SPECIAL INTEREST GROUP



PASIG MONTHLY CITATION BLAST: No. 109

October 2015

Dear Performing Arts SIG members:

The PASIG has been busy! We have a lot of updates, please see below:

Fellowship Taskforce Performing Arts Physical Therapy Analysis Survey:

An assembled team of members of the Orthopaedic Section, APTA, Performing Arts Special Interest Group (PASIG) and identified practitioners in the sub-specialty field of performing arts physical therapy, are working to revalidate the 2004 *Description of Specialized Clinical Practice (DSCP) in Physical Therapy for Performing Artists*.

By completing this survey you will be helping to revalidate the unique attributes that need to be taken into consideration for treating the performing artist population. You will be asked to assess each competency/skill/attribute in three ways: 1.) Frequency of use, 2.) Importance of skill, and 3.) Level of Mastery required. Demographic information, such as years of practice and practice setting, will also be requested in order to assess the generalizability of the survey responses across the sub-specialty field. The survey is estimated to take *approximately 30 minutes to complete. Once you exit the survey, you will not be able to re-enter at a later time.*

Please click here to access this survey:

<https://www.surveymonkey.com/r/6QKMWBN>

The intent of this revalidation process is three-fold: 1.) To provide current practice guidelines for practitioners in the sub-specialty field of Performing Arts Physical Therapy, 2.) To transform the 2004 DSCP to a Description of Advanced Specialized Practice (DASP), a document of skills, attributes, and competencies appropriate for fellowship level curriculum and expertise, and 3.) To create a Description of

Fellowship Practice (DFP) in Performing Arts Physical Therapy for fellowship curriculum development.

Thank you in advance for participating in this survey. We recognize that your time is valuable.

CSM 2016: PASIG will offer a preconference course, “Dynamic Neuromuscular Stabilization: Assessment & Management of Performing Artists,” given by Clare Frank, PT, DPT, OCS, FAAOMPT and Annette Karim, PT, DPT, OCS, FAAOMPT, on Wednesday, February 17, 2016, 8:00 AM- 5:00 PM. We will also have our regular PASIG programming, “Life on Broadway: Care of the Professional Theatrical Performer” by Jennifer Green, PT, MS, CMT on Friday, February 19th, after our annual business meeting: time TBA.

Call for 2016 PASIG committee chairs! We have several positions available. We have a lot of fun, and a little effort goes a long way, as we move forward in the areas of education, research, screening, membership, PR, and scholarship. Please consider nominating yourself and a colleague in order to become more involved with the PASIG. For more information, contact Liz Chesarek: echesarek@gmail.com

A **PASIG student scholarship** is available for performing arts poster and platform presentations at CSM 2016! Contact Anna Saunders, PASIG student scholarship chair, with your abstract: annarosemary@gmail.com

Call for case reports: If you have a brief, clinically-focused case report on a performing arts PT patient, or a clinical commentary, please contact Annette Karim to submit your writing for the next Orthopaedic Physical Therapy Practice Magazine: neoluvsonlyme@aol.com

Tweet Tweet! We have a Twitter page!

<https://twitter.com/PT4Performers>

Post your articles and info on your site, let's get connected!

Check out the Orthopaedic section Facebook page, where you can find and post PASIG info: <https://www.facebook.com/pages/APTA-Orthopaedic-Section/121020534595362>

Below is a list of the PASIG leadership. Please consult this list regarding contact info:

Annette Karim, President	2014-2017	neoluvsonlyme@aol.com
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WE NEED MORE CONTRIBUTORS TO OUR MONTHLY CITATION BLASTS!!!!

Past Monthly citation blasts are available, with citations and EndNote file, listed on the website:

http://www.orthopt.org/content/special_interest_groups/performing_arts/citations_endnotes

TOPICS THAT HAVE BEEN COVERED RECENTLY INCLUDE:

Stress fractures of the foot and ankle
Dry needling
Dynamic Warm Up and Stretching
Platelet Rich Plasma Injections
Back Pain in Dancers
Hallux Valgus in Dancers
Posterior ankle impingement
TMD in Musicians
Concussions
Bone Mineral Density in Dancers
Serratus Anterior Strengthening for Dancers
Focal Dystonia

If you are interested in contributing by writing a citation blast, contact us,

Brooke Winder: BrookeRwinder@gmail.com

Laura Reising: lbreising@gmail.com

Best regards,

Laura

Laura Reising, PT, DPT, OCS

PASIG EndNote Organizer

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PERFORMING ARTS CONTINUING EDUCATION, CONFERENCES, AND RESOURCES

Musician Health Series, Janice Ying, PT, DPT, OCS
Glendale Adventist Therapy and Wellness Center, Los Angeles area (Eagle Rock), CA
<http://www.musicianshealthcorner.com/>
Healthy Musician Series - Overuse

Orthopaedic Section Independent Study Course. *20.3 Physical Therapy for the Performing Artist.*

Monographs are available for:

- Figure Skating (J. Flug, J. Schneider, E. Greenberg),
 - Artistic Gymnastics (A. Hunter-Giordano, Pongetti-Angeletti, S. Voelker, TJ Manal),
- and
- Instrumentalist Musicians (J. Dommerholt, B. Collier).

Contact: Orthopaedic Section at: www.orthopt.org

Orthopaedic Section-American Physical Therapy Association,
Performing Arts SIG

http://www.orthopt.org/content/special_interest_groups/performing_arts

Performing Arts Citations and Endnotes

http://www.orthopt.org/content/special_interest_groups/performing_arts/citations_endnotes

ADAM Center

<http://www.adamcenter.net/>

Publications:

<http://www.adamcenter.net/#!vstc0=publications>

Conference abstracts:

<http://www.adamcenter.net/#!vstc0=conferences>

Dance USA

<http://www.danceusa.org/>

Research resources:

<http://www.danceusa.org/researchresources>

Professional Dancer Annual Post-Hire Health Screen:

<http://www.danceusa.org/dancerhealth>

Dancer Wellness Project

<http://www.dancerwellnessproject.com/>

Becoming an affiliate:

<http://www.dancerwellnessproject.com/Information/BecomeAffiliate.aspx>

Harkness Center for Dance Injuries, Hospital for Joint Diseases

<http://hjd.med.nyu.edu/harkness/>

Continuing education:

<http://hjd.med.nyu.edu/harkness/education/healthcare-professionals/continuing-education-courses-cme-and-ceu>

Resource papers:

<http://hjd.med.nyu.edu/harkness/dance-medicine-resources/resource-papers-and-forms>

Links:

<http://hjd.med.nyu.edu/harkness/dance-medicine-resources/links>

Informative list of common dance injuries:

<http://hjd.med.nyu.edu/harkness/patients/common-dance-injuries>

Research publications:

<http://hjd.med.nyu.edu/harkness/research/research-publications>

International Association for Dance Medicine and Science (IADMS)

<http://www.iadms.org/>

Resource papers:

<http://www.iadms.org/displaycommon.cfm?an=1&subarticlenbr=186>

Links:

<http://www.iadms.org/displaycommon.cfm?an=5>

Medicine, arts medicine, and arts education organization links:

<http://www.iadms.org/displaycommon.cfm?an=1&subarticlenbr=5>

Publications:

<http://www.iadms.org/displaycommon.cfm?an=3>

Performing Arts Medicine Association (PAMA)

<http://www.artsmed.org/>

<http://www.artsmed.org/symposium.html>

Interactive bibliography site:

<http://www.artsmed.org/bibliography.html>

Related links:

<http://www.artsmed.org/relatedlinks.html>

Member publications:

<http://artsmed.org/publications.html>

(Educators, researchers, and clinicians, please continue to email your conference and continuing education information to include in future blasts)

ACL Injuries in Dancers

This PASIG Citation Blast in October 2015 provides an overview of information that is currently available regarding anterior cruciate ligament (ACL) injuries in the dance population. While the incidence of ACL injuries is lower in dancers compared to team athletes, these injuries still occur in students through elite dancers. This month's Citation Blast highlights the current research in the frequency of ACL injuries in dancers, rationale on why dancers are less prone to this injury, as well as, current rehabilitation guidelines that we may be able to apply to the performing artist population. We can use this information to identify areas that need further research and to develop effective dance specific interventions.

Laura Reising, PT, DPT, OCS

Physical Therapist

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Adams D, Logerstedt DS, Hunter-Giordano A, Axe MJ, Snyder-Mackler L. Current concepts for anterior cruciate ligament reconstruction: a criterion-based rehabilitation progression. *J Orthop Sports Phys Ther.* 2012;42(7):601-614.

ABSTRACT: The management of patients after anterior cruciate ligament reconstruction should be evidence based. Since our original published guidelines in 1996, successful outcomes have been consistently achieved with the rehabilitation principles of early weight bearing, using a combination of weight-bearing and non-weight-bearing exercise focused on quadriceps and lower extremity strength, and meeting specific objective requirements for return to activity. As rehabilitative evidence and surgical technology and procedures have progressed, the original guidelines should be revisited to ensure that the most up-to-date evidence is guiding rehabilitative care. Emerging evidence on rehabilitative interventions and advancements in concomitant surgeries, including those addressing chondral and meniscal injuries, continues to grow and greatly affect the rehabilitative care of patients with anterior cruciate ligament reconstruction. The aim of this article is to update previously published rehabilitation guidelines, using the most recent research to reflect the most current evidence for management of patients after anterior cruciate ligament reconstruction. The focus will be on current concepts in rehabilitation interventions and modifications needed for concomitant surgery and pathology.

LEVEL OF EVIDENCE: Therapy, level 5.

Ambegaonkar JP, Caswell SV, Winchester JB, Shimokochi Y, Cortes N, Caswell AM. Balance comparisons between female dancers and active nondancers. *Res Q Exerc Sport*. 2013;84(1): 24-29.

PURPOSE: Female dancers have lower anterior cruciate ligament (ACL) injury rates compared with physically active women. Enhanced balance can decrease musculoskeletal injury risk. Dancers are proposed to have superior balance compared with physically active nondancers, and this may reduce their risk for ACL injury. However, whether female dancers actually have better balance than active nondancers is unclear.

METHOD: Thirty-three women (15 dancers, 18 nondancers) performed the Balance Error Scoring System (BESS; error scores), the Star Excursion Balance Test (SEBT; percent leg length), and the Modified Bass Test of Dynamic Balance (BASS; maximum score = 100). **RESULTS:** Dancers had fewer errors on the BESS than did nondancers ($p < .001$, 12.0 +/- 6.9 vs. 25.3 +/- 9.1). Dancers also had greater SEBT reach distances in the medial (right, $p = .03$, 90.4 +/- 4.2% vs. 86.5 +/- 5.5%; left, $p = .04$, 90.7 +/- 4.5% vs. 86.7 +/- 5.9%) and posteromedial directions (right, $p = .01$, 92.6 +/- 5.6% vs. 87.0 +/- 6.4%; left, $p = .01$, 93.9 +/- 6.3% vs. 87.9 +/- 6.3%), but not in the anteromedial direction (right, $p = .23$, 84.5 +/- 4.4% vs. 86.2 +/- 3.5%; left, $p = .51$, 86.4 +/- 3.5% vs. 85.5 +/- 4.0%). BASS scores were similar between groups ($p = .58$, 90.6 +/- 5.5 vs. 91.7 +/- 5.6).

CONCLUSIONS: The novel findings of the study are that dancers had greater balance than did nondancers in some but not all tests. Although dancing may improve balance as compared with not dancing, it is not better than physical activity in improving balance. Thus, balance comparisons between dancers and nondancers may not fully explain why female dancers exhibit low ACL injury rates compared with physically active women. Other factors (e.g., anticipated/unanticipated movement demands) should be examined to understand the ACL injury disparity between dancers and physically active women.

Ambegaonkar JP, Shultz SJ, Perrin DH, Schmitz RJ, Ackerman TA, Schulz MR. Lower body stiffness and muscle activity differences between female dancers and basketball players during drop jumps. *Sports Health*. 2011;3(1): 89-96.

BACKGROUND: Anterior cruciate ligament (ACL) injuries often occur during landing, with female athletes at higher injury risk than male athletes.

Interestingly, female dancers have lower ACL injury rates than do female athletes in general.

HYPOTHESIS: Female dancers will have earlier and greater lower extremity muscle activity and higher sagittal knee joint and leg stiffness than will female basketball players.

STUDY DESIGN: Cross-sectional group comparison.

METHODS: Fifty-five healthy female athletes (35 dancers, 20 basketball players) performed 5 double-leg drop jumps from a 45-cm box. Surface

electromyography (onsets and amplitudes; prelanding and postlanding) was recorded from the lateral gastrocnemius, medial and lateral hamstrings, lateral quadriceps muscles with a 3-dimensional electromagnetic tracking system, and forceplates recording biomechanics (leg spring stiffness and knee joint stiffness).

RESULTS: Compared with basketball players, dancers had greater leg spring stiffness ($P = 0.047$) but similar knee joint stiffness ($P = 0.44$). Although no significant differences were observed in overall muscle onset times ($P = 0.22$) or activation amplitudes (prelanding, $P = 0.60$; postlanding, $P = 0.78$), small to moderate effect sizes (ESs) suggest trends in dancers toward earlier (ES = 0.53) and higher medial hamstrings activation pre- (ES = 0.55) and post- (ES = 0.41) landing and lower lateral quadriceps (ES = 0.30) and higher gastrocnemius (ES = 0.33) postlanding muscle activation.

CONCLUSIONS: In dancers, the higher leg spring stiffness and trends toward higher hamstrings prelanding and postlanding, as well as lower quadriceps and higher gastrocnemius activation postlanding with similar knee joint stiffness, indicate lower extremity neuromechanical differences across other joints.

CLINICAL RELEVANCE: Female dancers may have lower extremity neuromechanics that are different from those of basketball players during drop jumps. If dancers use ACL-protective strategies during activity, then their training routines should be further investigated to improve ACL injury prevention programs.

Cortes N, Porter LD, Ambegaonkar JP, Caswell SV. Postural stability does not differ among female sports with high risk of anterior cruciate ligament injury. *Med Probl Perform Art.* 2014 Dec;29(4):216-20.

ABSTRACT: Dancers have a lower incidence of anterior cruciate ligament (ACL) injury compared to athletes in sports that involve cutting and landing motions. Balance can impact ACL injury risk and is related to neuromuscular control during movement. The purpose of this study was to investigate whether balance differences exist among female dancers and female soccer and basketball athletes. Fifty-eight female dancers, soccer, and basketball athletes (16.5 ± 1.6 yrs, 1.6 ± 0.2 m, 60.2 ± 14.1 kg) completed the Stability Evaluation Test (SET) on the NeuroCom VSR Sport (NeuroCom International, Clackamas, OR) to measure sway velocity. Video records of the SET test were used for Balance Error Scoring System (BESS) test scoring. A oneway ANCOVA compared composite sway velocity and BESS scores among sports. There was no statistically significant difference for sway velocity or BESS among sports (sway velocity soccer 2.3 ± 0.4 , dance 2.2 ± 0.4 , and basketball 2.4 ± 0.4 ; BESS soccer 13.6 ± 5.0 , dance 11.9 ± 5.5 , and basketball 14.9 ± 5.1 , $p > 0.05$). Balance was similar among athletes participating in different sports (dance, basketball, and soccer). Quasi-static balance may not play a significant role in neuromuscular control during movement and not be a significant risk factor to explain the disparity in ACL injury incidence among sports. Future research should examine the effects of dynamic balance and

limb asymmetries among sports to elucidate on the existing differences on ACL injury incidence rates.

Eggerding V, Meuffels DE, Bierma-Zeinstra SM, Verhaar JA, Reijman M. Factors related to the need for surgical reconstruction after anterior cruciate ligament rupture: a systematic review of the literature. *J Orthop Sports Phys Ther.* 2015;45(1): 37-44.

STUDY DESIGN: Systematic literature review. **OBJECTIVES:** To summarize and evaluate research on factors predictive of progression to surgery after nonoperative treatment for an anterior cruciate ligament (ACL) rupture. **BACKGROUND:** Anterior cruciate ligament rupture is a common injury among young, active individuals. Surgical reconstruction is often required for patients who do not regain satisfactory knee function following nonsurgical rehabilitation. Knowledge of factors that predict the need for surgical reconstruction of the ACL would be helpful to guide the decision-making process in this population.

METHODS: A search was performed for studies predicting the need for surgery after nonoperative treatment for ACL rupture in the Embase, MEDLINE (OvidSP), Web of Science, CINAHL, Cochrane Central Register of Controlled Trials, PubMed, and Google Scholar digital databases from inception to October 2013. Two reviewers independently selected the studies and performed a quality assessment. Best-evidence synthesis was used to summarize the evidence of factors predicting the need for surgical reconstruction after nonoperative treatment for an ACL rupture.

RESULTS: Seven studies were included, 3 of which were of high quality. Based on these studies, neither sex (strong evidence) nor the severity of knee joint laxity (moderate evidence) can predict whether, soon after ACL injury, a patient will need ACL reconstruction following nonoperative treatment. All other factors identified in this review either had conflicting or only minimal evidence as to their level of association with the need for surgical reconstruction. Noteworthy is that 1 high-quality study reported that the spherical shape of the femoral condyle was predictive of the need for ACL reconstruction.

CONCLUSION: Sex and knee joint laxity tests do not predict the need for ACL reconstruction soon after an ACL rupture. Independent validation in future research will be necessary to establish whether knee shape is a predictive factor.

LEVEL OF EVIDENCE: Prognosis, level 1a-

Griffin LY, Albohm MJ, Arendt EA, Bahr R, Beynonn BD, et al. Understanding and preventing noncontact anterior cruciate ligament injuries: a review of the Hunt Valley II meeting, January 2005. *Am J Sports Med.* 2006;345(9):1512-1532.

The incidence of noncontact anterior cruciate ligament injuries in young to middle-aged athletes remains high. Despite early diagnosis and appropriate operative and nonoperative treatments, posttraumatic degenerative arthritis

may develop. In a meeting in Atlanta, Georgia (January 2005), sponsored by the American Orthopaedic Society for Sports Medicine, a group of physicians, physical therapists, athletic trainers, biomechanists, epidemiologists, and other scientists interested in this area of research met to review current knowledge on risk factors associated with noncontact anterior cruciate ligament injuries, anterior cruciate ligament injury biomechanics, and existing anterior cruciate ligament prevention programs. This article reports on the presentations, discussions, and recommendations of this group.

Hincapié CA, Morton EJ, Cassidy, JD. Musculoskeletal injuries and pain in dancers: a systematic review. *Arch Phys Med Rehabil.* 2008;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.

Jacobs CL, Hincapié CA, Cassidy JD. Musculoskeletal injuries and pain in dancers: a systematic review update. *J Dance Med Sci.* 2012;16(2):74-84.

The objective of this study was to assemble and synthesize the best available literature from 2004 to 2008 on musculoskeletal injury and pain in dancers. MEDLINE and CINAHL were the primary sources of data. Indexed terms such as dance, dancer, dancing, athletic injuries, occupational injuries, sprains and strains, musculoskeletal diseases, bone density, menstruation disturbances, and eating disorders were used to search the databases. 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 screening, 19 articles were found to be scientifically admissible. Data from accepted studies were abstracted into evidence tables relating to: prevalence and associated factors; incidence and risk factors; intervention; and injury characteristics and prognosis of musculoskeletal injury and pain in dancers. Principal findings included: a high prevalence and incidence of lower extremity, hip and back injuries; preliminary evidence that psychosocial and psychological issues such as stress and coping strategies affect injury frequency and duration; history of a previous lateral ankle sprain is associated with an increased risk of ankle sprain in the contralateral ankle in dance students; fatigue may play a role in ACL injury in dancers; acute hamstring strains in dancers affect tendon more than muscle tissue, often resulting in prolonged absence from dance. It is concluded that, while there are positive developments in the literature on the epidemiology, diagnosis, prognosis, treatment, and prevention of MSK injuries and pain in dancers, much room for improvement remains. Suggestions for future research are offered.

Liederbach M, Dilgen FE, Rose DJ. Incidence of anterior cruciate ligament injuries among elite ballet and modern dancers: a 5-year prospective study. *Am J Sports Med.* 2008;36(9):1779-1788.

BACKGROUND: Ballet and modern dance are jump-intensive activities, but little is known about the incidence of anterior cruciate ligament (ACL) injuries among dancers.

HYPOTHESIS: Rigorous jump and balance training has been shown in some prospective studies to significantly reduce ACL injury rates among athletes. Dancers advance to the professional level only after having achieved virtuosic jump and balance technique. Therefore, dancers on the elite level may be at relatively low risk for ACL injury.

STUDY DESIGN: Descriptive epidemiology study.

METHODS: Dance exposure, injuries, and injury conditions were systematically recorded at 4 dance organizations over 5 years. Select neuromuscular and psychometric variables were compared between and

within ACL-injured and noninjured dancers.

RESULTS: Of 298 dancers, 12 experienced an ACL injury over the 5-year period. The incidence of ACL injury was 0.009 per 1000 exposures. Landing from a jump onto 1 leg was the mechanism of injury in 92% of cases.

Incidence was not statistically different between gender or dance groups, although women modern dancers had a 3 to 5 times greater relative risk than women ballet dancers and men dancers. No difference between ACL-injured and noninjured dancers emerged with regard to race, oral contraceptive use, or select musculoskeletal measures.

CONCLUSION: Dancers suffer considerably fewer ACL injuries than athletes participating in team ball sports. The training dancers undertake to perfect lower extremity alignment, jump, and balance skills may serve to protect them against ACL injury. Anterior cruciate ligament injuries happened most often late in the day and season, suggesting an effect of fatigue.

Liederbach M, Kremenec IJ, Orishimo KF, Pappas E, Hagins M. Comparison of landing biomechanics between male and female dancers and athletes, part 2: Influence of fatigue and implications for anterior cruciate ligament injury. *Am J Sports Med.* 2014;42(5): 1089-1095.

BACKGROUND: Fatigue is strongly linked to an increased risk of injuries, including anterior cruciate ligament (ACL) ruptures. Part 1 of this study identified differences in the biomechanics of landing from a jump between dancers and team athletes, particularly female athletes, which may explain the epidemiological differences in ACL injuries between dancers and team athletes and the lack of a sex disparity within dancers. However, it is not known if these biomechanical variables change differently between team athletes and dancers in the face of fatigue.

PURPOSE/HYPOTHESIS: The purpose of this study was to compare dancers' and team athletes' resistance to fatigue and its effect on the biomechanics of single-legged drop landings. The primary hypotheses were that dancers may be more resistant than team athletes to the onset of fatigue and/or may have different biomechanical responses than athletes in landing tasks once fatigue has been achieved.

STUDY DESIGN: Controlled laboratory study.

METHODS: Kinematics and kinetics were recorded as 40 elite modern and ballet dancers (20 men and 20 women) and 40 team sport athletes (20 men and 20 women; National Collegiate Athletic Association Division I-III) performed single-legged drop landings from a 30-cm platform before and after a fatigue protocol consisting of step-ups and vertical jumps. Unfatigued and fatigued joint kinematics and kinetics were compared between groups and sexes with multivariate analyses of variance, followed by pairwise t tests as appropriate.

RESULTS: Dancers took longer ($P = .023$) than team athletes to reach a similar state of fatigue. Multiple kinetic (eg, increased peak knee valgus moment; $P < .001$) and kinematic (eg, increased lateral and forward trunk flexion; $P < .001$ and $P = .002$, respectively) parameters of landing changed

with fatigue, such that both fatigued dancers and athletes landed with mechanics that were more at risk for ACL injuries as compared with before fatigue.

CONCLUSION: Dancers took significantly longer to reach fatigue than team athletes. Female athletes consistently exhibited landing patterns associated with a risk for ACL injuries when compared with the other 3 groups. Fatigue changed landing mechanics similarly in both dancers and athletes, such that all groups landed with worse alignment after being fatigued.

CLINICAL RELEVANCE: Dancers are more resistant to lower extremity fatigue than athletes, and this may partially explain the lower incidence of ACL injuries in both male and female dancers compared to team athletes. The extensive training in landing technique and daily practice that dancers undergo from a young age may be responsible for the higher levels of endurance.

Meuffels DE, Verhaar JAN. Anterior cruciate ligament injury in professional dancers. *Acta Orthop.* 2008;79(4):515-518.

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.

Meuffels DE, Poldervaart MT, Diercks RL, Fievex A, Patt TW, et al. Guideline on anterior cruciate ligament injury. *Acta Orthop.* 2012; 83(4): 379-386.

ABSTRACT: The Dutch Orthopaedic Association has a long tradition of development of practical clinical guidelines. Here we present the recommendations from the multidisciplinary clinical guideline working group for anterior cruciate ligament injury. The following 8 clinical questions were formulated by a steering group of the Dutch Orthopaedic Association.

What is the role of physical examination and additional diagnostic tools? Which patient-related outcome measures should be used? What are the relevant parameters that influence the indication for an ACL reconstruction? Which findings or complaints are predictive of a bad result of an ACL injury treatment? What is the optimal timing for surgery for an ACL injury? What is the outcome of different conservative treatment modalities? Which kind of graft gives the best result in an ACL reconstruction? What is the optimal postoperative treatment concerning rehabilitation, resumption of sports, and physiotherapy? These 8 questions were answered and recommendations were made, using the "Appraisal of Guidelines for Research and Evaluation" instrument. This instrument seeks to improve the quality and effectiveness of clinical practical guidelines by establishing a shared framework to develop, report, and assess. The steering group has also developed 7 internal indicators to aid in measuring and enhancing the quality of the treatment of patients with an ACL injury, for use in a hospital or practice.

Orishimo KF, Kremenic IJ, Pappas E, Hagins M, Liederback M. Comparison of landing biomechanics between male and female professional dancers. *Am J Sports Med.* 2009;37(11): 2187-2193.

BACKGROUND: The incidence of anterior cruciate ligament injuries among dancers is much lower than that among team sport athletes and no clear gender disparity has been reported in the dance population. Although numerous studies have observed differences in lower extremity landing biomechanics between male and female athletes, there is currently little research examining the landing biomechanics of male and female dancers. Comparing landing biomechanics within this population may help explain the lower overall anterior cruciate ligament injury rates and the lack of gender disparity.

HYPOTHESIS: Due to the fact that dancers receive jump-specific and balance-specific training from a very young age, we hypothesized that there would be no gender differences in drop-landing biomechanics in professional dancers.

STUDY DESIGN: Controlled laboratory study.

METHODS: Kinematics and ground-reaction forces were recorded as 33 professional modern and ballet dancers (12 men and 21 women) performed single-legged drop landings from a 30-cm platform. Joint kinematics and kinetics were compared between genders.

RESULTS: No gender differences in joint kinematics or kinetics were found during landings (multivariate analysis of variance: $P = .490$ and $P = .175$, respectively). A significant relationship was found between the age at which the dancers began training and the peak hip adduction angle during landing ($r = .358$, $P = .041$).

CONCLUSION: In executing a 30-cm drop landing, male and female dancers exhibited similar landing strategies and avoided landing patterns previously associated with increased injury rates.

CLINICAL RELEVANCE: Commonly reported biomechanical differences between men and women, as well as the gender disparity among athletes in

the incidence of ACL injuries, may be the result of inadequate experience in proper balance and landing technique rather than intrinsic gender factors. Beginning jump-specific and balance-specific training at an early age may counteract the potentially harmful adaptations in landing biomechanics observed in female athletes after maturity.

Orishimo KF, Liederbach M, Kremenec IJ, Hagins M, Pappas E. Comparison of landing biomechanics between male and female dancers and athletes, part 1: Influence of sex on risk of anterior cruciate ligament injury. *Am J Sports Med.* 2014;42(5): 1082-1088.

BACKGROUND: The incidence of anterior cruciate ligament (ACL) injuries among dancers is much lower than among team sport athletes, and no clear disparity between sexes has been reported in the dance population. Although numerous studies have observed differences in landing biomechanics of the lower extremity between male and female team sport athletes, there is currently little research examining the landing biomechanics of male and female dancers and none comparing athletes to dancers. Comparing the landing biomechanics within these populations may help explain the lower overall ACL injury rates and lack of sex disparity.

HYPOTHESIS: The purpose was to compare the effects of sex and group (dancer vs team sport athlete) on single-legged drop-landing biomechanics. The primary hypothesis was that female dancers would perform a drop-landing task without demonstrating typical sex-related risk factors associated with ACL injuries. A secondary hypothesis was that female team sport athletes would display typical ACL risk factors during the same task. **Study Design:** Controlled laboratory study.

METHODS: Kinematics and kinetics were recorded as 40 elite modern and ballet dancers (20 men and 20 women) and 40 team sport athletes (20 men and 20 women) performed single-legged drop landings from a 30-cm platform. Joint kinematics and kinetics were compared between groups and sexes with a group-by-sex multivariate analysis of variance (MANOVA) followed by pairwise t tests.

RESULTS: Dancers of both sexes and male team sport athletes landed similarly in terms of frontal-plane knee alignment, whereas female team sport athletes landed with a significantly greater peak knee valgus ($P = .007$). Female dancers were found to have a lower hip adduction torque than those of the other 3 groups ($P = .003$). Dancers (male and female) exhibited a lower trunk side flexion ($P = .002$) and lower trunk forward flexion ($P = .032$) compared with team sport athletes.

CONCLUSION: In executing a 30-cm drop landing, female team sport athletes displayed a greater knee valgus than did the other 3 groups. Dancers exhibited better trunk stability than did athletes.

CLINICAL RELEVANCE: These biomechanical findings may provide insight into the cause of the epidemiological differences in ACL injuries between dancers and athletes and the lack of a sex disparity within dancers.

Ramesh R, von Arx O, Azzopardi T, Schranz PJ. The risk of anterior cruciate ligament rupture with generalized joint laxity. *J Bone Joint Surg Br.* 2005;87-B(6): 800-803.

ABSTRACT: We assessed hyperextension of the knee and joint laxity in 169 consecutive patients who underwent an anterior cruciate ligament reconstruction between 2000 and 2002 and correlated this with a selected number of age- and gender-matched controls. In addition, the mechanism of injury in the majority of patients was documented. Joint laxity was present in 42.6% (72 of 169) of the patients and hyperextension of the knee in 78.7% (133 of 169). All patients with joint laxity had hyperextension of their knee. In the control group only 21.5% (14 of 65) had joint laxity and 37% (24 of 65) had hyperextension of the knee. Statistical analysis showed a significant correlation for these associations. We conclude that anterior cruciate ligament injury is more common in those with joint laxity and particularly so for those with hyperextension of the knee.

Wilk KE. Anterior cruciate ligament injury prevention and rehabilitation: let's get it right. *J Orthop Sports Phys Ther.* 2015;45(10):729-730.

ABSTRACT: Anterior cruciate ligament (ACL) injuries are among the most common and functionally disabling conditions in orthopaedics and sports medicine. As professionals, we need to do a better job of screening individuals to determine who is at greatest risk of sustaining an ACL injury, as well as implementing injury prevention programs. We also need to do a better job with programs that return individuals to their preinjury activity levels, including implementing thorough functional testing to determine if a patient is ready to return to sports or strenuous activities post-ACLR.

