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.65 **October 2011**

Dear PASIG members:

PASIG programming for CSM 2012 will occur on Friday, February 10th, from 8:00am to 12:30pm. Our PASIG business meeting will be held directly following the programming in the same room. Our program topic this year is "*The Core of the Matter: from the Hips to the Lips*" with Mary Massery, Jeff Stenback, and Amy Humphrey speaking.

As we prepare for CSM 2012 and PASIG programming, please let me know if you are presenting performing arts-related research and I will be sure to include you in our calendar in our January Blast. Please remind your students to check our webpage (www.orthopt.org/sig_pa.php) if they have had an abstract accepted and would like to be considered for the annual student research scholarship. This award is to recognize students, who have had an abstract accepted to CSM, for their contribution to performing arts medicine and research. Students with additional questions can contact Amy Humphrey (amy@lancasterpt.com)

Elections for the Orthopaedic Section open in November. We have one elected position open, for the Nominating Committee. There are three candidates running: Rosie Canizares, PT, DPT; Danelle Dickson, PT, DPT; and Melissa Strzelinski, PT, MPT. Thanks to each of you for agreeing to run.

The PASIG board unanimously approved Annette Karim PT, DPT, OCS as our new Chair for the Research Committee. She is excited to bring new ideas to foster research in the performing arts. Welcome Annette!

PERFORMING ARTS CONTINUING EDUCATION AND CONFERENCES

****Performing Arts Independent Study Couses****
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

International Association for Dance Medicine and Science (IADMS) 21st Annual Meeting
October 13 – 16, 2011, Washington DC
Contact: www.iadms.org

For this October Citation BLAST, Brooke Winder and Kari Oki have compiled the topic, "*Achilles Tendinopathy*." The format is an annotated bibliography of articles generally from the last decade. The PASIG Research Committee initiated this monthly Citation BLAST on performing arts-related topics in June 2005 in the hopes of encouraging our members to stay current in the literature and, perhaps, consider conducting research themselves. Each month we send a new list of performing arts (PA) citations to members of the PASIG to further the pursuit of PA-related scholarship. (Information about EndNote referencing software can be found at http://www.endnote.com, including a 30-day free trial).

Regards,
Shaw

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Achilles Tendinopathy

The purpose of this month's blast is to present research related to Achilles tendinopathy. Many of the demands of dance movements, such as pliés, jumps and

leaps, relevés, and pointe work, involve repetitive loading to the Achilles tendon. Therefore, understanding contributing factors to injury as well as optimal treatment interventions is of particular interest. The citations below include investigations on the likely etiology of this injury, including biomechanical factors. Current research on biomechanical factors in dancers remains sparse; however, the included literature on runners with Achilles tendinopathy can provide a useful foundation from which we can draw. There are several studies presenting evidence for the effectiveness of an eccentric loading program for the Achilles tendon, with investigation into possible changes in tendon morphology. Unfortunately, there are currently no studies using this intervention with a cohort of dancers or other performing artists. Further investigation into this topic will help us to understand more about preserving the health of the Achilles tendon throughout a dancer's career, as well as how to tailor tendon reloading and other interventions to the demands of dance.

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Alfredson H, Cook J. A treatment algorithm for managing Achilles tendinopathy: new treatment options. *Br J Sports Med*. 2007;41:211-6.

This review article suggests a time course for managing Achilles tendinopathy utilizing a variety of primarily conservative and effective treatment options. A treatment algorithm is provided to place these options in a clinical reasoning order appropriate for most individuals with Achilles tendon pain. After excluding tendon rupture and peritendinous structures as the source of pain, the author recommends initiating his literature-supported eccentric heel-drop exercise program. This intervention has demonstrated clinical success in 90% of individuals with mid-tendon pain and 30% of those with insertional pain. Protocol: Knee straight and knee flexed heel drops up to 3x15 repetitions each, 2 times per day for 12 weeks. Patients encouraged to perform exercises through Achilles tendon pain and to increase resistance if pain is not provoked. If unsuccessful in alleviating symptoms, exercise should be combined with use of a topical glyceryl trinitrate patch, shock-wave therapy, corticosteroid and/or sclerosing injections. Once these conservative options are exhausted, the patient is considered a candidate for surgical repair. The author cautions, however, that clinical judgment takes precedence over the treatment algorithm, especially with elite athletes, individuals who cannot fully bear weight on the lower extremity, or the elderly who may not be physically able to complete a rigorous eccentric training program.

Azevedo LB, Lambert MI, Vaughan CL, O'Connor CM, Schwellnus MP. Biomechanical variables associated with Achilles tendinopathy in runners. *Br J Sports Med*. 2009;43(4):288-292.

This case-control study investigated biomechanical factors in Achilles tendinopathy. Twenty-one runners free from injury (16 men, 5 women) and 21 runners with Achilles tendinopathy (16 men, 5 women) performed 10 running trials with standardized running shoes. Injured runners were diagnosed clinically according to established diagnostic criteria. Uninjured runners had been injury-free for at least 2 years. During each trial, kinetic and lower limb kinematic data were measured using a force plate and six infrared cameras. Electromyographic data from six muscles (tibialis anterior (TA), peroneus longus (PE), lateral

gastrocnemius (LG), rectus femoris (RF), biceps femoris (BF) and gluteus medius (GM)) were measured. Results: Knee range of motion (heel strike to midstance) was significantly lower in injured runners than in uninjured runners. Similarly, preactivation (integrated EMG (IEMG) in 100 ms before heel strike) of TA was lower for injured runners than uninjured runners. RF and GM IEMG activity 100 ms after heel strike was also lower in the injured group. However, impact forces were not different between the two groups. The authors concluded that altered knee kinematics and reduced muscle activity are associated with Achilles tendinopathy in runners. Rehabilitation exercises or other mechanisms that affect kinematics and muscle activity may therefore be beneficial in the treatment of runners with Achilles tendinopathy.

Fernandez-Palazzi F, Rivas S, Mujica P. Achilles tendinitis in ballet dancers. *Clin Orthop Relat Res.* 1990; (257):257-261.

The author states that classical ballet dancers performing en pointe, demi pointe, or plié exert forces that, although normal in magnitude, are increased in frequency, thus overusing the Achilles tendon. In this study all cases of Achilles tendinopathy seen in a period of three years in three ballet companies were reviewed by an orthopedic clinic. The cause, development, and progression to chronic tendinopathy, as well as measures to prevent it, were analyzed in 19 cases. Contributing factors to Achilles tendinopathy in the cases included: tight heel cord, pronated feet, poor gastrocnemius-soleus flexibility, improper exercise regimens without scheduled rest, and flooring surfaces. The methods of treatment, including conservative treatment with rest and refraining from dancing, local treatment such as ice and adhesive strapping, anti-inflammatory drugs, local injections, thermotherapy, and laser therapy, were compared, and the time of recovery and ability to resume dancing were evaluated. Two cases required surgical treatment to subside, and the patients had to retire from professional dancing. The roentgenographic diagnosis of stage and progression of the tendinopathy is emphasized in this study as a valuable sign.

Hodgkins CW, Kennedy JG, O'Loughlin PF. Tendon injuries in dance. *Clin Sports Med.* 2008; 27(2):279-288.

This review article outlines several tendons commonly injured in dancers, including the Achilles tendon. The Achilles tendon experiences high loads during dance movements and must transmit up to 6 times body weight during running and jumping. Factors cited in the development of Achilles tendon injury include tight heel cords, small/thin tendon mass, excessive pronation, incomplete relevé, and a cavus foot with a Haglund's deformity. Injury to the Achilles tendon is discussed briefly in acute and chronic tendinopathy as well as rupture. Acute tendinitis, characterized by swelling, crepitus, and tenderness, can be treated with rest, immobilization, ice, and other anti-inflammatory treatments, followed by initiation of stretching and movement re-training. Tendinosis occurs with degeneration of the tendon, and surgical intervention is discussed within this review. Acute ruptures of the tendon occur most commonly in male dancers over age 30, and are also treated with surgical repair.

Kulig K, Loudon JK, Popovich JM, Pollard CD, Winder BR. Dancers with Achilles tendinopathy demonstrate altered lower extremity kinematics. *J Orthop Sports Phys Ther.* 2011; 41(8):606-613.

This is a controlled laboratory study using a cross-sectional design. The objective of this study was biomechanical in nature: To analyze lower extremity kinematics during takeoff of a "saut de chat" in dancers with and without a history of Achilles tendinopathy (AT). Subjects included sixteen female dancers with and without a history of AT (mean ± SD age, 18.8 ± 1.2 years). Three-dimensional kinematics at the hip, knee, and ankle were quantified for the takeoff of the saut de chat using a motion analysis system. A force platform was used to determine braking and push-off phases of takeoff. Peak sagittal, frontal, and transverse plane joint positions during the braking and push-off phases of the takeoff were examined

statistically. Independent samples t-tests were used to evaluate group differences (α = 0.05). Results: The dancers in the tendinopathy group demonstrated significantly higher peak hip adduction during the braking phase of takeoff (mean ± SD, 13.5° ± 6.1° versus 7.7° ± 4.2°; *P* = 0.046). During the push-off phase, dancers with AT demonstrated significantly more internal rotation at the knee (13.2° ± 5.2° versus 6.9° ± 4.9°; *P* = 0.024). The authors concluded that dancers with AT demonstrate increased peak transverse and frontal plane kinematics when performing the takeoff of a saut de chat, and that the larger displacements may be either causative or compensatory factors in the development of AT.

Langberg H, Ellingsgaard H, Madsen T, et al. Eccentric rehabilitation exercise increases peritendinous type I collagen synthesis in humans with Achilles tendinosis. *Scand J Med Sci Sports*. 2007; 17:61-6.

This study sought to elucidate the mechanism by which Achilles tendon remodeling occurs following 12 weeks of an eccentric calf training program. Training consisted of 3 sets of 15 repetitions of straight and flexed-knee eccentric heel drops (targeting gastrocnemius and soleus muscles, respectively) with progressive resistance performed 2 times per day. Subjects were 12 elite male soccer players (mean age 26 yrs), 6 with Achilles tendinosis (mean duration of symptoms 19 months) and 6 healthy controls. Researchers utilized a microdialysis technique to quantify molecular markers of type I collagen synthesis and degradation in the Achilles tendon before and after eccentric calf training. Results: Prior to training, there were no differences in collagen synthesis between injured and healthy tendons. Following the intervention, a significant increase in collagen synthesis was exhibited in healthy tendons ($p<0.05$) compared with injured tendons, which demonstrated no increase in collagen synthesis. Pain upon loading of the Achilles tendon in injured subjects (VAS) was reduced ($p<0.05$). Authors conclude that an increase in collagen synthesis may be one mechanism by which Achilles tendons remodel following 12 weeks of eccentric loading.

Maffulli N, Walley G, Sayana MK, Longo UM, Denaro V. Eccentric calf muscle training in athletic patients with Achilles tendinopathy. *Disabil Rehabil*. 2008; 30(20-22):1677-84.

This study sought to evaluate the effects of eccentric strengthening exercises (ESE) in athletic patients with Achilles tendinopathy. ESE protocol consisted of single-leg eccentric heel drop exercises performed with knee straight and flexed. Subjects progressed from 1 set of 10 repetitions to 3x15 repetitions performed through moderate tendon pain; weight was added in increments of 5 kg when they could do heel drops without pain. Exercises were preceded by a 3 minute warm-up and stretch, and were followed by 10-15 minutes of ice massage to the Achilles tendon. The exercise program was considered effective if a patient did not reported pain interfering with normal activities, and if VISA-A scores improved by more than 10 points at the end of the 12 week intervention. Results: Sixty percent (27/45) of the subjects (mean age 26 yrs) responded to ESE. Of the 18 whose Achilles tendinopathies did not resolve, 15 showed significant improvement following peritendinous aprotinin and local anesthetic injections or surgical repair. This study did not compare subjects who participated in ESE to a control group. However, authors conclude that young, athletic subjects with Achilles tendinopathy are able to benefit from intensive, heavy load ESE.

McCrory JL, Martin DF, Lowery RB, et al. Etiologic factors associated with Achilles tendinitis in runners. *Med Sci Sports Exerc*. 1999; 31(10):1374-1381.

The purpose of this study was to determine whether relationships exist between selected training, anthropometric, isokinetic muscular strength, and endurance, ground reaction force, and rearfoot movement variables in runners with Achilles tendinitis. The authors examined differences in selected measures between an uninjured cohort of 58 runners and a cohort of 31 injured runners with Achilles tendinitis. Isokinetic, kinetic, and kinematic measures were collected using an isokinetic dynamometer, AMTI force plate, and Motion Analysis high-speed ideography. Separate discriminant function analyses were performed on each of the

five sets of variables to identify the factors that best discriminate between the injured and control groups. Results: Years running (injured runners had been running for more years), training pace (injured runners trained at a faster pace), stretching habits (injured runners were less likely to incorporate stretching into their training routine), touchdown angle (injured group was more inverted at touchdown, had more pronation, a shorter time to maximum pronation, and a greater maximum pronation velocity), plantar flexion peak torque at $180°\cdot s^{-1}$ (the injured group demonstrated less strength), and arch index (injured runners had slightly higher arches) were found to be significant discriminators between groups.

Ohberg L, et al. Eccentric training in patients with chronic Achilles tendinosis: normalized tendon structure and decreased thickness at follow up. *Br J Sports Med*. 2004; 38:8-11.

The purpose of this study was to investigate tendon thickness and structure via ultrasonography in patients treated with eccentric calf muscle training for painful chronic Achilles tendinosis. Authors examined 26 tendons in 25 subjects (mean age 50 yrs; mean duration of symptoms 17 months). Measurements were taken prior to and 4 years following a 12-week eccentric calf training program. Training regimen details are not specified in the article. Results: Prior to eccentric calf training, all subjects exhibited thickening of the Achilles tendon 2-6 cm from calcaneal insertion, as well as focal hypoechoic areas and irregular tendon structure. Four years after the intervention, there was a significant decrease in the thickness of tendinotic tendons (Wilcoxon Signed-Ranks Test; $p<0.005$). Qualitatively, 19/26 tendons no longer exhibited areas of hypoechoicity or structural irregularity. A subject-completed questionnaire at follow-up showed that 22/25 patients were satisfied with the eccentric training protocol and were able to perform Achilles tendon loading activities at their desired levels.

Rompe JD, Nafe BN, Furia JP, Maffulli N. Eccentric loading, shock-wave treatment, or a wait-and-see policy for tendinopathy of the main body of tendo Achillis: A randomized controlled trial. *Am J Sports Med.* 2007; 3593):374-83.

In this study, the efficacy of 3 protocols for treating chronic Achilles tendinopathy was compared: eccentric calf strengthening (ECC), a repetitive, low-energy shock wave therapy (SWT), and a “wait-and-see” approach. Calf strengthening was performed 2 times per day for 12 weeks, beginning with 1x10 repetitions of eccentric gastrocnemius and soleus heel drops and progressing to 3x15 repetitions; patients continued through mild/moderate pain. Once exercises became pain-free, patients were allowed to add resistance in multiples of 5 kgs as long as they could maintain technique. SWT parameters: 3 sessions in 3 weeks of 2000 pulses per session (duration approx 10 minutes) at a frequency of 8 pulses/second and pressure of 3 bars, applied to the area of maximal tenderness. The wait-and-see policy entailed an orthopedist’s advice regarding training modifications, stretches, ergonomics, and prescription of NSAIDs while awaiting spontaneous improvement. Seventy-five patients with more than 6 months of recalcitrant Achilles tendinopathy (3-6 cm from calcaneal insertion) were selected. Results: At 4 month follow-up, VISA-A scores improved significantly within ECC and SWT groups ($p<0.01$) and when compared with the wait-and-see group ($p<0.001$). Subjects from ECC and SWT groups rated their improvement significantly higher than those in the wait-and-see cohort ($p\leq0.001$). Achilles tendon pain levels and pain thresholds improved within all groups ($p<0.001$); ECC and SWT subjects achieved greater improvements than wait-and-see patients. Interestingly, Achilles tendon thickness did not change pre- to post-treatment in any group. Authors conclude that spontaneous recovery after more than 6 months of Achilles tendinopathy is unlikely, and that ECC and SWT treatment should be offered as alternatives to surgery.

Silbernagel KG, Thomee R, Eriksson BI, Karlsson J. Continued Sports Activity, Using a Pain-Monitoring Model, During Rehabilitation in Patients With Achilles Tendinopathy. *Am J Sports Med*. 2007; 35: 897-906.

This was a randomized controlled trial to determine if continued running and jumping during treatment with an Achilles tendon loading program has an effect on outcome. 38 patients were randomly allocated to two different treatment groups. One training group was allowed, with the use of a pain-monitoring model, to continue Achilles tendon loading activity. The active rest group stopped such activities for the first 6 weeks of rehabilitation. An identical rehabilitation program was utilized with each group, consisting of an Achilles tendon-loading strengthening program for 12 weeks to 6 months. Exercises consisted mainly of 1-legged, 2-legged, eccentric, and fast rebounding toe raises with progressive increases in intensity. The results were as follows: Significant symptomatic improvements were shown in both groups with the rehabilitation protocol utilized (improvements in VISA-A scores and decreased pain with hopping). Continued loading of the Achilles tendon during the rehabilitative process did not contribute to any negative effects on outcome.

Silbernagel KG, Thomee R, Thomee P, Karlsson J. Eccentric overload training for patients with chronic Achilles tendon pain – a randomized controlled study with reliability testing of evaluation methods. *Scand J Med Sci Sports*. 2001; 11:197-206.

The purposes of this study were to 1) examine the reliability of measurement techniques used to evaluate Achilles tendon pain (ankle ROM; pain on palpation, while jumping, and at rest; jumping ability; calf muscle endurance) and 2) to evaluate the effect of an eccentric overload exercise program on patients with chronic Achilles tendon pain. Treatment for the experimental group entailed a 12-week progressive program with 3 phases. Phase 1: ankle ROM and stretches, concentric/eccentric toe/heel raises; Phase 2: same exercises with an increase in repetitions; Phase 3: same exercises as phase 2 with increase in repetitions and addition of single-leg concentric/eccentric toe raises and quick, rebounding toe raises. Control group patients performed double and single-leg concentric/eccentric toe raises and calf stretches for 12 weeks. Thirty-two subjects participated in the reliability study, while 40 subjects took part in the study evaluating the exercise programs. Measurements were taken after 6 weeks of treatment, and 3 and 6 months following treatment. A questionnaire was administered at 1 year follow-up. Results: All measurement techniques for evaluating Achilles tendon pain were reliable except for pain rating on VAS at rest. Regarding treatment protocols, the experimental group demonstrated greater improvements in plantar flexion ROM, reduction in pain on palpation and while walking, number of asymptomatic periods, Achilles tendon swelling, and satisfaction after one year compared to the control group. However, after treatment, both groups exhibited increased jump height, number of toe-raises performed, and frequency of tendons not tender to palpation. Authors recommend the use of programs with eccentric overload exercises for treatment of chronic Achilles tendon pain.

Williams DS, Zambardino JA, Banning VA. Transverse-plane mechanics at the knee and tibia in runners with and without a history of achilles tendonopathy. *J Orthop Sports Phys Ther*. 2008; 38(12):761-767.

This was a retrospective cohort study to determine if runners with a history of Achilles tendinopathy (AT) demonstrate a difference in transverse-plane motion and moments at the distal tibia and knee compared to runners without a history of AT. Subjects were 8 runners with a history of AT and an uninjured control group consisting of 8 runners. The subjects ran along a 20 meter runway at a fixed speed. Biomechanical measurements were taken using a 6 camera motion analysis system and a force plate. Student t-tests were employed to determine statistically significant differences in transverse-plane motion and moment variables at the distal tibia and knee between groups. Results: The AT group showed less tibial external rotation moment ($P = 0.01$) and peak knee internal rotation ($P = 0.05$) compared to the control group. There was no difference in external rotation moment at the knee ($P = 0.34$) or peak tibial internal rotation ($P = 0.44$). The authors concluded that lack of control in the transverse-plane at the distal tibia may be due to decreased function of the muscles primarily responsible for transverse-plane motion, resulting in greater strain on the

AT in the transverse-plane. However, EMG measurements of muscle activation were not taken or analyzed in this study. Designing an exercise program to strengthen lower leg muscles and improve distal tibial control in the transverse-plane may reduce the risk for developing AT or augment the rehabilitation of AT.

Woodley BL, Newsham-West RJ, Baxter GD. Chronic tendinopathy: effectiveness of eccentric exercise. *Br J Sports Med*. 2007; 41:188-99.

The purpose of this systematic review was to evaluate the current evidence for the effectiveness of eccentric exercise (EE) programs in the treatment of tendinopathies. Studies included were randomized controlled trials investigating the use of EE to treat Achilles, patellar, wrist extensor, and rotator cuff tendons. Outcome measures were pain, function, and patient satisfaction with activity level. Studies were assessed for methodological quality using PEDro and van Tulder scales. Levels of evidence for EE were determined based on the included studies' quality ratings and results. Results: There is limited evidence suggesting that EE is more effective in reducing tendon pain, and improving function and patient satisfaction with activity level than other treatment protocols (concentric exercise, stretching, splinting, and modalities). Authors report a need for more high-quality, randomized controlled studies to better determine the effectiveness of EE compared to other treatments in managing tendinopathies.