



PASIG PERFORMING ARTS
SPECIAL INTEREST GROUP



ORTHOPAEDIC SECTION
AMERICAN PHYSICAL THERAPY ASSOCIATION



PASIG MONTHLY CITATION BLAST: No.79

January 2013

Dear Performing Arts SIG members:

Please join us for this year's APTA Combined Sections Meeting.

***The 2013 APTA Combined Sections Meeting will be held
January 21-24 in San Diego, CA.***

<http://www.apta.org/csm/>

Our PASIG courses at CSM will be held on:

Wednesday, January 23, 2013

Part 1 from 8:00 am–10:00 am, and Part 2 from 11:00 am–1:00 pm

Our PASIG topic this year is:

***Dancers, Runners, Jumpers: Same Diagnoses, Similar Presentations—
Unique Interventions?***

Part 1: Low Back Pain and Patellar Tendinopathy, and PASIG Programming

Part 2: Achilles Tendinopathy and PASIG Business Meeting

Our speakers are:

Jo Armour Smith, PT, MManTher, OCS

Kornelia Kulig, PT, PhD, FAPTA

Krissy Sutton, PT, DPT, ATC

After CSM, the opportunity for growth, education, and connection continues! We hope you can join us for the APTA's **First Annual Orthopaedic Section Meeting**, held May 2 to 4, 2013 at the beautiful Orlando World Center Marriott in Orlando, Florida! This 2-day meeting will provide the physical

therapist attendee an opportunity to attend general session lectures and hand's-on breakout sessions related to physical therapist examination and treatment of the lumbosacral spine and lower extremity. Attendees will have the ability to choose between multiple small-group breakout sessions during both days of this conference. **REGISTRATION IS NOW OPEN!**

Please consider compiling Performing Arts-related abstracts for a citation blast this year. It's easy to do, and a great way to become involved with PASIG! Just take a look at our Performing Arts Citations and Endnotes, look for what's missing, and email me your contribution!

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

This month's citation blast is on stabilization and balance for the dancer. A performing arts writer recently asked about the use of stabilization devices for dancers with lower extremity injuries. This prompted me to investigate the most current research literature in regards to rehabilitative techniques and classification schema for lumbar and lower extremity balance and stability deficits in the dancer. I hope the abstracts entice you into reading the full articles and engaging in discussion with others, perhaps igniting original research questions for you to investigate in 2013! Happy New Year!

Best regards,

Annette

Annette Karim, PT, DPT, OCS
Chair, PASIG Research Committee

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PERFORMING ARTS CONTINUING EDUCATION, CONFERENCES, AND RESOURCES

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 Independent Study Course. [Dance Medicine: Strategies for the Prevention and Care of Injuries to Dancers](#).

This is a 6-monograph course and includes many PASIG members as authors.

- Epidemiology of Dance Injuries: Biopsychosocial Considerations in the Management of Dancer Health (MJ Liederbach),
- Nutrition, Hydration, Metabolism, and Thinness (B Glace),
- The Dancer's Hip: Anatomic, Biomechanical, and Rehabilitation Considerations (G. Grossman),
- Common Knee Injuries in Dance (MJ Liederbach),
- Foot and Ankle Injuries in the Dancer: Examination and Treatment Strategies (M. Molnar, R. Bernstein, M. Hartog, L. Henry, M. Rodriguez, J. Smith, A. Zujko),
- Developing Expert Physical Therapy Practice in Dance Medicine (J. Gamboa, S. Bronner, TJ Manal).

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

Annual conference: Philadelphia, PA, June 12-15, 2013

<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/>

The 23rd Annual Meeting of the International Association for Dance Medicine & Science (IADMS) will be held in Seattle, Washington, USA from October 17 - 19, 2013. Meeting activities and sessions will be held at the Renaissance Seattle Hotel. On Sunday, October 20, 2013, Special Interest Groups (SIG) Day will be held, with special programs available.

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/>

Annual symposium: July 20-23, 2013 Medical Problems of Performing Artists: "Maximizing Performance, Artistry, Implementation, and Empowerment"

<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 me your conference and continuing education information and I will include it in the upcoming blasts.)

Stabilization and Balance in the Dancer

Batson, G. (2010). "Validating a dance-specific screening test for balance: preliminary results from multisite testing." *Med Probl Perform Art* **25**(3): 110-115.

Few dance-specific screening tools adequately capture balance. The aim of this study was to administer and modify the Star Excursion Balance Test (oSEBT) to examine its utility as a balance screen for dancers. The oSEBT involves standing on one leg while lightly targeting with the opposite foot to the farthest distance along eight spokes of a star-shaped grid. This task simulates dance in the spatial pattern and movement quality of the gesturing limb. The oSEBT was validated for distance on athletes with history of ankle sprain. **METHOD:** Thirty-three dancers (age 20.1 +/- 1.4 yrs) participated from two contemporary dance conservatories (UK and US), with or without a history of lower extremity injury. Dancers were verbally instructed (without physical demonstration) to execute the oSEBT and four modifications (mSEBT): timed (speed), timed with cognitive interference (answering questions aloud), and sensory disadvantaging (foam mat). Stepping strategies were tracked and performance strategies video-recorded. **RESULTS:** Unlike the oSEBT results, distances reached were not significant statistically ($p = 0.05$) or descriptively (i.e., shorter) for either group. Performance styles varied widely, despite sample homogeneity and instructions to control for strategy. Descriptive analysis of mSEBT showed an increased number of near-falls and decreased timing on the injured limb. **CONCLUSIONS:** Dancers appeared to employ variable strategies to keep balance during this test. Quantitative analysis is warranted to define balance strategies for further validation of SEBT modifications to determine its utility as a balance screening tool.

Blasing, B., B. Calvo-Merino, et al. (2012). "Neurocognitive control in dance perception and performance." *Acta Psychol (Amst)* **139**(2): 300-308.

Dance is a rich source of material for researchers interested in the integration of movement and cognition. The multiple aspects of embodied cognition involved in performing and perceiving dance have inspired scientists to use dance as a means for studying motor control, expertise,

and action-perception links. The aim of this review is to present basic research on cognitive and neural processes implicated in the execution, expression, and observation of dance, and to bring into relief contemporary issues and open research questions. The review addresses six topics: 1) dancers' exemplary motor control, in terms of postural control, equilibrium maintenance, and stabilization; 2) how dancers' timing and on-line synchronization are influenced by attention demands and motor experience; 3) the critical roles played by sequence learning and memory; 4) how dancers make strategic use of visual and motor imagery; 5) the insights into the neural coupling between action and perception yielded through exploration of the brain architecture mediating dance observation; and 6) a neuroesthetics perspective that sheds new light on the way audiences perceive and evaluate dance expression. Current and emerging issues are presented regarding future directions that will facilitate the ongoing dialog between science and dance.

Bruyneel, A. V., S. Mesure, et al. (2010). "Organization of postural equilibrium in several planes in ballet dancers." *Neurosci Lett* **485**(3): 228-232.

This study analyzed the balance strategies of ballet dancers during postural equilibrium in three single leg balance conditions with and without vision and regard to age. Dancers participating formed two groups of 20 dancers each, one aged between 8 and 16 years (young group) and the other aged between 17 and 30 years (adult group). Ground reaction forces (GRFs) (mediolateral (ML), anteroposterior (AP) components, vertical (V)) were recorded. Results analysis enabled us to extract some spatiotemporal data for each component of the GRF (number of GRF oscillations, variability and impulses). Young dancers are characterized, compared to adult dancers, by an instability combined with an increase of oscillations number and a decrease variability mainly visible on the ML component. In the two groups, the absence of vision implies an increase of AP, ML and V impulsions and GRF variability. Balance with the gesturing limb to the rear increases the age and vision effect compared to balances with the limb forward or to the side. Young dancers are less efficient at controlling their balance than adult dancers. This observation may be related to the number of hours practicing dance, which differs between groups. The dancers have a visual dependence to control the postural balance.

Cloak, R., A. M. Nevill, et al. (2010). "Vibration training improves balance in unstable ankles." *Int J Sports Med* **31**(12): 894-900.

Functional ankle instability (FAI) is a common condition following ankle injury characterised by increased risk of injury. Ankle sprains are a common acute form of injury suffered in dancing and loss of balance can affect not only risk of injury risk but also performance aesthetics. Whole

body vibration training (WBVT) is a new rehabilitation method that has been linked with improving balance and muscle function. 38 female dancers with self reported unilateral FAI were randomly assigned in 2 groups: WBVT and control. Absolute centre of mass (COM) distribution during single leg stance, SEBT normalised research distances and Peroneus longus mean power frequency (f(med)) were measured pre and post 6-week intervention. There was a significant improvement in COM distribution over the 6 weeks from 1.05 +/- 0.57 to 0.33 +/- 0.42 cm(2) (P<0.05), and 4 of the 8 planes of direction in the SEBT Ant, Antlat, Med and Antmed from 77.5 +/- 7.1 to 84.1 +/- 5.8% (P<0.05) compared to control groups during the course of the 6 week training intervention. There was no evidence of improvement in peroneus longus (f(med)) over time (P=0.915) in either group. WBVT improved static balance and SEBT scores amongst dancers exhibiting ankle instability but did not affect peroneus longus muscle fatigue.

Dubois, K. (1991). "Analogy between training for dancers and problems of adjustment to microgravity: an evaluation of the subjective vertical in dancers." Acta Astronaut 25(8-9): 605-613.

"Moderne dance" (as opposed to a more academic or classical dance form) uses techniques from kinesiology, anatomy and improvization which are adapted to a cultural, technological and political environment. The function of a choreographic system is to take and give a measure of the world. This includes, with the present tendency of the evolution of culture, a new "naturalism" which seeks the secrets of the body. Dance movements express in terms of space the dimension fo the infinite. It gives somehow the measure of a world within which everything is relative. Except for the speed of light, time and space are bound together by the same principle. The qualities of body awareness and specific motricity in dancers imply--besides a strict discipline--balance, coordination, muscular performance and perfect orientation, problems that astronauts also encounter in microgravity. Could chosen exercises used in modern dance technique be applied to the training of astronauts? Dancer-choreographer Kitsou Dubois has been working in this direction since 1988. She was granted a "Villa Medicis Hors Les Murs" by the French Ministry of Foreign Affairs, to carry on with her research at NASA, Houston, Tex. in April 1989. It allowed her to investigate the reality of this analogy. She intends to evaluate the dancers' subjective vertical refering to Mittelstaedt's observations on the proportional relationship between "space sickness" and some astronauts poor evaluation of the subjective vertical. This study should create a relationship between a choreographer's empirical intuition and a scientific reality.

Hagins, M. (2011). "The use of stabilization exercises and movement reeducation

to manage pain and improve function in a dancer with focal degenerative joint disease of the spine." J Dance Med Sci **15**(3): 136-142.

Little has been written about rehabilitation of low back pain (LBP) specific to the professional dancer. However, there is a rapidly increasing amount of rehabilitation research related to the care of LBP in the general population that may be applied to the dancer population. The purpose of this case report is to describe the physical therapy management of a 37-year-old female professional dancer with a 5-year history of spinal pain and loss of function in the presence of degenerative joint disease at a single segment (T12-L1). Patient interventions focused on stabilization exercises and movement reeducation. The dancer returned to limited dance performance at 6 weeks. At 5 months she had returned to complete dance function, with pain and functional (Oswestry) levels improved from initial values of 7/10 and 48%, respectively, to 1/10 and 26%.

Hugel, F., M. Cadopi, et al. (1999). "Postural control of ballet dancers: a specific use of visual input for artistic purposes." Int J Sports Med **20**(2): 86-92.

Dance is a specific expression of human motor behaviour. This artistic physical activity depends upon an effective technical training with important postural components and necessitates the codification of sensory inputs to build mental representations of the action to be produced. Proprioception and vision being two fundamental sensory modalities in classical ballet, this study attempted to determine the importance of the visual input for postural control during the practice of this activity. First, this work compared the performances of 18 professional ballet dancers and 46 non-dancers on a platform of forces during static posturographic tests in open or closed eyes situation. Then, we studied how professional dancers achieve balance in postures specific of classical ballet: on demi-pointe and on pointe. The results indicate that visual inputs are important in classical ballet since dancers only performed better than controls in eyes open conditions. The similar results obtained on pointe with eyes open or closed conversely suggest that training in classical ballet develops specific modalities of balance which are not transferable to posture control in daily life situations.

Jola, C., A. Davis, et al. (2011). "Proprioceptive integration and body representation: insights into dancers' expertise." Exp Brain Res **213**(2-3): 257-265.

The experience of the body as a single coherent whole is based on multiple local sensory signals, integrated across different sensory modalities. We investigated how local information is integrated to form a single body representation and also compared the contribution of proprioceptive and visual information both in expert dancers and non-dancer controls. A number of previous studies have focused on individual

differences in proprioceptive acuity at single joints and reported inconsistent findings. We used the established endpoint position matching task to measure absolute and directional errors in matching the position of one hand with the other. The matching performance was tested in three different conditions, which involved different information about the target position: only proprioceptive information from a 'target' hand which could be either the left or the right, only visual information, or both proprioceptive and visual information. Differences in matching errors between these sensory conditions suggested that dancers show better integration of local proprioceptive signals than non-dancers. The dancers also relied more on proprioception when both proprioceptive and visual information about hand position were present.

Lee, H. H., C. W. Lin, et al. (2012). "Changes in biomechanics and muscle activation in injured ballet dancers during a jump-land task with turnout (Sissonne Fermee)." *J Sports Sci* **30**(7): 689-697.

Large impact loading with abnormal muscle activity and motion patterns may contribute to lower extremity injuries in ballet dancers. Yet, few studies investigated the influence of injury on the ballet movement. The purpose of this study was to find the neuromuscular and biomechanical characteristics in dancers with and without ankle injury during a jump-landing Sissonne Fermee task. Twenty-two ballet dancers were recruited and divided into the injured group (n = 11) and the uninjured group (n = 11). They performed a ballet movement called "Sissonne Fermee" with reflective markers and electrodes attached to their lower extremities. Ground reaction force, joint kinematics, and muscle activity were measured. The injured dancers had greater peak ankle eversion but smaller hindfoot-to-tibial eversion angles. Also, the injured dancers had greater activity of the hamstring of the dominant leg and tibialis anterior of the non-dominant leg during the pre-landing phase. The injured dancers had greater tibialis anterior activity of the dominant leg but less muscle activity in the medial gastrocnemius of the non-dominant leg during the post-landing phase. The injured dancers had a greater co-contraction index in the non-dominant ankle and a lower loading rate. The higher co-contraction indices showed that the injured dancers required more muscle effort to control ankle stability. Furthermore, the injured dancers used a "load avoidance strategy" to protect themselves from re-injury. Neuromuscular control training of the ankle joint for ballet dancers to prevent injury is necessary.

Lin, C. F., I. J. Lee, et al. (2011). "Comparison of postural stability between injured and uninjured ballet dancers." *Am J Sports Med* **39**(6): 1324-1331.
BACKGROUND: Ballet movements require a limited base of support; thus, ballet dancers require a high level of postural control. However, postural

stability in ballet dancers is still unclear and needs to be understood. **PURPOSE:** To evaluate ballet dancers' postural stability in performing single-leg standing, the en pointe task, and the first and fifth positions and to determine differences in task performance among healthy nondancers, healthy dancers, and dancers with ankle sprains. **STUDY DESIGN:** Controlled laboratory study. **METHODS:** Injured dancers, uninjured dancers, and nondancers were recruited for this study (N = 33 age-matched participants; n= 11 per group). The tasks tested were single-leg standing with eyes open and closed, first position, fifth position, and en pointe. Center of pressure parameters were calculated from the ground-reaction force collected with 1 force plate. Analysis of variance was used to assess the differences of center of pressure parameters among 3 groups in single-leg standing; independent t test was used to examine the differences of center of pressure parameters between injured and uninjured dancers. **RESULTS:** During single-leg standing, injured dancers had significantly greater maximum displacement in the medial-lateral direction and total trajectory of center of pressure, compared with the uninjured dancers and nondancers. During the first and fifth positions, the injured dancers demonstrated significantly greater standard deviation of center of pressure position in the medial-lateral and anterior-posterior directions, compared with the uninjured dancers. During en pointe, the injured dancers had significantly greater maximum displacement in the medial-lateral direction and the anterior-posterior direction, compared with the uninjured dancers. **CONCLUSION:** The injured and uninjured dancers demonstrated differences in postural stability in the medial-lateral direction during single-leg standing and the ballet postures. Although the injured dancers received ballet training, their postural stability may still be inferior to that of the nondancers. **CLINICAL RELEVANCE:** This study is a first step in understanding that injured ballet dancers do not have the same postural stability as uninjured dancers and that it is even inferior to that of nondancers, which is important to understand for further study on rehabilitation. The future development of effective balance training programs for ballet dancers with ankle injuries should emphasize improvements in medial-lateral directional balance.

Munn, J., S. J. Sullivan, et al. (2010). "Evidence of sensorimotor deficits in functional ankle instability: a systematic review with meta-analysis." J Sci Med Sport **13**(1): 2-12.

Functional ankle instability (FAI) has been associated with impaired sensorimotor function; however individual studies have produced conflicting results. In an attempt to reduce this ambiguity, a systematic review with meta-analysis was undertaken to determine which sensorimotor deficits exist with FAI. Fifty-three studies assessing sensorimotor factors in subjects with FAI were included from 465 identified

articles. Studies were rated for methodological quality and data were pooled for peroneal reaction time, joint position sense, and postural sway during single-leg stance and time to stabilisation from a single-leg jump. Data on joint movement sense were unable to be pooled. When subjects with unstable ankles were compared to healthy controls, sensorimotor impairments were demonstrated for passive joint position sense (mean difference (MD)=0.7 degrees , 95% confidence interval (CI): 0.2-1.2 degrees , p=0.004), active joint position sense (MD=0.6 degrees , 95% CI: 0.2-1.0 degrees , p=0.002), postural sway in single-leg stance (standardised MD (SMD)=0.6, 95% CI: 0.2-1.0, p=0.002), the star excursion balance test (SMD=0.4, 95% CI: 0.1-0.7, p=0.009), and time to stabilisation from a single-leg jump in a medio-lateral (MD=0.6 ms, 95% CI: 0.4-0.8, p<0.0001) and an antero-posterior direction (MD=0.7 ms, 95% CI: 0.4-1.0, p<0.0001). Peroneal reaction time was not affected. Sensorimotor deficits occur for joint position sense and postural control in subjects with FAI. Deficits in peroneal muscle reaction time following perturbation are not evident.

Ross, S. E., B. L. Arnold, et al. (2007). "Enhanced balance associated with coordination training with stochastic resonance stimulation in subjects with functional ankle instability: an experimental trial." *J Neuroeng Rehabil* 4: 47.

BACKGROUND: Ankle sprains are common injuries that often lead to functional ankle instability (FAI), which is a pathology defined by sensations of instability at the ankle and recurrent ankle sprain injury. Poor postural stability has been associated with FAI, and sports medicine clinicians rehabilitate balance deficits to prevent ankle sprains. Subsensory electrical noise known as stochastic resonance (SR) stimulation has been used in conjunction with coordination training to improve dynamic postural instabilities associated with FAI. However, unlike static postural deficits, dynamic impairments have not been indicative of ankle sprain injury. Therefore, the purpose of this study was to examine the effects of coordination training with or without SR stimulation on static postural stability. Improving postural instabilities associated with FAI has implications for increasing ankle joint stability and decreasing recurrent ankle sprains. **METHODS:** This study was conducted in a research laboratory. Thirty subjects with FAI were randomly assigned to either a: 1) conventional coordination training group (CCT); 2) SR stimulation coordination training group (SCT); or 3) control group. Training groups performed coordination exercises for six weeks. The SCT group received SR stimulation during training, while the CCT group only performed coordination training. Single leg postural stability was measured after the completion of balance training. Static postural stability was quantified on a force plate using anterior/posterior (A/P) and medial/lateral (M/L) center-of-pressure velocity (COPvel), M/L COP standard deviation

(COPsd), M/L COP maximum excursion (COPmax), and COP area (COParea). RESULTS: Treatment effects comparing posttest to pretest COP measures were highest for the SCT group. At posttest, the SCT group had reduced A/P COPvel (2.3 +/- 0.4 cm/s vs. 2.7 +/- 0.6 cm/s), M/L COPvel (2.6 +/- 0.5 cm/s vs. 2.9 +/- 0.5 cm/s), M/L COPsd (0.63 +/- 0.12 cm vs. 0.73 +/- 0.11 cm), M/L COPmax (1.76 +/- 0.25 cm vs. 1.98 +/- 0.25 cm), and COParea (0.13 +/- 0.03 cm² vs. 0.16 +/- 0.04 cm²) than the pooled means of the CCT and control groups (P < 0.05). CONCLUSION: Reduced values in COP measures indicated postural stability improvements. Thus, six weeks of coordination training with SR stimulation enhanced postural stability. Future research should examine the use of SR stimulation for decreasing recurrent ankle sprain injury in physically active individuals with FAI.

Ross, S. E., K. M. Guskiewicz, et al. (2009). "Balance measures for discriminating between functionally unstable and stable ankles." Med Sci Sports Exerc **41**(2): 399-407.

PURPOSE: To identify force plate measures that discriminate between ankles with functional instability and stable ankles and to determine the most accurate force plate measure for enabling this distinction. METHODS: Twenty-two subjects (177 +/- 10 cm, 77 +/- 16 kg, 21 +/- 2 yr) without a history of ankle injury and 22 subjects (177 +/- 10 cm, 77 +/- 16 kg, 20 +/- 2 yr) with functional ankle instability (FAI) performed a single-leg static balance test and a single-leg jump-landing dynamic balance test. Static force plate measures analyzed in both anterior/posterior (A/P) and medial/lateral (M/L) directions included the following: ground reaction force (GRF) SD; center-of-pressure (COP) SD; mean, maximum, and total COP excursion; and mean and maximum COP velocity. COP area was also analyzed for static balance. A/P and M/L time to stabilization quantified dynamic balance. Greater values of force plate measures indicated impaired balance. A stepwise discriminant function analysis examined group differences, group classification, and accuracy of force plate measures for discriminating between ankle groups. RESULTS: The FAI group had greater values than the stable ankle group for A/P GRF SD (P = 0.027), M/L GRF SD (P = 0.006), M/L COP SD (P = 0.046), A/P mean COP velocity (P = 0.015), M/L mean COP velocity (P = 0.016), A/P maximum COP velocity (P = 0.037), M/L mean COP excursion (P = 0.014), M/L total COP excursion (P = 0.016), A/P time to stabilization (P = 0.011), and M/L time to stabilization (P = 0.040). M/L GRF SD and A/P time to stabilization had the greatest accuracy scores of 0.73 and 0.72, respectively. CONCLUSION: Although 10 measures identified group differences, M/L GRF SD and A/P time to stabilization were the most accurate in discriminating between ankle groups. These results provide evidence for choosing these GRF measures for evaluating static and

dynamic balance deficits associated with FAI.

Roussel, N., M. De Koning, et al. (2012). "Motor Control and Low Back Pain in Dancers." Int J Sports Med.

Professional dancers suffer a high incidence of injuries, especially to the spine and lower extremities. There is a lack of experimental research addressing low back pain (LBP) in dancers. The aim of this study is to compare lumbopelvic motor control, muscle extensibility and sacroiliac joint pain between dancers with and without a history of LBP. 40 pre-professional dancers (mean age of 20.3 years) underwent a clinical test battery, consisting of an evaluation of lumbopelvic motor control, muscle extensibility, generalized joint hypermobility, and sacroiliac joint pain provocation tests. Also self-reported measurements and standardized questionnaires were used. 41% of the dancers suffered from LBP during at least 2 consecutive days in the previous year. Only one dancer suffered from sacroiliac joint pain. Compared to dancers without a history of LBP, dancers with a history of LBP showed poorer lumbopelvic motor control ($p < 0.05$). No differences in muscle extensibility or joint hypermobility were observed between dancers ($p > 0.05$). Despite their young age, pre-professional dancers suffer from LBP frequently. Sacroiliac joint pain, generalized joint hypermobility or muscle extensibility appears unrelated to LBP in dancers. Motor control is decreased in those with a history of LBP. Further research should examine whether motor control is etiologically involved in LBP in dancers.

Simmons, R. W. (2005). "Sensory organization determinants of postural stability in trained ballet dancers." Int J Neurosci **115**(1): 87-97.

Trained ballet dancers and nondancer controls completed six balance tests using computerized dynamic posturography. The tests facilitated assessment of the type of sensory organization used to maintain postural control under conditions ranging from quiet standing to a situation in which visual and/or somatosensory information was systematically removed or made unreliable. Results indicated that ballet dancers and controls have comparable balance ability during eyes open and eyes closed conditions. However, when somatosensory information alone or in combination with visual information was made unreliable, dancers were significantly less stable than controls and utilized a hip strategy to maintain postural control.


Simmons, R. W. (2005). "Neuromuscular responses of trained ballet dancers to postural perturbations." Int J Neurosci **115**(8): 1193-1203.

The balance of trained ballet dancers and non-dancer controls was mechanically perturbed in order to evaluate the time of onset of muscle activation and the consistency of muscle activation. Results supported the prediction that ballet dancers have significantly faster long-latency (LL)

neuromuscular responses than controls and are significantly more consistent in muscle activation. These findings indicate a superior postural control mechanism in trained dancers and may explain the ability of dancers to maintain static balances over a small base of support.

Smith, J. (2009). "Moving beyond the neutral spine: stabilizing the dancer with lumbar extension dysfunction." J Dance Med Sci **13**(3): 73-82.

Dancers commonly suffer from low back pain. This is often associated with the extreme lumbar extension range of motion and prolonged lordotic postures required by some dance forms. There is ample literature documenting extension-related instabilities such as spondylolisthesis in dancers. The aim of this article is to review the changes in motor control that occur in patients with subtle clinical instability and recurrent low back pain. Recent studies have consistently demonstrated changes in neuromuscular function in patients with back pain, and spinal stability retraining has become a popular component of treatment. However, most research to date has focused on maintenance of neutral spinal postures during assessment and treatment, whereas dancers must be trained to move with control through full lumbar extension range of motion.



Please remember to update your orthopaedic section profile, thank you!
https://www.orthopt.org/surveys/membership_directory.php