

PASIG PERFORMING ARTS

SPECIAL INTEREST GROUP



ORTHOPAEDIC SECTION
AMERICAN PHYSICAL THERAPY ASSOCIATION



PASIG MONTHLY CITATION BLAST: No.37

January 2009

Dear PASIG members:

We look forward to seeing you at Combined Sections Meeting in Las Vegas next month. We hope our members will attend all our PASIG business meeting (with continental breakfast) and programming, as well as support our members presenting their research. Below is a summary of PASIG activities and performing arts-related presentations at CSM. Stop by the Orthopaedic Section table for a handout of these PA-relevant topics or print this out.

Combined Sections Meeting, Las Vegas, 2009

Wednesday, February 11

PLATFORMS

- 8:00 – 10:00 AM **Cardiovascular and Pulmonary Platform Presentation I.** Location: Mandalay Bay, Banyan F, South CC Level 3.
- 9:00 – 9:20 AM The effects of a 6-week Interactive video dance exercise program in an adult population. Speakers: AA Clifford, AM Downs, JD Huckstep, H Merket, Hy Wilkinson; JD Yoder.
- 1:00 – 3:00 PM **Clinical Electrophysiology and Wound Management Research Platform.** Location: Mandalay Bay, Palm B, South CC Level 3.
- 1:20 – 1:38 PM Use of high intensity electrical stimulation to resolve medial calf pain in a collegiate ice skater. Speakers: TJ Manal, L Sturgil.

POSTERS

7:00 – 11:00 AM

Hip Rotator Muscle Strength Tested With the Hip Flexed Compared to the Hip Extended (OPO2149) *Cornbleet SL, Bloom NJ*

Electromyographical Analysis of the Gluteus Medius in Weight-Bearing Exercises (OPO2155) *Krause DA, Jacobs R, Pilger K, Sather B, Sibunka S, Hollman JH*

The Effect of Acute Fatigue of the Hip Abductors on Control of Balance in Young Adult Females (OPO2160) *Bellew JW, Panwitz B, Brock M, Peterson L, Olson K, Staples B*

Lower-Extremity Joint Kinetics During the Takeoff Phase of a Grand Jeté Performed by Elite Dancers (OPO2195) *Winder B, Asami D, Pollard CD, Souza R, Arya S, Popovich J, Kulig K.*
* PASIG Student Research Scholarship Award.

Cardiorespiratory Fitness in Professional Ballet and Modern Dancers Using an Accelerated Step Test (OPO2196) *Bailey J, Bronner S, Ojofeitimi S*

Determining Lumbopelvic Posture Control in University Modern Dancers and Its Relationship to Dance Skill Level (OPO2197) *Shoaf LD*

Motion and Forces Sustained in Selected Hip Hop Dance Sequences (OPO2198) *Bronner S, Ojofeitimi S*

Injury Incidence and Patterns in Hip Hop Dancers (OPO2199) *Ojofeitimi S, Bronner S, Woo H*

5:30 – 7:30 PM Orthopaedic Section Social Hour & Membership Meeting. Location: Mandalay Bay, South Pacific F, North CC Lower Level.

Thursday, February 12

7:00 – 8:00 AM **PASIG Business Meeting** and breakfast. Location: Mandalay Bay, Islander A, North CC Lower Level.

8:00 – 11:00 AM **PASIG PROGRAMMING.** Location: Mandalay Bay, Islander A, North CC Lower Level.

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

8:00 – 8:40 AM Evaluation of the foot and ankle in performing artists - Measurement reliability and ability measures. *RobRoy L. Martin, Ph.D., PT, CSCS*

8:40 - 9:00 AM Clinical case - The influence of boots in figure skating. *Eric Greenberg, PT, DPT*

9:00 – 9:40 AM Rehabilitation and manual therapy for the foot and ankle of performing artists. *Gail Apte PT, ScD, OCS, FAAOMPT*

9:40 – 10:40 AM Clinical Cases - Flexor hallucis longus tendonitis, MTP plantar plate tear, sesmoid fracture, cuboid subluxation, and laceration and repair of extensor hallucis longus and brevis. *Sheyi Ojofeitimi, MPT and Shaw Bronner PT, PhD, OCS*

10:40 – 11:00 AM Clinical case - Taping procedures and clinical applications. *Jason Tonley PT, DPT, OCS*

PLATFORMS

1:00 – 2:45 PM Orthopaedic Platform Presentation

1:00 – 1:15 PM Better That Matters. Frequency and Predictors of Meaningful Functional Improvements: The MOST Study. Speaker: D White

1:15 – 1:30 PM Effect of Femoral Strapping on Medial Femoral Rotation, Patellofemoral Joint Alignment and Pain Response in Females with Patellofemoral Pain:

Assessment Using Weightbearing MRI. Speaker: R Souza

1:30 – 1:45 PM Does Diminished Hip Muscle Strength Influence Medial-lateral Dynamic Stability in Females with Patellofemoral Pain? Speaker: S-P Lee

3:00 – 4:45 PM Orthopaedic Platform Presentation Location: Mandalay Bay, South Seas I, South CC Level 3.

3:15 – 3:30 PM Time-to-Stability Differences Between Male and Female Professional Dancers After a Jumping Task. Speaker: E Pappas

For this January Citation BLAST, I've selected references related to our CSM PASIG programming: "*The Foot and Ankle in Performing Artists*". The format is an annotated bibliography of articles on the selected topic from 1996 – 2008. Each month's citations and Blasts are available on the PASIG webpage for our members to access and download. (Information about EndNote referencing software can be found at <http://www.endnote.com>, including a 30-day free trial). Anyone interested in contributing a special topic citation blast, please volunteer. As always, your comments and suggestions are welcome. Please drop me an e-mail anytime.

Regards,
Shaw

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The Foot and Ankle in Performing Artists

The annotated bibliography this month is focused on foot and ankle topics related to our CSM programming in Las Vegas. This includes foot and ankle outcome instruments, figure skating boots and injury, dance injury and rehabilitation, and taping. I look forward to seeing all of you in Las Vegas.

Shaw Bronner PT, PhD, OCS
ADAM Center, Long Island University

Aper RL, Saltzman CL, et al. (1994). The effect of hallux sesamoid resection on the effective moment of the flexor hallucis brevis. Foot Ankle Int **15**(9): 462-70.

In this cadaver study, the functional significance of the hallux sesamoid bones was quantified by measuring the effective tendon moment arm (ETMA) of the flexor hallucis brevis (FHB) force. (The ETMA differs from the anatomic tendon moment arm in that ETMA's are determined by the experimentally measured moment of the tendon force, rather than by the actual location and orientation of the tendon pull in the joint). The intact case was compared with three levels of progressive sesamoid resection: distal half of the medial sesamoid excised, entire medial sesamoid excised, and both the medial and lateral

sesamoids excised. Five dorsiflexion angles of the metatarsophalangeal joint were tested, ranging from -10° to 50° . A known active load was applied to the FHB muscle of fresh frozen cadaver specimens while the corresponding resisting forces from three orthogonally mounted transducers were being recorded. Results showed that the ETMAs decreased significantly ($P < .05$) only with the excision of both sesamoids. The percent decrease in ETMA was smallest at dorsiflexion angles of -10° and 15° (4.3% and 2.4%, respectively) and largest at dorsiflexion angles of 25° , 35° , and 50° (29.2%, 22.4%, and 26.7%, respectively). The clinical significance of the results is that distal hemiresection of the medial sesamoid or full medial sesamoid excision is unlikely to appreciably compromise the effective mechanical advantage of the FHB muscle. However, this mechanical advantage may be profoundly diminished by excision of both hallux sesamoids.

Aper RL, Saltzman CL, et al. (1996). The effect of hallux sesamoid excision on the flexor hallucis longus moment arm. Clin Orthop Relat Res(325): 209-17.

Surgical treatments for chronic, painful hallux sesamoid disorders typically involve partial or complete resection of 1 or both sesamoids. Although these approaches generally result in satisfactory symptom relief, their effect on biomechanical function of the major hallux flexors is not completely understood. The effects of selective sesamoid resections on the effective tendon moment arm of the flexor hallucis longus tendon were evaluated. Twelve fresh frozen cadaver first rays were each mounted in a device that held rigid the metatarsal. A ramp-controlled displacement of an MTS ram supplied a functional load input force to the flexor hallucis longus. The components of the resultant output force necessary to resist the input flexor hallucis longus force were transduced simultaneously by a multicomponent load cell. Subsequently, 3 progressively more extensive sesamoid resections were done: (1) distal hemiresection, (2) complete resection, and (3) resection of both sesamoids. Six specimens were tested with the medial sesamoid removed first and 6 with the lateral sesamoid removed first. Statistical analysis showed that significant decreases in the effective tendon moment arms occurred with full medial sesamoid resection, full lateral sesamoid resection, and resection of both the medial and lateral sesamoids.

Berglund, CL, Philips LE, Ojofeitimi S (2006). Flexor hallucis longus among dancers. Orthopaedic Physical Therapy Practice **18**(3): 26-31.

Bloch RM (1999). Figure skating injuries. Phys Med Rehabil Clin N Am **10**(1): 177-88, viii.

Figure skaters who train regularly sustain primarily lower extremity injuries, especially overuse injuries. Quadriceps and hamstring stretching may help prevent or decrease anterior knee pain. Foot and ankle problems may be related to the rigidity of the leather skating boot. The need for trunk strength to maintain body position is frequently under-emphasized. Air quality may also be a problem for those who skate in enclosed rinks.

Bronner S, Novella T, Becica L (2007). Management of a delayed-union sesamoid fracture in a dancer. J Orthop Sports Phys Ther **37**(9): 529-40.

BACKGROUND: Misdiagnosed o sesamoid bone pathology in dancers may result in prolonged pain, disability, and career limitation. A thorough understanding of sesamoid disorders and appropriate treatment facilitates timely recovery. The potential loss of hallux plantar flexion strength consequent to sesamoidectomy is a major consideration for dancers. **CASE DESCRIPTION:** An 18-year-old dance student sustained a delayed-union fracture of her lateral (fibular) sesamoid. Treatment included an inductive coupling external bone stimulator with pulsed electromagnetic field, activity, and weight-bearing restrictions, protective padding, strengthening, functional retraining, and progressive return to dance. **OUTCOME:** Following use of an external bone stimulator for 12 months, the dancer successfully returned to her previous level of dancing. Repeated SF-36 and Dance

Functional Outcome System scores confirmed this improvement. DISCUSSION: Loss of hallux plantar flexion strength with sesamoid resection can be devastating to a dancer who requires push-off strength for multiple turns and jumps. Treatment with bone stimulation was therefore selected over more invasive measures. The dancer was compliant with systematic functional progression. Improvement, as seen on radiographs and outcome scores, accompanied her full functional recovery.

Bronner S, Ojofeitimi S, Rose D (2008). Repair and rehabilitation of extensor hallucis longus and brevis tendon lacerations in a professional dancer. J Orthop Sports Phys Ther **38**(6): 362-70.

STUDY DESIGN: Case report. BACKGROUND: Tendon lacerations of the hallux are potentially devastating to a dancer. Strength of the hallux musculature is necessary to attain and maintain balance, push-off in multiple turns, and decelerate in jumps and hops. The purpose of this paper is to report on the repair and rehabilitation of extensor hallucis longus and extensor hallucis brevis tendon lacerations in a professional dancer. CASE DESCRIPTION: A 30-year-old dancer sustained complete laceration of her extensor hallucis longus and extensor hallucis brevis tendons, and partial laceration of the dorsal aspect of the hallux metatarsophalangeal (MTP) joint capsule. Following primary repair, at 9 weeks postsurgery, hallux MTP joint active dorsiflexion was limited to 5 degrees and passive dorsiflexion to 70 degrees. First toe dorsiflexion and plantar flexion strength was 4/5 at the MTP and 3+/5 at the interphalangeal joint. Rehabilitation included functional electrical stimulation to address considerable calf atrophy, strengthening exercises, functional retraining, and progressive return to dance. OUTCOME: The dancer returned to her previous level of dancing in 18 weeks, with 73 degrees and 85 degrees of hallux MTP joint active and passive dorsiflexion, and 30 degrees and 35 degrees of active and passive plantar flexion, respectively. Hallux MTP and interphalangeal joint muscle strength were 5/5 and 4+/5, respectively. Improvement, manifested in her SF-36 and Dance Functional Outcome System scores, accompanied her full functional recovery. DISCUSSION: Hallux stability provided by coactivation of the great toe extensors and flexors is crucial to accomplish the demands of bipedal and unipedal balances and activities in dance. This report demonstrates the success of primary surgical repair and rehabilitation in a dancer/athlete experiencing this injury.

Brown TD, T. Varney E, et al. (2000). Malleolar bursitis in figure skaters. Indications for operative and nonoperative treatment. Am J Sports Med **28**(1): 109-11.

Figure skaters are unique athletes who must train for extended periods of time performing motions and routines that create excessive compressive and shear forces between their malleoli and boots. As a result, they are susceptible to the development of a painful adventitious malleolar bursitis. Most often these patients will relate a recent increase in their training schedule or the purchase of a new pair of skating boots. This condition usually responds favorably to nonoperative measures including stretching of the boot over the affected area and protective padding placed around the inflamed bursa. If the swelling is marked, then an aspiration, subsequent injection with cortisone, and a compressive wrap may be indicated. This treatment regimen will enable the majority of figure skaters to continue skating. If the symptoms continue or increase despite nonoperative measures, then cessation of skating for a brief period must be considered. If this is not a viable option for the skater, surgical excision of the bursa may be warranted. If septic bursitis occurs, immediate surgical debridement and intravenous antibiotics are indicated. A *Staphylococcus aureus* organism is most often responsible and should be treated with appropriate antibiotics. These patients may return to skating when there is no sign of further infection, the soft tissues have fully healed, and there is no sign of residual inflammatory bursa, usually at 4 to 6 weeks after surgery.

Bruening DA, Richards JG (2006). The effects of articulated figure skates on jump landing forces. *J Appl Biomech* **22**(4): 285-95.

Lower extremity injuries in figure skating have long been linked to skating boot stiffness, and recent increases in jump practice time may be influencing the frequency and seriousness of these injuries. It is hypothesized that stiff boots compromise skaters' abilities to attenuate jump landing forces. Decreasing boot stiffness by adding an articulation at the ankle may reduce the rate and magnitude of landing forces. Prototype articulated figure skating boots were tested in this study to determine their effectiveness in enabling skaters to land with lower peak impact forces. Nine competitive figure skaters, who trained in standard boots and subsequently in articulated boots, performed off-ice jump simulations and on-ice axels, double toe loops, and double axels. Analysis of the off-ice simulations showed decreases in peak heel force and loading rate with use of the articulated boot, although the exact kinematic mechanisms responsible for these decreases are still unclear. Analysis of the on-ice jumps revealed few kinematic differences between boot types, implying that the skaters did not use the articulation. Greater adaptation and training time is likely needed for the results seen off-ice to transfer to difficult on-ice jumps.

Carcia CR, Martin RL, Drouin JM (2008). Validity of the Foot and Ankle Ability Measure in athletes with chronic ankle instability. *J Athl Train* **43**(2): 179-83.

CONTEXT: The Foot and Ankle Ability Measure (FAAM) is a region-specific, non-disease-specific outcome instrument that possesses many of the clinimetric qualities recommended for an outcome instrument. Evidence of validity to support the use of the FAAM is available in individuals with a wide array of ankle and foot disorders. However, additional evidence to support the use of the FAAM for those with chronic ankle instability (CAI) is needed.

OBJECTIVE: To provide evidence of construct validity for the FAAM based on hypothesis testing in athletes with CAI. DESIGN: Between-groups comparison. SETTING: Athletic training room. PATIENTS OR OTHER PARTICIPANTS: Thirty National Collegiate Athletic Association Division II athletes (16 men, 14 women) from one university. MAIN OUTCOME MEASURE(S): The FAAM including activities of daily living (ADL) and sports subscales and the global and categorical ratings of function. RESULTS: For both the ADL and sports subscales, FAAM scores were greater in healthy participants (100 +/- 0.0 and 99 +/- 3.5, respectively) than in subjects with CAI (88 +/- 7.7 and 76 +/- 12.7, respectively; $P < .001$). Similarly, for both ADL and sports subscales, FAAM scores were greater in athletes who indicated that their ankles were normal (98 +/- 6.3 and 96 +/- 6.9, respectively) than in those who classified their ankles as either nearly normal or abnormal (87 +/- 6.6 and 71 +/- 11.1, respectively; $P < .001$). We found relationships between FAAM scores and self-reported global ratings of function for both ADL and sports subscales. Relationships were stronger when all athletes, rather than just those with CAI, were included in the analyses.

CONCLUSIONS: The FAAM may be used to detect self-reported functional deficits related to CAI.

Eils E, Imberge S, et al. (2006). Passive Stability Characteristics of Ankle Braces and Tape in Simulated Barefoot and Shod Conditions. *Am J Sports Med*.

BACKGROUND: Ankle sprains are among the most common injuries in barefoot sport activities such as dance, gymnastics, or trampoline. At present, the use of external ankle devices for prevention of ligament injuries for barefoot activities remains unclear.

HYPOTHESIS: External ankle devices have a significant loss of passive stability when used without a shoe in barefoot activities. STUDY DESIGN: Controlled laboratory study.

METHODS: Twenty-five healthy subjects participated in the project (mean age, 26.2 +/- 3.3 years; mean body mass, 71.2 +/- 10.3 kg; mean height, 178 +/- 7 cm). Passive range of motion measurements were performed with 3 different ankle stabilizers (a stirrup brace, a

lace-up brace, and tape), as well as 2 different shoe conditions (cutout shoe [simulated barefoot] and normal shoe). RESULTS: In the simulated barefoot condition, a significantly reduced stabilizing effect for inversion and eversion (19% and 29%, respectively) was found for the stirrup ankle brace. Small decreases were noted with the soft brace and tape, but these were not statistically significant. CONCLUSION: The passive stability characteristics of ankle braces depend to a great extent on being used in combination with a shoe. This is especially true for semirigid braces with stirrup design. Therefore, it is recommended that soft braces (like the one tested in the present investigation) be used in barefoot sports for restricting passive range of motion of the foot and ankle complex. CLINICAL RELEVANCE: This study provides useful information for clinicians to select or recommend an external ankle stabilizing device in barefoot sports to restrict passive range of motion of the foot-ankle complex most effectively.

Franettovich M, Chapman A, et al. (2008). Tape that increases medial longitudinal arch height also reduces leg muscle activity: a preliminary study. Med Sci Sports Exerc 40(4): 593-600.

PURPOSE: To evaluate the initial effects of antipronation taping (APT) on foot posture and electromyographic (EMG) activity of tibialis anterior (TA), tibialis posterior (TP), and peroneus longus (PL) muscles during walking. METHODS: Five asymptomatic individuals who exhibited lower medial longitudinal arch height on a clinical assessment of gait walked on a treadmill for 10 min before and after the application of an APT technique-specifically, the augmented low-Dye. Arch height (AH) in standing as well as peak and average amplitude, duration, time of onset, and time of offset of recorded EMG activity during walking were analyzed for each condition. RESULTS: APT produced a mean (95% confidence interval (CI)) increase in AH of 12.9% (6.5-19.3; $P = 0.005$). Mean (95% CI) reductions in peak and average EMG activation of TA (peak: -23.9% (-34.0 to -13.9); average: -7.8% (-13.6 to -2.0)) and TP (peak: -45.5% (-77.3 to -13.7); average: -21.1% (-41.6 to -0.6)) were observed when walking with APT ($P < 0.05$). The APT also produced a small increase in duration of TA EMG activity of 3.7% (0.9-6.5) of the stride cycle duration, largely because of an earlier onset of EMG activity (4.4%; -8.1 to -0.8 of a stride cycle; $P < 0.05$). CONCLUSION: APT reduces activity of the TA and TP muscles during walking while increasing AH, which provides preliminary evidence of its role in reducing the load of these key extrinsic muscles of the ankle and the foot. Follow-up study is required to evaluate these findings.

Holmes CF, Wilcox D, et al. (2002). Effect of a modified, low-dye medial longitudinal arch taping procedure on the subtalar joint neutral position before and after light exercise. J Orthop Sports Phys Ther 32(5): 194-201.

STUDY DESIGN: Single-group repeated measures design pre- and postintervention. OBJECTIVES: To determine if the modified low-Dye medial longitudinal arch (MLA) taping procedure places the subtalar joint into the neutral position and maintains the subtalar joint neutral (STJN) position following 10 minutes of walking. BACKGROUND: Subtalar malalignment in excessive pronation is commonly accepted as a contributing factor to a variety of musculoskeletal pathologies. The modified low-Dye MLA taping procedure is often used on the plantar surface of the foot as a short-term corrective tool for excessive foot pronation. However, research that evaluates the efficacy of this taping technique during light exercise is lacking. Measurement of navicular height is commonly used as a measure of subtalar position. METHODS AND MEASURES: Prior to the study, one tester-established reliability in the navicular drop technique measurement by initially practicing the measurements on 400 feet, followed by a reliability study performed on 29 subjects. In this study, a screening procedure excluded subjects with ankle or foot pathology, supinated feet, or neutral feet, and included only subjects with pronated feet. The study, which included 40 subjects, involved four steps: (1) measuring navicular height in the relaxed position; (2)

measuring navicular height in the STJN position; (3) measuring navicular height after application of the modified low-Dye MLA taping procedure; and (4) measuring navicular height after subjects had walked for 10 minutes with the taping. RESULTS: Results indicated an intrarater intraclass correlation coefficient (ICC) for measuring navicular height of 0.96 for the right foot and 0.94 for the left foot. Repeated measures ANOVA revealed that significant differences existed ($P < 0.05$) among the 4 measures. A Bonferroni post hoc analysis showed a difference between relaxed stance measurements and all other measurements, and between taped-prewalking measurements and taped-postwalking measurements. In addition, no significant difference was observed between navicular height measured in STJN and the taped-prewalking and taped-postwalking conditions. The average navicular height for the taped-prewalking condition was 1.6 mm higher than that for the STJN position. For the taped-postwalking condition, the average height of the navicular was 1.2 mm lower than that of the STJN position. CONCLUSION: These results demonstrate that the modified low-Dye MLA taping procedure places the subtalar joint near the neutral position. Despite a significant reduction in the height of the navicular after the subjects walked for 10 minutes with the tape on, the height of the navicular was still not significantly different than that of the STJN position.

Jennings J, Davies GJ (2005). Treatment of cuboid syndrome secondary to lateral ankle sprains: a case series. J Orthop Sports Phys Ther **35**(7): 409-15.

STUDY DESIGN: Case series. BACKGROUND: Plantar flexion/inversion ankle sprains are one of the most frequently occurring sports injuries. Cuboid syndrome, which is difficult to diagnose, may result from a plantar flexion/ inversion ankle injury and could become the source of lateral ankle/midfoot pain. The objective of this case series is to describe the examination, evaluation, and treatment of the cuboid syndrome following a lateral ankle sprain. CASE DESCRIPTION: Seven patients were seen in our clinic 1 to 8 weeks following a lateral ankle sprain with a chief complaint of lateral ankle/midfoot pain. In these 7 patients, the presence of cuboid syndrome was identified independently by 2 examiners. Treatment consisted of a cuboid manipulation. OUTCOMES: All 7 patients returned to sports activities following 1 to 2 treatments consisting of the "cuboid whip" manipulation. No recurrence of symptoms was reported upon immediate return to competition or during the remainder of the season (mean follow-up, 5.7 months; range, 2 to 8 months). DISCUSSION: Based on those 7 patients, our results suggest that patients who are properly diagnosed with cuboid syndrome and receive the cuboid manipulation can return to competitive activity within 1 or 2 visits without injury recurrence.

Keenan AM, Tanner CM (2001). The effect of high-Dye and low-Dye taping on rearfoot motion. J Am Podiatr Med Assoc **91**(5): 255-61.

High-Dye and low-Dye taping are commonly used by clinicians to treat a variety of foot and ankle pathologies, particularly those associated with excessive rearfoot pronation. While the effects of taping on end range of motion have been extensively studied, relatively little is understood about the effect of the two styles of taping on rearfoot motion. Eighteen participants were analyzed in three conditions: 1) barefoot, 2) with high-Dye taping, and 3) with low-Dye taping. Two-dimensional motion of the rearfoot was assessed for each condition. The results indicated maximum inversion was increased with both high-Dye and low-Dye taping as compared with no taping. Only high-Dye taping, however, significantly reduced the maximum eversion of the rearfoot. The results suggest that high-Dye taping is an appropriate taping choice when control of eversion of the rearfoot is desired.

Kolettis GJ, Micheli LJ, et al. (1996). Release of the flexor hallucis longus tendon in ballet dancers. J Bone Joint Surg Am **78**(9): 1386-90.

Thirteen female ballet dancers had an operative release of the flexor hallucis longus tendon because of isolated stenosing tenosynovitis, and the results were reviewed after a mean duration of follow-up of six years and six months (range, two to ten years). All of the patients danced at the advanced or professional level, and all had failed to respond to non-operative management. The mean age of the patients at the time of the operation was twenty years (range, 13 to 26 years). Symptoms, which included pain and tenderness over the medial aspect of the subtalar joint, had been present for a mean of six months (range, two to twelve months) preoperatively and were exacerbated by jumping and by attempts to perform en pointe work. Crepitus was present in six patients, and triggering was present in three. No patient had evidence of a symptomatic os trigonum. Postoperatively, all patients participated in a formal physical-therapy program for a mean of 9 weeks (range, four to thirteen weeks). All patients returned to dancing, within a mean of five months (range, 2 to 9 months), and eleven reached a level of full participation in dancing without restriction. At the time of the most recent follow-up, all patients noted improvement compared with the pre-operative condition. Eight patients were professional ballet dancers, four were students at advanced ballet schools, and one had stopped performing ballet for reasons unrelated to the tenosynovitis of the flexor hallucis longus. In addition, two of the students had decided not to pursue careers in dancing because of persistent, but greatly diminished, symptoms. No complications were noted in this series. We concluded that an operative release of the flexor hallucis longus is effective for the treatment of isolated stenosing tenosynovitis in female ballet dancers who place high demands on the foot and ankle and for whom non-operative treatment has failed.

Marshall P, Hamilton WG (1992). Cuboid subluxation in ballet dancers. Am J Sports Med **20**(2): 169-75.

Cuboid subluxation is a common but poorly recognized condition. Its symptoms include lateral midfoot pain and an inability to "work through the foot." In addition, pressing on the plantar surface of the cuboid in a dorsal direction produces pain. The normal dorsal/plantar joint play is reduced or absent when compared to the uninjured side, and subtle forefoot valgus is present. Frequently, there is a shallow depression on the dorsal surface of the foot and palpable fullness on the plantar aspect of the cuboid. Documentation by radiograph, CT scan, or magnetic resonance imaging is difficult because of the normal variations found in the relationship between the cuboid and its surrounding structures. The diagnosis is primarily subjective, and must be made on the basis of the patient's history and physical findings. Treatment requires recognition of the condition, manual reduction by a therapist or physician familiar with the condition, and follow-up to be certain that the cuboid remains in place. Therapists and orthopaedists involved in the care of dancers should be alert to the possibility of cuboid subluxation and be able to recognize it when it occurs.

Martin RL, Irrgang JJ (2007). A survey of self-reported outcome instruments for the foot and ankle. J Orthop Sports Phys Ther **37**(2): 72-84.

The information acquired from self-reported outcome instruments is useful only if there is evidence to support the interpretation of obtained scores. To properly interpret scores, there should be evidence for content validity, construct validity, reliability, and responsiveness. Evidence regarding score interpretation must also contain a description of the applicable test conditions, including information about the characteristics of subjects, timing of data collection, and construct of change. The objective of this review was to identify self-reported outcome instruments that have evidence to support their usefulness for assessing the effect of treatment directed at individuals with foot and ankle-related pathologic conditions in an orthopaedic physical therapy setting. In addition, we provide specific information that will allow clinicians and researchers to select an appropriate instrument and properly interpret the obtained scores. Fourteen self-reported outcome instruments that met the objective of

this review were identified. Five instruments, the Foot and Ankle Ability Measure, Foot Function index, Foot Health Status Questionnaire, Lower Extremity Function Scale, and Sports Ankle Rating System quality of life measure, satisfied all 4 categories of evidence (content validity, construct validity, reliability, and responsiveness) outlined herein.

Martin RL, Irrgang JJ, et al. (2005). Evidence of validity for the Foot and Ankle Ability Measure (FAAM). Foot Ankle Int **26**(11): 968-83.

BACKGROUND: There is no universally accepted instrument that can be used to evaluate changes in self-reported physical function for individuals with leg, ankle, and foot musculoskeletal disorders. The objective of this study was to develop an instrument to meet this need: the Foot and Ankle Ability Measure (FAAM). Additionally, this study was designed to provide validity evidence for interpretation of FAAM scores. **METHODS:** Final item reduction was completed using item response theory with 1027 subjects. Validity evidence was provided by 164 subjects that were expected to change and 79 subjects that were expected to remain stable. These subjects were given the FAAM and SF-36 to complete on two occasions 4 weeks apart. **RESULTS:** The final version of the FAAM consists of the 21-item activities of daily living (ADL) and 8-item Sports subscales, which together produced information across the spectrum ability. Validity evidence was provided for test content, internal structure, score stability, and responsiveness. Test retest reliability was 0.89 and 0.87 for the ADL and Sports subscales, respectively. The minimal detectable change based on a 95% confidence interval was +/-5.7 and +/-12.3 points for the ADL and Sports subscales, respectively. Two-way repeated measures ANOVA and ROC analysis found both the ADL and Sports subscales were responsive to changes in status ($p < 0.05$). The minimal clinically important differences were 8 and 9 points for the ADL and Sports subscales, respectively. Guyatt responsive index and ROC analysis found the ADL subscale was more responsive than general measures of physical function while the Sports subscale was not. The ADL and Sport subscales demonstrated strong relationships with the SF-36 physical function subscale ($r = 0.84, 0.78$) and physical component summary score ($r = 0.78, 0.80$) and weak relationships with the SF-36 mental function subscale ($r = 0.18, 0.11$) and mental component summary score ($r = 0.05, -0.02$). **CONCLUSIONS:** The FAAM is a reliable, responsive, and valid measure of physical function for individuals with a broad range of musculoskeletal disorders of the lower leg, foot, and ankle.

Martin RL, Irrgang JJ, et al. (2006). Current concepts review: foot and ankle outcome instruments. Foot Ankle Int **27**(5): 383-90.

Meier K, McPoil TG, et al. (2008). Use of antipronation taping to determine foot orthoses prescription: a case series. Res Sports Med **16**(4): 257-71.

In order to determine if the use of antipronation taping could be used to direct foot orthoses prescription, seven high school athletes with lower extremity or foot pain caused by overuse stress were taped for 3 days during practice sessions. A visual pain scale and the Foot and Ankle Ability Measure sports subscale were used to monitor pain and function improvement caused by taping. If the taping was effective, foot orthotics were fabricated and posted according to the change in foot posture created by the tape. After wearing the foot orthotics for 4 weeks, all athletes reported a substantial short-term (4-week) reduction in pain and an increase in function. The results of this case series indicate that changes in foot posture created by taping can be used to guide foot orthosis prescription.

Meyer J, Kulig K, et al. (2002). Differential diagnosis and treatment of subcalcaneal heel pain: a case report. J Orthop Sports Phys Ther **32**(3): 114-22; discussion 122-4.

OBJECTIVE: To describe the examination and intervention strategy utilized in the differential diagnosis and treatment of a patient with subcalcaneal heel pain. **BACKGROUND:** The

patient was a 44-year-old man with an 8-month history of left subcalcaneal heel pain. He presented with a chief complaint of limited standing and walking tolerance secondary to pain in the left heel. He had not responded to previous treatments of rest, anti-inflammatory medication, cortisone injections, and exercise prescription. **MATERIALS AND METHODS:** The patient's subcalcaneal heel pain was reproduced utilizing the straight leg raise (SLR) in combination with ankle dorsiflexion and eversion to sensitize the tibial nerve. These findings suggested a neurogenic component to the dysfunction. Because restricted ankle dorsiflexion, excessive pronation, and posterior tibialis weakness were also found, mechanical dysfunctions also likely contributed to the etiology of heel pain. The patient was treated for 10 visits over a period of 1 month. Treatment consisted of active and passive motions aimed at restoring pain-free soft-tissue motion along the course of the tibial nerve. In addition, low-dye taping and therapeutic exercises were utilized to control excessive pronation and reduce stress on the plantar structures of the foot. **RESULTS:** The patient's SLR increased from 42° to 54° and became pain-free. Dorsiflexion range of motion increased from 3° to 8° in the left ankle, and left posterior tibialis strength was normalized. Over a period of 1 month the patient's symptoms were resolved, and his standing and walking tolerance was fully restored. **CONCLUSION:** Assessment and potential contribution of neural dysfunction should be considered in patients with subcalcaneal heel pain.

Nishikawa T, Kurosaka M, et al. (2000). Protection and performance effects of ankle bracing. Int Orthop **24**(5): 285-8.

We investigated the protection afforded to ankle ligaments by ankle supports and the extent to which these were associated with a diminution of motor performance. Eleven volunteers were subjected to a 10 degrees tilt in four directions (inversion, eversion, plantar flexion and dorsiflexion) on a rocking platform. Three-dimensional videography was used to record complex ankle kinematics. The prophylactic ankle supports used were a semi-rigid brace, a lace-up cloth brace, and taping. The ankle supports provided similar initial protection against acute ligamentous inversion sprains. The semi-rigid ankle brace produced a smaller restriction of plantar flexion-dorsiflexion movement than either the lace-up cloth brace or taping.

Radford JA, Landorf KB, et al. (2006). Effectiveness of low-Dye taping for the short-term treatment of plantar heel pain: a randomised trial. BMC Musculoskelet Disord **7**: 64.

BACKGROUND: Plantar heel pain is one of the most common musculoskeletal disorders of the foot and ankle. Treatment of the condition is usually conservative, however the effectiveness of many treatments frequently used in clinical practice, including supportive taping of the foot, has not been established. We performed a participant-blinded randomised trial to assess the effectiveness of low-Dye taping, a commonly used short-term treatment for plantar heel pain. **METHODS:** Ninety-two participants with plantar heel pain (mean age 50 +/- 14 years; mean body mass index 30 +/- 6; and median self-reported duration of symptoms 10 months, range of 2 to 240 months) were recruited from the general public between February and June 2005. Participants were randomly allocated to (i) low-Dye taping and sham ultrasound or (ii) sham ultrasound alone. The duration of follow-up for each participant was one week. No participants were lost to follow-up. Outcome measures included 'first-step' pain (measured on a 100 mm Visual Analogue Scale) and the Foot Health Status Questionnaire domains of foot pain, foot function and general foot health. **RESULTS:** Participants treated with low-Dye taping reported a small improvement in 'first-step' pain after one week of treatment compared to those who did not receive taping. The estimate of effect on 'first-step' pain favoured the low-Dye tape (ANCOVA adjusted mean difference -12.3 mm; 95% CI -22.4 to -2.2; P = 0.017). There were no other statistically significant differences between groups. Thirteen participants in the taping group experienced an adverse event however most were mild to moderate and short-lived. **CONCLUSION:**

When used for the short-term treatment of plantar heel pain, low-Dye taping provides a small improvement in 'first-step' pain compared with a sham intervention after a one-week period.

Requejo SM, Kulig K, et al. (2000). Management of foot pain associated with accessory bones of the foot: two clinical case reports. J Orthop Sports Phys Ther **30**(10): 580-91; discussion 592-4.

STUDY DESIGN: Case study. **OBJECTIVES:** To discuss the differential diagnosis, the nonsurgical and postoperative management of common accessory bones of the foot. **BACKGROUND:** Accessory bones of the foot that are formed during abnormal ossification are commonly found in asymptomatic feet. Two of the most common accessory bones are the accessory navicular and the os peroneum. Their painful presence must be considered in the differential diagnosis of any acute or chronic foot pain. The optimal treatment for the conservative and postoperative management of painful os peroneum and accessory navicular bones remains undefined. **METHODS AND MEASURES:** Therapeutic management of the fractured os peroneum included bracing, taping, and foot orthotics to allow healing of involved tissues, and stretching. The focus of the postoperative management of the accessory navicular was joint mobilization and progressive strengthening. Dependent variables included level of pain with provocation and alleviation tests of joint and soft tissue; girth and sensory tests of the foot and ankle; goniometric measures of foot and ankle; strength of ankle and hip muscles; functional tests; and patient's self-reported pain status. **RESULTS:** The patient with the fractured os peroneum was treated in 13 visits for 10 weeks. At discharge from physical therapy, the patient had the following outcomes relative to the noninvolved side: 100% return of normal sensation tested by light touch and vibration; pain decreased from 6/10 to 1/10; 100% reduction of swelling with ankle girth to normal; 100% range of motion of ankle and subtalar joints. Strength in plantar flexion and eversion remained 20% impaired (80% return to normal) secondary to pain. Upon discharge, he still reported mild pain when walking but was able to return to previous leisure activities. The second patient with the accessory navicular was treated in 18 visits over 9 weeks. Relative to the uninvolved side, she was discharged with the following: 70% return of range of motion in the foot and ankle, 100% of strength in hip and ankle, and 100% return of balance. She could squat and jump without pain and she returned to full pre-morbid activity level. **CONCLUSIONS:** Rehabilitative management of both cases addressed specific impairments and was successful in improving the patients' activity limitation. Clinicians should be aware that these accessory bones are possible sources of disability, secondary to foot pain.

Smith AD, Ludington R (1989). Injuries in elite pair skaters and ice dancers. Am J Sports Med **17**(4): 482-8.

Figure skating coaches have become concerned about the increasing number of injuries among competitive skaters, particularly pair skaters. This study prospectively examines the incidence, severity, and cause of injuries sustained by a group of elite pair skaters and ice dancers. Thirty-three serious injuries, causing the skater to alter training significantly or to cease training completely for at least 7 consecutive days, were recorded over a 9 month period. Female senior pair skaters reported an average of 1.4 serious injuries, and other groups averaged greater than 0.5 serious injury/skater. The lower extremities were injured most frequently, and 7 of the 33 serious injuries were directly related to the skating boot. Eleven serious injuries were caused by lifts. Few of the serious injuries appeared preventable. Changes in boot design and the training for lifting maneuvers should be initiated and studied prospectively to attempt to reduce the unacceptably high injury rate among elite pair skaters and ice dancers.

Wilkerson GB (2002). Biomechanical and neuromuscular effects of ankle taping and bracing. J Athl Train **37**(4): 436-445.

OBJECTIVE: An extensive review of clinically relevant research is provided to assist clinicians in understanding the underlying mechanisms by which various ankle-support systems may provide beneficial effects. Strategies for management of different types of ankle ligament conditions are also discussed. **BACKGROUND:** Much of the literature pertaining to ankle instability and external support has focused on assessment of inward displacement of the hindfoot within the frontal plane. Some researchers have emphasized the importance of (1) pathologic rotary displacement of the talus within the transverse plane, (2) the frequent presence of subtalar joint ligament lesions, and (3) the interrelated effects of ankle support on deceleration of inversion velocity and facilitation of neuromuscular response. **DESCRIPTION:** The traditional method for application of adhesive tape to the ankle primarily restricts inward displacement of the hindfoot within the frontal plane. The biomechanical rationale for a method of ankle taping that restricts lower leg rotation and triplanar displacement of the foot associated with subtalar motion is presented. **CLINICAL ADVANTAGES:** The lateral subtalar-sling taping procedure may limit strain on the anterior talofibular ligament associated with subtalar inversion, restrain anterolateral rotary subluxation of the talus in the presence of ligament laxity, and protect the subtalar ligaments from excessive loading. The medial subtalar sling may reduce strain on the anterior-inferior tibiofibular syndesmosis and enhance hindfoot-to-forefoot force transfer during the push-off phase of the gait cycle.

Wilkerson GB, Kovaleski JE, et al. (2005). Effects of the subtalar sling ankle taping technique on combined talocrural-subtalar joint motions. Foot Ankle Int **26**(3): 239-46.

BACKGROUND: The findings of research on the effectiveness of ankle taping for protection against ligament injury have been inconsistent, and the topic remains controversial. The precise orientation of the force vectors created by tension within the various tape strip components of an ankle taping procedure may be a critical factor influencing the degree of motion restraint that is provided. We hypothesized that the addition of the subtalar sling component to the widely recognized standard (Gibney) ankle taping procedure would enhance restraint of ankle motion. This was a controlled laboratory study, with fully repeated measures (subjects served as their own controls). **METHODS:** An ankle arthrometer was used to quantify anteroposterior (AP) translation and frontal plane inversion-eversion (I-E) tilt of the talocrural-subtalar joints under untaped and taped conditions in normal subjects. A 15-minute exercise session was conducted to loosen the tape before measurement of its effect on motion restraint. **RESULTS:** The ankle taping procedure that incorporated the subtalar sling provided significantly greater restriction of postexercise AP translation ($p < 0.001$, $\eta^2(2) = 0.63$) and postexercise I-E tilt ($p < 0.001$, $\eta^2(2) = 0.66$). **CONCLUSIONS:** The subtalar sling ankle taping procedure provides greater restriction of motions associated with ankle instability than the more widely used Gibney procedure.