PASIG PERFORMING ARTS
SPECIAL INTEREST GROUP

ORTHOPAEDIC SECTION
AMERICAN PHYSICAL THERAPY ASSOCIATION

APTA
American Physical Therapy Association
The Science of Healing. The Art of Caring.

PASIG MONTHLY CITATION BLAST: No.93 **May 2014**

Dear Performing Arts SIG members:

Our second **annual Orthopaedic Section will be held next week: May 15-17, 2014, in St. Louis, Missouri**, at the Hyatt Regency at the Arch. The two-day meeting will focus on: ***"The Triangle of Treatment: Integrating Movement System Impairments, Manual Therapy and the Biopsychosocial Approach in the Treatment of the Upper Quarter."*** We hope that many of you are able to attend!

For registration information, please go to:
https://www.orthopt.org/content/home

Call for abstracts! APTA Combined Sections Meeting 2015 (February 4-7, 2015 in Indianapolis, IN)
If you are interested in submitting an abstract for a poster presentation or brief platform presentation for CSM 2015, the deadline is June 2nd.
http://www.apta.org/uploadedFiles/APTAorg/National_Conferences/CSM/Submissions/CSM2015callforabstracts_Feb2014.pdf

If you are looking to increase your involvement with PASIG,
we are currently looking for a PASIG member to fill the position of PR Chair.
If you are interested in serving in any way, or would like further information on this position's job description, please contact Rosie Canizares, Nominating Chair:
Caniz002@duke.edu

Performing Arts Clinical Affiliation Sites: Please update your current info for the PASIG. You can send any updates to Mark Sleeper:
m-sleeper@northwestern.edu

Don't forget to update your Orthopaedic Section and PASIG membership! You will find links to the website for updating at the end of this blast. Also, please contact Amanda Blackmon, membership chair, to make sure she has your current information for receiving blasts and updates as well as confirming your membership: Mandy@onetherapy.com

Please look into the updated list of education conferences and resources below. For those of you interested in learning more about **Musician Health**, there is a new lecture series offered in the Southern California area (the first item listed). Thank you Janice Ying, PT, DPT, OCS for developing this much-needed series!

Research Call to action:

1. We still need writers for the 2014 Citation blasts!!! These are put together on a monthly basis. Please contact me for more information, at brookerwinder@gmail.com. Go to the website to look at topics that have been covered, add new content or update old citation topics: http://www.orthopt.org/content/special_interest_groups/performing_arts/citations_endnotes
2. We need case reports and original research papers that focus on clinical applications to the care of performing artists to publish in our quarterly Orthopaedic Practice Magazine, in the PASIG pages. Orthopaedic Practice Magazine is a great way of getting your case reports, original research, and clinical pearls into the hands of our PASIG members. Please contact Annette Karim if you are interested in submitting your writing: neoluvsonlyme@aol.com
3. If you are seeking research participants, or are seeking a researcher to work with your potential participants, contact both Brooke Winder, Research Chair: Brookerwinder@gmail.com and Amanda Blackmon, Membership Chair: mandy@onetherapy.com
4. We are working on creating a brief dance screen as a resource for the PASIG website. The new contact for dance screening is Sarah Wegner: Sbw28@drexel.edu

This month's citation blast is a collection of abstracts focused on dance jump landings and associates injuries, compiled by Meredith Dake, PT, DPT, OCS. I am excited to see that there are more studies coming out with the focus on biomechanical assessment of dance jumping and possible links to injury. Thank you, Meredith!

The practice of compiling abstracts has been an easy way for interns and clinicians to provide content for a citation blast as well as prepare for a clinical inservice or case study report. 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 or ideas on future citation blasts. (brookeRwinder@gmail.com)

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

Best regards,

Brooke

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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)

Dancers, Jump Landings, and Associates Injuries

I recently suffered an inversion ankle sprain while attempting to land a brisé. I think that the contributing factors were a combination of having my weight too far forward and the floor being too "tacky" for my pointe shoe. I was curious to see what research has been done regarding dancers and injuries from jump landings. I searched the terms "dancer" and "landing" in EBSCOHost, limiting the search to academic journals. I hope these results inform your practice as you improve the skills of dancers and dance educators.

Meredith Dake, PT, DPT
Physiotherapy Associates, Denver, CO

Della Valle CJ, Su E, Nihal A, Rosenberg ZS, Trepman E. Acute Disruption of the Tarsometatarsal (Lisfranc's) Joints in a Ballet Dancer. *Journal of Dance Medicine & Science.* 2000;4(4):128-131.

Abstract: A 15-year-old female ballet dancer suffered acute midfoot pain when landing from a jump. Physical examination and imaging studies revealed acute disruption of the tarsometatarsal (Lisfranc's) joints with rupture of Lisfranc's ligament. Fluoroscopic examination under anesthesia confirmed instability of the first, second, and third tarsometatarsal joints. Treatment included operative open reduction and rigid internal fixation to re-establish stable alignment, and postoperative protection (non-weightbearing) in a bivalved cast. The screws were removed 14 weeks after fixation, and weightbearing and physiotherapy were advanced.

Follow-up evaluation at 10 months after initial treatment showed maintenance of stable alignment. The patient had no pain at the tarsometatarsal joints, but there was pain at the metatarsal heads after dance activity. She was able to plie, tendu, and work on demi-pointe, and had achieved her age level of dance, but had not resumed Pointe work because of limitation in plantar flexion. Acute tarsometatarsal disruption is rare in young dancers and may be difficult to diagnose. Recognition of this type of injury is important because delay in the diagnosis and treatment may be associated with residual instability and poor prognosis.

Didier J, West V. Vertical Jumping and Landing Mechanics: Female Athletes and Nonathletes. *International Journal of Athletic Therapy & Training. .* 2011;16(6):17-20.

Abstract: The article discusses a study of the kinematics and kinetics of female athletes at risk of anterior cruciate ligament (ACL) and nonathletic controls during loading and landing phases of a maximal vertical jump. The low-risk group were identified as dancers and cheerleaders while volleyball and soccer players were categorized as members of the high-risk group. The study involved 59 collegiate undergraduates. The role of training in reducing ACL risk is noted.

Fietzer AL, Chang YJ, Kulig K. Dancers with patellar tendinopathy exhibit higher vertical and braking ground reaction forces during landing. *J Sports Sci.* 2012;30(11):1157-1163.

Abstract: Dancers are exposed to the effects of repetitive jumping and leaping as are other athletes that tend to develop patellar tendinopathy. Greater vertical ground reaction forces occur during landing from a dance leap than during takeoff and during other common athletic activities. The purposes of this study were: (1) to compare the landing ground reaction force profiles of participants with and without clinically diagnosed patellar tendinopathy, and (2) to determine the strength of the relationship between landing angle, and braking impulse. Eighteen elite pre-professional dancers (12 healthy, 6 with patellar tendinopathy; both groups 50% male) performed sauts de chat for kinetic and kinematic analysis. Dancers with patellar tendinopathy demonstrated greater peak vertical ground reaction force and impulse (36% and 15% greater, respectively). Dancers with patellar tendinopathy demonstrated greater peak braking ground reaction force and impulse (82% and 126% greater, respectively). Landing angle explained 67% of the braking impulse. Dancers with patellar tendinopathy exhibited greater vertical and braking impulses than healthy dancers. Braking impulse was strongly correlated with landing angle. While there was no difference between groups in landing angle, dancers with patellar tendinopathy exhibited greater braking impulse than their non-tendinopathic counterparts, even at similar landing angles.

Hagins M, Pappas E, Kremenic I, Orishimo KF, Rundle A. The effect of an inclined landing surface on biomechanical variables during a jumping task. *Clin Biomech (Bristol, Avon).* Nov 2007;22(9):1030-1036.

Abstract: Background: Professional dancers sustain a high number of injuries. Epidemiological studies have suggested that performing on inclined “raked” stages increases the likelihood of injury. However, no studies have examined if biomechanical differences exist between inclined and flat surfaces during functional tasks, such as landing from a jump. Such differences may provide a biomechanical rationale for differences in injury risk for raked stages. Methods: Eight professional dancers performed drop jumps from a 40cm platform on flat and inclined surfaces while forces, lower extremity kinematics, and electromyographic activity were collected in a controlled laboratory environment. Findings: Dancers landed on the laterally inclined surface with significantly higher knee valgus (4°), peak knee flexion (9°), and medial–lateral ground reaction force (GRF) (13.4% body weight) compared to the flat condition. The posterior GRF was higher in the anterior inclined condition compared to the flat condition. In the anterior inclined condition, subjects landed with 1.4° higher knee valgus, 4° more plantarflexion at initial contact, and 3° less dorsiflexion at the end of landing. Interpretation: Biomechanical variables that have been suggested to contribute to injury in previous studies are increased in the inclined floor conditions. These findings provide a preliminary biomechanical rationale for differences in injury rates found in observational studies of raked stages.

Kulig K, Fietzer AL, Popovich JM, Jr. Ground reaction forces and knee mechanics in the weight acceptance phase of a dance leap take-off and landing. *J Sports Sci.* Jan 2011;29(2):125-131.

Abstract: Aesthetic constraints allow dancers fewer technique modifications than other athletes to negotiate the demands of leaping. We examined vertical ground reaction force and knee mechanics during a saut de chat performed by healthy dancers. It was hypothesized that vertical ground reaction force during landing would exceed that of take-off, resulting in greater knee extensor moments and greater knee angular stiffness. Twelve dancers (six males, six females; age 18.9 ± 1.2 years, mass 59.2 ± 9.5 kg, height 1.68 ± 0.08 m, dance training 8.9 ± 5.1 years) with no history of low back pain or lower extremity pathology participated in the study. Saut de chat data were captured using an eight-camera Vicon system and AMTI force platforms. Peak ground reaction force was 26% greater during the landing phase, but did not result in increased peak knee extensor moments. Taking into account the 67% greater knee angular displacement during landing, this resulted in less knee angular stiffness during landing. In conclusion, landing was accomplished with less knee angular stiffness despite the greater peak ground reaction force. A

link between decreased joint angular stiffness and increased soft tissue injury risk has been proposed elsewhere; therefore, landing from a saut de chat may be more injurious to the knee soft tissue than take-off.

Lee HH, Lin CW, Wu HW, Wu TC, Lin CF. Changes in biomechanics and muscle activation in injured ballet dancers during a jump-land task with turnout (Sissonne Fermee). *J Sports Sci.* 2012;30(7):689-697.

Abstract: 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 Fermée 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 Fermée" 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.

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.* Sep 2008;36(9):1779-1788.

Abstract: 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.

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

Abstract: 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.

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

Abstract: 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.

Pappas E, Kremenic I, Liederbach M, Orishimo KF, Hagins M. Time to stability differences between male and female dancers after landing from a jump on flat and inclined floors. *Clin J Sport Med.* Jul 2011;21(4):325-329.

Abstract: The article presents a study which determines the effect of gender and inclined floor on time to stability (TTS) after landing from a vertical jump. The study used a repeated measures design with male and female professional dancers landing on a flat and four inclined floors. It was concluded that female dancers exhibited longer TTS after landing from a vertical jump compared with their male counterparts. This balance difference may be due to the higher rate of ankle sprain among female dancers.

Reeve HK, Hopper LS, Elliott BC, Ackland TR. Lower limb kinematic variability in dancers performing drop landings onto floor surfaces with varied mechanical properties. *Hum Mov Sci.* Aug 2013;32(4):866-874.

Elite dancers perform highly skilled and consistent movements. These movements require effective regulation of the intrinsic and extrinsic forces acting within and on the body. Customized, compliant floors typically used

in dance are assumed to enhance dance performance and reduce injury risk by dampening ground reaction forces during tasks such as landings. As floor compliance can affect the extrinsic forces applied to the body, secondary effects of floor properties may be observed in the movement consistency or kinematic variability exhibited during dance performance. The aim of this study was to investigate the effects of floor mechanical properties on lower extremity kinematic variability in dancers performing landing tasks. A vector coding technique was used to analyze sagittal plane knee and ankle joint kinematic variability, in a cohort of 12 pre-professional dancers, through discrete phases of drop landings from a height of 0.2 m. No effect on kinematic variability was observed between floors, indicating that dancers could accommodate the changing extrinsic floor conditions. Future research may consider repeat analysis under more dynamic task constraints with a less experienced cohort. However, knee/ankle joint kinematic variability was observed to increase late in the landing phase which was predominantly comprised of knee flexion coupled with the terminal range of ankle dorsiflexion. These findings may be the result of greater neural input late in the landing phase as opposed to the suggested passive mechanical interaction of the foot and ankle complex at initial contact with a floor. Analysis of joint coordination in discrete movement phases may be of benefit in identifying intrinsic sources of variability in dynamic tasks that involve multiple movement phases.

Simpson KJ, Kanter L. Jump distance of dance landings influencing internal joint forces: I. Axial forces. *Med Sci Sports Exerc.* Jul 1997;29(7):916-927.

Abstract: The purpose of this study was to investigate the effect of jumping distance on component ankle and knee joint axial forces (AFs) generated during the landing phase of traveling jumps. Six female dancers performed 10 jumps each at 30, 60, and 90% maximum jump distance (JD) and 15 jumps ranging from 35 to 100% JD. A sagittal view of the right leg landing onto a force platform was filmed. Greater ground reaction force maxima, knee flexion, knee and ankle flexion velocity, tibial landing angle, net ankle and knee joint moment maxima, ankle and knee joint reaction AFs, and quadriceps AFs (QuadAF) peak magnitudes and rates of AF application (dF[sub]max[/sub]/dt) were observed at increased JD. The QuadAF was a more important determinant of Knee AF than joint reaction AF. Increased quadriceps force was useful for accommodating impact forces but served to increase its contribution to Knee AF, particularly during the later portion of the impact phase. High impact situations create significant magnitudes (e.g.,14 BW) and dF[sub]max[/sub]/dt of muscle AFs which could contribute to excessive joint wear.

Simpson KJ, Pettit M. Jump distance of dance landings influencing internal joint forces:

II. Shear forces. *Med Sci Sports Exerc.* Jul 1997;29(7):928-936.

Abstract: The purpose of the study was to investigate the effect of jumping distance (JD) on contributors of ankle and knee shear forces (SF) generated during the landing phase of traveling jumps. Six female dancers performed 10 trials each at 30, 60, and 90% maximum JD and 15 jumps ranging from 35 to 100% JD. A sagittal view of the right leg landing onto a force platform was filmed using a high-speed cine camera. Greater ankle and knee joint reaction shear forces and quadriceps SF (QuadSF) were observed at increased JD. Although the triceps surae SF also increased at greater JD for all but one participant, the effect on minimizing the increase in the ankle SF was minor. The peak QuadSF magnitude and rate of loading were always greater than the corresponding knee joint reaction shear forces variables. However, the increased QuadSF that occurred at longer jumps led to increased knee SF for only half of the participants.

Smith JA, Siemienski A, Popovich JM, Jr., Kulig K. Intra-task variability of trunk coordination during a rate-controlled bipedal dance jump. *J Sports Sci.* 2012;30(2):139-147.

Abstract: In this study, we investigated trunk coordination during rate-controlled bipedal vertical dance jumps. The aims of the study were to investigate the pattern of coordination and the magnitude of coordination variability within jump phases and relative to phase-defining events during the jump. Lumbar and thoracic kinematics were collected from seven dancers during a series of jumps at 95 beats per minute. The vector coding technique was used to quantify the pattern and variability of trunk coordination. Coordination was predominantly anti-phase during propulsion and landing. Mean coordination variability peaked just before the landing phase and at the transition from landing to propulsion phases, and was lowest during the propulsion phase just before toe-off. The results indicate that peaks in variability could be explained by task and phase-specific biomechanical demands.

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https://www.orthopt.org/sig_pa_join.php

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