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. 114 **April 2016**

Dear Performing Arts SIG members:

Upcoming Conferences! We look forward to providing more programming at conferences in 2017. Upcoming events for the Orthopaedic Section are the 2016 Annual Conference on May 5-7, in Atlanta, Georgia and CSM 2017 on Feb 15-17 in San Antonio, TX. The 2017 annual conference will be San Diego Hyatt Regency mission bay April 20-22. Programming submissions are open for CSM 2017, Due May 9. Please contact Rosie Canizares, our new Vice-President and Education Chair with your interest.

Looking for new committee members! There is room for new committee members, and students are welcome to participate. Please refer to the list below for contact information.

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Looking for great residency and fellowship opportunities? See below:

The Harkness Center for Dance Injuries Residency Program is accepting applications for the 2016-2017 year! A WONDERFUL opportunity:

The NYU Langone Medical Center (NYULMC) Harkness Center for Dance Injuries is a clinical site for NYU Steinhardt School of Education's Orthopedic Physical Therapy Residency (ORP). The ORP is a 12-month program that provides the Resident with an intensive, individualized experience in orthopedic physical therapy and dance medicine. The goal of the residency program, which follows the guidelines and accreditation standards of the American Physical Therapy Association (APTA), is to enable the Resident to develop the advanced clinical skills necessary to provide a superior level of patient care. Upon completion of the residency program, the Resident will have gained the knowledge and experience to be a competent advanced practitioner, and be qualified to sit for board certification in Orthopedics (OCS). Please note that all applicants must apply to New York University's Orthopedic Physical Therapy residency program and also be interviewed and accepted by the Harkness Center for Dance Injuries. Please visit http://steinhardt.nyu.edu/pt/opt and http://hjd.med.nyu.edu/harkness/healthcare-professionals for more information.

Interested in a Performing Arts Fellowship? The American Board of Physical Therapy Residency and Fellowship Education (ABPTFRE) has approved the PASIG Description of Specialist Practice (DSP) for the Performing arts as an area of study. We are now working with the ABPTFRE to turn the DSP into a Description of Fellowship Practice (DFP). We anticipate the DFP will be available online by June 2016. This means that sites can begin forming fellowships in dance medicine, music medicine, theater medicine, etc. The PASIG will provide the fellowship criteria for accreditation. We may have a meeting on creating a performing arts fellowship at CSM 2017 and/or the 2017 Orthopaedic Section annual meeting. Please contact Rosie Canizares, Mariah Nierman, and Laurel Abbruzzese if interested.

Current PASIG members, please remember to update your membership: https://www.orthopt.org/login.php?forward_url=/surveys/membership_directory.php

Keep up with us on Facebook by contacting Dawn Doran. It is a closed group, so you need to contact Dawn first. Keep up with us and post on Twitter: We are **PT4Performers.** https://twitter.com/PT4Performers

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

WE NEED MORE CONTRIBUTORS TO OUR MONTHLY CITATION BLASTS!!!!
Past Monthly citation blasts are available, with citations and EndNote file, listed on the website:
http://www.orthopt.org/content/special_interest_groups/performing_arts/citations_endnotes

TOPICS THAT HAVE BEEN COVERED RECENTLY INCLUDE:
Hand and Wrist Conditions in Gymnasts (Current Issue)
Factors in Optimal Turnout
Achilles tendinopathy
Biomechanics and Posture in Musicians
Pilates
ACL Injuries in Dancers
Patellofemoral Pain and Dance
Neural Entrapments Found Among Musicians
Stress fractures of the foot and ankle
Dry needling
Dynamic Warm Up and Stretching
Platelet Rich Plasma Injections
Back Pain in Dancers

If you are interested in contributing by writing a citation blast or joining the research committee, contact me at lbreising@gmail.com.

Sincerely,

Laura
Laura Reising, PT, DPT, MS, OCS
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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
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ADAM Center
http://www.adamcenter.net/
Publications:
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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)

Hand and Wrist Conditions in Gymnasts

Gymnasts are required to bear significant loads through their upper extremities, making hand and wrist pain, as well as injury of significant concern to these competitive athletes. The Linder and Caines article reported that 30/100 gymnasts sustained an injury, with increased prevalence in the more elite athletes. The purpose of this article compilation was to provide a general overview of comparisons between osseous and soft tissue injures, overuse and traumatic injuries, and conservative care and surgical intervention. Further research is needed to establish age and level-appropriate injury prevention guidelines that can be incorporated into the gymnast's training regimen.

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Abrams R, Tontz W. Pisotriquetral arthrodesis as an alternative to excision for pisotriquetral instability in high-demand patients: a case report in a gymnast. *J Hand Surg Am. 2006*;31(4):611-4.
A gymanast developed ulnar wrist pain caused by pisotriquetral instability. Pisotriquetral arthrodesis resulted in pain relief and sufficient functional return to allow her to return to gymnastics. Pisotriquetral arthrodesis is a feasible alternative to pisiform excision worth consideration in high-demand patients with symptomatic pisotriquetral instability or arthrosis.
TYPE OF STUDY/LEVEL OF EVIDENCE: Therapeutic, Level V.

Brooks TJ. Madelung deformity in a collegiate gymnast: a case report. *J Athl Train*. 2001;36(2):170-173.
OBJECTIVE: To present the case of a 21-year-old female collegiate gymnast with acute left wrist pain.
BACKGROUND: Madelung deformity is a developmental abnormality of the wrist. It is characterized by anatomic changes in the radius, ulna, and carpal bones, leading to palmar and ulnar wrist subluxation. It is more common in female patients and is usually present bilaterally. The deformity usually becomes evident clinically between the ages of 6 and 13 years.
DIFFERENTIAL DIAGNOSIS: Traumatic distal radius physeal arrest, congenital anatomic variant.
TREATMENT: The athlete was treated with symptomatic therapeutic modalities and nonsteroidal anti-inflammatory medication for pain. She was able to continue to participate successfully in competitive gymnastics, minimally restricted, with the aid of palmar wrist tape and a commercially available wrist brace to prevent end-range wrist extension.
UNIQUENESS: Madelung deformity can result in wrist pain and loss of forearm rotation, leading to decreased function of the wrist and hand. This patient was able to participate successfully in elite- and college-level gymnastics with no wrist pain or injury until the age of 21 years. Furthermore, she was able to continue to participate, experiencing only periodic pain, with the aid of taping and bracing support and without the need for reconstructive surgery.
CONCLUSIONS: Although rare, Madelung deformity is typically corrected surgically in athletes with chronic pain and disability. This case demonstrates an example of successful conservative management in which the athlete continued to participate in sport.

Bezek EM, Vanheest AE, Hutchinson DT. Grip lock injury in male gymnast. *Sports Health*. 2009;1(6):518-21.
BACKGROUND: Grip lock is a high bar injury in male gymnastics and occurs while the gymnast is rotating around the high bar. Its mechanism and treatment have been poorly documented.

STUDY DESIGN: Case reports.
RESULTS: One gymnast sustained an extensor tendon injury and ulnar styloid fracture and was treated nonoperatively. The second gymnast sustained open fracture of the radius and ulna with extensor tendon ruptures and was surgically treated. Both gymnasts healed and were able to return to collegiate gymnastics despite residual finger extensor lag.
CONCLUSIONS: Grip lock is a physically and psychologically devastating injury on the men's high bar that can cause forearm fractures and extensor tendon injuries at the wrist (Zone 8), which may result in residual extensor tendon lag. Injuries may be prevented with proper grip fit, appropriate maintenance of grips, and limited duration of use, as well as education of athletes, athletic trainers, and coaches.

Caine D, Howe W, Ross W, Bergman G. Does repetitive physical loading inhibit radial growth in female gymnasts? *Clin J Sport Med.* 1997;7(4):302-8.
OBJECTIVE**:** Stress-related injuries to the distal radius have been noted in female gymnasts with potential for resultant premature closure and abnormal growth at this site. The purpose of this study was comprehensively to review and critically to appraise the available literature to examine the evidence related to this question: does repetitive physical loading inhibit growth of the radius in female gymnasts?
DATA SOURCES: MEDLINE and SPORT Discuss were searched from 1975 to the present by using "gymnast" in combination with injury, growth plate, epiphyseal, and ulnar variance. Additional references were retrieved from the bibliographies of the retrieved articles.
STUDY SELECTION: All descriptive and analytic studies that included data related to stress-related injuries affecting the distal radius of competitive female gymnasts were included. Conclusions regarding the effects of gymnastics training on radial growth of female gymnasts were limited to data from case reports, clinical series, cross-sectional studies, and descriptive cohort studies. Data from relevant experimental animal studies also were included.
DATA EXTRACTION AND SYNTHESIS: In reviewing the literature, particular attention was paid to the relative strengths of the different study designs. From these data, information associated with growth inhibition at the distal radius was examined.
MAIN RESULTS: The descriptive research reviewed included clinical, cross-sectional, and cohort studies that establish the existence of stress-related injuries affecting one or more constituent parts of the epiphyseal-physeal-metaphyseal (EPM) complex of the distal radius, symptomatic ulna-radial-length difference (URLD), and distal radius physeal arrest among female gymnasts. Five cross-sectional studies showed radiographic abnormalities consistent with distal radius physeal-stress reaction in 10-85% of gymnasts studied. Two cross-sectional studies indicated "abnormal" positive URLD in 8-20% of wrists radiographed. Four cross-sectional studies showed significant correlations between training

intensity and URLD, suggesting a dose-response relation. Three cross-sectional studies indicate greater URLD in gymnasts compared with nongymnasts. Radiographic evidence of distal radius physeal arrest involving physically immature female gymnasts is presented in four studies (two clinical series, one cross-sectional, and one descriptive cohort). In animal studies, prolonged physical training has also been shown to inhibit or stop growth in weight-bearing long bones. However, there were no rigorous studies (i.e., randomized control trials or analytic cohorts) examining the question.
CONCLUSION: The results of this critical review of the scientific literature support the plausibility of stress-related distal radius physeal arrest with secondary URLD. However, the strength of evidence is inadequate to be conclusive.

Chawala A, Wiesler ER. Nonspecific wrist pain in gymnasts and cheerleaders. *Clin Sports Med*. 2015;34(1):143-9.
Participation in gymnastics and other upper extremity weight-bearing sports frequently requires athletes to bear significant loads through their wrists. This requirement makes wrist pain and injury of significant concern to competitive gymnasts. Athletes' wrist pain, and their ultimate evaluation and treatment, are subject to many variables. Diagnosing the cause of wrist pain in a gymnast requires understanding of the interplay between sport-specific mechanics imparted to the wrist and the individual athlete's characteristics. Treatment entails the appropriate use of conservative measures or surgical intervention with an emphasis on collaborating with all members of the patient's treatment and training team.

DiFiori JP, Puffer JC, Aish B, Dorey F. Wrist pain, distal radial physeal injury, and ulnar variance in young gymnasts: does a relationship exist? *Am J Sports Med*. 2002;30(6):879-85.
BACKGROUND: Chronic wrist pain affects up to 79% of young gymnasts. Distal radial growth plate injury and positive ulnar variance have also been reported in this population.
HYPOTHESIS: There is a relationship between wrist pain, radiographic findings of distal radial growth plate injury, and ulnar variance in skeletally immature young gymnasts.
STUDY DESIGN: Cross-sectional study.
METHODS: Fifty-nine gymnasts (28 girls and 31 boys; average age, 9.3 years) completed a questionnaire detailing training and wrist pain symptoms. Each received a wrist examination, grip strength measurement, and bilateral wrist radiographs.
RESULTS: Wrist pain was reported by 56% of the gymnasts (33 of 59), with 45% (15 of 33) describing pain of at least 6 months' duration. Factors significantly associated with wrist pain included higher skill level, older age, and more years of training. For those between 10 and 14 years of age, 83% had wrist pain, compared with 44% for those outside of that age range. Fifty-one percent of the gymnasts (30 of 59) had findings of stress injury to the distal radial physis of at

least a grade 2; 7% (4) had frank widening of the growth plate. Wrist pain prevalence was significantly related to the grade of radiographic injury. Mean ulnar variance was significantly more positive than established norms. Ulnar variance was not associated with wrist pain or radiographic injury of the distal radial physis.
CONCLUSIONS: Radiographic findings of distal radial physeal injury are associated with wrist pain among young nonelite gymnasts.

Difiori JP, Caine DJ, Malina RM. Wrist pain, distal radial physeal injury, and ulnar variance in the young gymnast. *Am J Sports Med.* 2006;34(5):840-9.
In gymnastics, the wrist joint is subjected to repetitive loading in a weightbearing fashion. In this setting, chronic wrist pain is quite common. Because gymnasts ordinarily enter the sport at very young ages and train for several years before skeletal maturity is attained, the growth plates of the wrist are at risk for injury. In addition, imaging studies have identified evidence of injury to the distal radial physis and the development of positive ulnar variance. Recent studies provide more information on the relationships between these findings, as well as factors that may predispose some gymnasts to wrist pain. This article provides a comprehensive review of these issues and offers suggestions for management, preventive measures, and future research.

Dobyns JH, Gabel GT. Gymnast's wrist. *Hand Clin*. 1990;6(3):493-505.
The wrist is a frequent site of symptoms and injury in the gymnast, both acute and chronic. The chronic injuries are due to repetitive loading of the musculoskeletal system, and their incidence rises as participation and level of competition rises. More attention needs to be directed toward prevention, but many of these injuries seem to be inherent to the sport as it transforms the upper extremities into weight-bearing limbs. Evaluation and recognition of wrist injuries in the gymnast will allow appropriate management for these patients; however, the compulsive and intense nature of many gymnasts can lead to recurrent or new injury and continued wrist symptoms. Much more sophisticated and detailed examination of the gymnast's wrist should be done before onset of training, before increase of intensity of training, before competition, and with the onset of any symptoms, including observed guarding. In addition, pretraining and annual follow-up wrist radiographs should be considered for the skeletally immature gymnast. Follow-up evaluation after skeletal maturity and retirement from active participation is needed to elucidate the long-term effect of gymnastics on the wrist.

Dwek JR, Cardoso F, Chung CB. MR imaging of overuse injuries in the skeletally immature gymnast: spectrum of soft-tissue and osseous lesion in the hand and wrist. *Pediatr Radiol.* 2009;39(12):1310-6.
BACKGROUND: In the pediatric gymnast, stress-related physeal injuries have been well described with characteristic imaging findings. However, a spectrum of overuse injuries, some rarely reported in the literature, can be encountered in the

gymnast's hand and wrist.
OBJECTIVE: To demonstrate the MR appearance of a spectrum of overuse injuries in the skeletally immature wrist and hand of pediatric gymnasts.
MATERIALS AND METHODS: A total of 125 MR exams of the hand and wrist in skeletally immature children were performed at our institution during a 2-year period. Clinical histories were reviewed for gymnastics participation. MR studies of that subpopulation were reviewed and abnormalities tabulated.
RESULTS: Of the MR studies reviewed, ten gymnasts were identified, all girls age 12-16 years (mean age 14.2 years) who presented with wrist or hand pain. Three of these children had bilateral MR exams. Abnormalities included chronic physeal injuries in three children. Two girls exhibited focal lunate osteochondral defects. Triangular fibrocartilage tears were present in three girls, one of whom had a scapholunate ligament tear. Two girls manifested metacarpal head flattening and necrosis.
CONCLUSION: A variety of soft-tissue and osseous lesions can be encountered in the skeletally immature gymnast. Familiarity with these stress-related injuries is important for accurate diagnosis.

Fujihara T, Gerbais P. Circles with a suspended aid: reducing pommel reaction forces. *Sports Biomech*. 2012;11(1):34-47.
The aim of this study was to investigate the influence of a suspended aid on the reaction forces during a basic skill on pommel horse. Twenty gymnasts performed three sets of 10 circles with and without a suspended aid on a pommel horse under which two force plates were set. The results confirmed that the suspended aid could reduce the magnitude of the pommel reaction forces during circles while maintaining the general loading pattern. On the left hand, the average and peak forces were attenuated to 0.59 body weight (BW) and 0.85 BW from 0.76 BW and 1.13 BW, respectively. The right hand experienced slightly larger forces with no-aid trials, but the asymmetry between the hands decreased with the aid. Despite a relatively large variability, all gymnasts experienced smaller impact peak forces with the aid. A suspended aid is most commonly used for a beginner gymnast as an introduction to pommel horse exercises. However, this study confirmed that it can also be useful for all levels of gymnasts who would like to practice pommel horse exercises with reduced pommel reaction forces for a purpose such as a progression for learning a new skill, control of training volume, or rehabilitation.

Gabel GT. Gymnastic wrist injuries. *Clin Sports Med.* 1998;17(3):611-21.
Wrist injuries in the gymnast are due to the transformation of the upper extremity into a weight bearing entity. Both acute and chronic disorders occur and are difficult to manage in these athletes because of the intensity of training and competition. Treatment is dependent on the injury as well as the expectations of the patient, coach, and family--a situation that at times may alter the usual management program.

Ghasempour H, Rajabi R, Alizadeh MH, Nikro H. Correlation between elite male Iranian gymnast's wrist injuries and their anthropometric characteristics. *Electron Physician*. 2014:6(4):932-8.

BACKGROUND: In gymnastics, wrists are under considerable force that causes various injuries. The influences of various risk factors have not been studied sufficiently to date to reduce the wrist injuries of gymnasts. The aim of this research was to determine the relationship between anthropometric characteristics and the wrist injuries of elite male gymnasts who took part in the Iranian Premier League and Division One in 2012.
METHODS: This was a cross-sectional correlation study concerning the injuries of 43 elite male gymnasts. The extent of their wrist injuries was determined by a questionnaire and interviews. Also, their anthropometric characteristics were collected according to the criteria established by the International Society for the Advancement of Kinanthropometry. Event tree analysis and the Spearman rho correlation coefficient were used for statistical analysis.
RESULTS: Among the gymnasts, 53.5% experienced wrist injuries over the past year, and the rate of wrist injuries was three per gymnast for one year. The incidents of skin and muscular injuries were the most prevalent type of injuries followed by Injuries to ligaments and bones respectively. Body weight was the only anthromopetric characteristic of the participants that was found to have a significant positive relationship with wrist injuries ($P < 0.05$).
CONCLUSION: Gymnasts and their coaches should pay special attention to gymnasts' weight as an intrinsic risk factor and take the required actions to prevent wrist injuries.

Hibino N, Hamada Y. Bilateral proximal radial shaft fracture dislocations resulting from 2 separate injuries with the same mechanism, each associated with median nerve entrapment: a case report in a gymnast performing back hand springs: bony entrapment of median nerve at proximal radius. *J Hand Microsurg*. 2015;7(1):123-6.

We report a rare case of entrapment of the median nerve following a closed fracture of the proximal one-fourth of the radius in an adolescent in failure of back hand spring. We proposed that the forearm pronation and the wrist extension in, "the Back Handspring position" made the median nerve close to the radius at one-fourth proximal radius, played an important role in this complication.

Kox LS, Kuijer P, Kerkhoffs G, Maas M, Frings-Dresen M. Prevalence, incidence and risk factors for overuse injures of the wrist in young athletes: a systematic review. *Br J Sports Med*. bjsports-2014-094492Published Online First: 14 April 2015 doi:10.1136/bjsports-2014-094492

BACKGROUND: Overuse wrist injuries can cause long-term symptoms in young athletes performing wrist-loading sports. Information on the prevalence, incidence and associated risk factors is required.
PURPOSE**:** We aimed to review the prevalence and incidence of overuse wrist

injuries in young athletes and to identify associated risk factors. We focused on popular wrist-loading youth sports—gymnastics, tennis, field hockey, volleyball, judo and rowing.
STUDY DESIGN**:** Systematic review.
METHODS**:** We conducted a literature search on athletes aged <18 years performing wrist-loading focus sports. Prevalence, incidence and/or risk factor ORs for overuse wrist injuries were extracted directly or calculated from reported data.
RESULTS**:** The search identified six studies on prevalence, five on incidence, and one on risk factors. Prevalence rates were 32–73% for *wrist pain* and 10–28% for *overuse wrist injury*. Incidence rates were 7–9% for *wrist pain* and 0.02–26% for *overuse wrist injury.* The three criteria associated with wrist pain were (with OR): age of 10–14 years (11.5), training intensity (1.2), and earlier onset of gymnastics training (1.97).
CONCLUSIONS**:** Prevalence and incidence of overuse wrist injuries was high in multiple studies of gymnasts, and largely unknown in other wrist-loading focus sports. Three key risk factors for wrist pain in gymnasts were age between 10 and 14 years, earlier training commencement, and training intensity. Using 'wrist pain' in defining overuse, and further investigating risk factors can aid in identifying overuse wrist injuries in young athletes.

Lindner KJ, Caine DJ. Injury patterns of female competitive club gymnasts. *Can J Sport Sci*. 1990;15(4):254-61.
Gymnast and injury information on 178 competitive female gymnasts was collected through questionnaires and interviews in a 3-year prospective epidemiologic study. The injury rate was 30/100 gymnasts/year, .52 injuries/1000 h. Injury rates excluding risk exposure increased with competitive level, but the top level gymnasts had the lowest rate per 1000 h of practice. Fractures of the wrist, fingers and toes were most common, followed by sprains of ankle and knee. Nearly 40% of the sudden-onset injuries occurred in the floor event. 'Missed move' was most frequently cited as the injury mechanism, while somersaults and handsprings were the most injury-producing moves. Most injuries happened with moves that were basic or moderately difficult and well-established. There was an increased chance of injury when the gymnast had been on the apparatus for an extended period of time. One major source of injury is loss of concentration, and a key to injury prevention may be the reorganization of the practice session.

Matzkin E, Singer DI. Scaphoid stress fracture in a 13-year-old gymnast: a case report. *J Hand Surg Am*. 2000;25(4):710-3.
We present a 13-year-old gymnast with a stress fracture of the scaphoid. Treatment was successful with immobilization for 8 weeks in a long arm spica cast followed by 4 weeks in a short arm splint.

McLaren K, Byrd E, Herzog M, Polikandriotis JA, Willimon SC. Impact shoulder angles correlate with impact wrist angles in standing back

handsprings in preadolescent and adolescent female gymnasts. Int J *Sports Phys Ther.* 2015;10(3):341-6.

BACKGROUND AND PURPOSE**:** In gymnastics, the wrist is exposed to many different stresses including increased extension, especially during back handsprings. Currently a wrist extension angle during impact that places the wrist in danger has not been established. The purpose of this study was to: (1) determine the mean impact wrist angle during a standing back handspring in female preadolescent and adolescent gymnasts and (2) determine which factors predict impact wrist angles.

METHODS**:** Fifty female gymnasts from six facilities, ages 8-15 were included in this study. Each gymnast completed a questionnaire about gymnastics participation and history of wrist pain. Active range of motion of the shoulder, elbow, wrist, hip, and ankle was measured. Each gymnast was asked to perform a standard back handspring, which was videotaped. The wrist and shoulder flexion angles, at maximum impact, were recorded and measured using motion analysis software. Two-sample t-test was used to assess the relationship between impact wrist angle and wrist pain. Multiple linear regression was used to determine the association between related variables and impact wrist angle.

RESULTS**:** The mean back handspring impact wrist angle was 95°. Fifteen subjects (30%) reported wrist pain. Years of participation (p=0.02) and impact shoulder angle (p=0.04) were predictive of impact wrist angles.

CONCLUSION**:** Shoulder angles and years of participation correlate with impact wrist angles during the performance of a standing back handspring. Future studies are necessary to determine if addressing these factors can affect the impact wrist angles.

LEVEL OF EVIDENCE**:** 3.

Nakamoto JC, Saito M, Medina G, Schor B. Scaphoid stress fracture in high-level gymnast: a case report. Case Rep Orthop. 2011; 2011:492407. doi: 10.1155/2011/492407. Epub 2011 Sep 26.

We present the case of an 18-year-old high-level gymnast who sustained a stress fracture of the scaphoid associated with a distal radial epiphysiolysis. Clinical evaluation demonstrated decreased range of motion of the affected wrist and insidious pain on the snuffbox and tenderness on the distal radial physis. He was submitted to surgical treatment with scaphoid percutaneous fixation and radial styloid process in situ fixation. Clinical features improved, and he got back to competition 6 months after surgery without symptoms and with complete range of motion.

Paz DA, Chang GH, Yetto JM, Dwek JR, Chung CB. Upper extremity overuse injuries in pediatric athletes: clinical presentation, imaging findings, and treatment. *Clin Imaging*. 2015;39(6):954-64.

OVERVIEW: Given the frequency and severity of overuse injuries in pediatric athletes and the potential for long-term deleterious effects, it is important for

radiologists to have a comprehensive understanding of these injuries and their imaging spectrum. This article addresses chronic overuse injuries involving the upper extremity in the pediatric athlete. Chronic upper extremity overuse injuries in competitive pediatric athletes yield imaging findings that can be subtle, obvious and characteristic, or atypical. Prompt application of the appropriate imaging modalities and their accurate interpretation expedites management, returning the pediatric athlete to the playing field while minimizing long-term adverse outcomes.
SUMMARY STATEMENT: Proper modality selection and interpretation in the imaging evaluation of upper extremity overuse injuries in pediatric athletes include an understanding of skeletal development, mechanism of injury, and clinical presentation to provide accurate diagnoses and mitigate long-term adverse sequelae.
LEARNING OBJECTIVES: After reading this article and taking the test, the reader will be able to: • Describe the clinical presentation and imaging characteristics of a variety of pediatric overuse injuries in the upper extremity including little league shoulder, rotator cuff tendinosis, gymnast wrist, climber's finger, and myriad pathologies about the elbow. • Explain how the physis plays a crucial role in pediatric overuse injury and how to evaluate physeal injury in a multimodal approach. • Understand the clinical management for certain pediatric overuse injuries, especially those that have potential for long-term and/or permanent disability.

Rettig AC. Athletic injuries of the wrist and hand. Part I: traumatic injuries of the wrist. *Am J Sports Med*. 2003;31(6):1038-48.
Hand and wrist injuries in sports are some of the most common injuries reported. This review discusses briefly the causes of hand and wrist injuries in sports and discusses pertinent biomechanical findings regarding the range of motion required in different sports activities. The bulk of the review discusses specific traumatic and overuse injuries to the hand and wrist commonly seen in the athlete. Emphasis is placed on problematic traumatic injuries such as carpal scaphoid fractures and hook of the hamate fractures, as well as ligament injuries to the wrist with regard to diagnosis, treatment, and return to athletic competition.

Rettig AC. Athletic injuries of the wrist and hand. Part II: overuse injuries of the wrist and traumatic injuries of the hand. *Am J Sports Med*. 2004;32(1):262-73.
Hand and wrist injuries in sports are some of the most common injuries reported. This review discusses common overuse injuries of the wrist including tendon injuries such as de Quervain's syndrome, subluxation of the extensor carpi ulnaris, and the common dorsal carpal impingement syndrome. The main focus of this section is the discussion of traumatic injuries to the hand in the athlete. Included is a discussion and review of fractures of the phalanges and metacarpals, common proximal interphalangeal joint injuries, and thumb carpal metacarpal and metacarpophalangeal joint injuries. Emphasis is placed on more

common injuries seen regarding diagnosis, indications for non-operative versus operative treatment, and time to return to athletic competition.

Sathyendra V, Payatakes A. Grip lock injury resulting in extensor tendon pseudorupture: case report. *J Hand Surg Am.* 2013 Dec;38(12):2335-8.
Grip lock injuries are uncommon, potentially devastating occurrences in male gymnasts performing high bar routines, and typically cause severe wrist sprains or forearm fractures. We retrospectively reviewed medical records of a 24-year-old former collegiate gymnast surgically treated for complete loss of index and long finger extension (pseudorupture) after a grip lock injury. Intraoperative evaluation 3 weeks after injury revealed profound intratendinous attenuation of index and long finger extensors with adhesions in the fourth compartment. We performed tenolysis and imbrication of the affected tendons. At 12-month follow-up, the patient had no pain, full digital range of motion with the wrist in neutral, but residual extensor lag with the wrist in extension. He had returned to gymnastics with some apprehension. This case broadens the known spectrum of grip lock injuries.

Webb BG, Rettig LA. Gymnastic Wrist Injures. *Curr Sports Med Rep*. 2008;7(5): 289-295.
During gymnastic activities, the wrist is exposed to many different types of stresses, including repetitive motion, high impact loading, axial compression, torsional forces, and distraction in varying degrees of ulnar or radial deviation and hyperextension. Many of these stresses are increased during upper extremity weight-bearing and predispose the wrist to high rates of injury during gymnastics. Distal radius stress injuries are the most common and most documented gymnastic wrist conditions. Other conditions include scaphoid impaction syndrome, dorsal impingement, scaphoid fractures, scaphoid stress reactions/fractures, capitate avascular necrosis, ganglia, carpal instability, triangular fibrocartilage complex tears, ulnar impaction syndrome, and lunotriquetral impingement. It is important to diagnose quickly and accurately the specific injury to initiate expediently the proper treatment and limit the extent of injury. In addition, a gymnast's training regimen should also include elements of injury prevention.

Weiker GG. Hand and wrist problems in the gymnast. *Clin Sports Med*. 1992;11(1):189-202.
The exact pathomechanics of problems in the wrists of gymnasts are yet to be defined. This article discusses injuries and overload phenomena in the wrist and skin problems, fractures, and sprains of the hand, including mallet finger.

Wilson SM, Dubert T, Rozenblat M. Extensor tendon impingement in a gymnast. *J Hand Surg Br*. 2006;31(1):66-7.
Wrist injuries in the gymnast are due to the transformation of the upper extremity into a weight bearing entity. Gymnast wrist pain presents a difficult diagnostic and

therapeutic challenge. Here, we present a new case of extensor tendon impingement in an elite gymnast. To our knowledge, there is no similar report in the literature.