DIAGNOSIS AND TREATMENT OF ANCONEUS EPITROCHLEARIS IN A 19-YEAR OLD FEMALE BASKETBALL PLAYER: A CASE STUDY

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Background: A 19-year-old female basketball player presented with pain on the medial aspect of the right elbow. The patient was experiencing muscle spasms of the triceps brachii and forearm flexor group. Initial evaluation revealed swelling of the antero-medial forearm, tenderness of the proximal wrist flexors, ulnar collateral ligament, insertion of the triceps brachii, and cubital tunnel. Manual muscle tests of the triceps brachii, brachialis, brachioradialis, biceps brachii, and pronator teres were all at full strength. The patient reported pain during the valgus stress test and moving valgus stress test but no laxity was found when tested bilaterally. The patient reported paresthesia in her fifth digit and lateral aspect of the fourth digit. Differential Diagnosis: Differential diagnoses included medially tracking ulnar nerve pathology, ulnar collateral ligament sprain, ulnar nerve entrapment, pronator teres syndrome and anconeus epitrochlearis. Treatment: An MRI arthrogram revealed an accessory muscle originating on the medial epicondyle of the humerus and inserting on the olecranon process of the ulna. The final diagnosis of the injury was anconeus epitrochlearis. Conservative treatment protocol was implemented and included massage and Graston tools to assist with soft tissue manipulation of the triceps brachii, accessory anconeus muscle, and flexor and extensor muscle groups of the forearm. The patient receives ice with compression following daily activity. Treatments have been successful in reducing pain to a tolerable level for the patient; however pain is still consistent during daily activities. The patient is restricted from activity involving high frequency repetitions of elbow extension, such as repetitive basketball shooting, but is otherwise cleared for participation. Uniqueness: Epidemiology of anconeus epitrochlearis is unknown due to infrequency of symptomatic patients. The symptoms typically only become present in individuals with well-developed accessory anconeus muscle due to participation in activity requiring elbow extension at high frequency and intensity. Conclusions: The patient began experiencing pain, numbness, and muscle spasm in her right elbow. An MRI and physician examination concluded the diagnosis of anconeus epitrochlearis. The patient experiences consistent pain in the medial elbow, distal triceps, and proximal forearm flexor muscles but is fully participating in basketball. Consistent with research presented by Tiong and Kelly (2012), regular treatments using Graston tools, massage, and preventative taping are administered prior to activity as needed to manage pain. Relevant Evidence: Research presented by Tiong and Kelly (2011) and Dekelver, Glabbeek, Dijs, and Stassijns (2012) state anconeus epitrochlearis as a leading cause of ulnar nerve entrapment and associated neural symptoms. Although excision surgery is presented as a treatment form by Tiong and Kelly (2011), conservative treatment to include splinting, therapeutic exercise, and possible cortisone injections should be administered prior to surgical intervention (Dekelver et al., 2012). Word Count: 511
POSTERIORLY DISPLACED MIDBODY SCAPULAR FRACTURE IN A FOOTBALL PLAYER

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**Background:** The objective of this case study is to provide information on a scapular fracture; a traumatic injury unique to the athletic setting. The athlete is a seventeen-year-old white male football player at the wide receiver position. His previous medical history consists of a partial labral tear of the left shoulder and an ipsilateral scapular contusion earlier in the season. No other medical history was relevant to his injury. The scapular fracture occurred during a Friday night game when the athlete was tackled between two opposing players and forced to the ground. Upon initial evaluation, the player presented with a significant amount of edema surrounding the left posterior shoulder and reduced range of motion; his abduction and flexion were less than 15 degrees. No gross deformity or ecchymosis was evident. The athlete stated that the pain "felt different" when compared to his previous labral tear. Palpation was restricted due to the athlete's tenderness. Further evaluation was performed the Monday after the incident. With minimal reduction in edema and pain, the athlete was referred to a physician for evaluation and diagnostic imaging. Radiographs and computerized tomography scans revealed that the injury was a minimally displaced fracture to the body of his left scapula. **Differential Diagnosis:** The injury was initially suspected to be a labral tear; the patient had sustained a partial labral tear to the ipsilateral shoulder prior to injury. Other possible injuries included a humeral head subluxation, rotator cuff strain or tear, and a scapular contusion. **Treatment:** No surgical intervention was indicated. Surgery is not usually required or recommended for fractures of the scapular body unless it is exceptionally displaced. Through conservative treatment, such as cryotherapy and immobilization, the patient was cleared for return to play by the physician after meeting the required criteria of normal range of motion, strength, and function. Range of motion and strength were predominantly recovered through a rehabilitation program created by the Athletic Trainer. **Uniqueness:** Scapular fractures are unique to traumatic experiences, such as motor vehicle accidents, due to the high impact mechanism. Accordingly, they only account for less than 1% of all fractures. **Conclusion:** Scapular fractures in the athletic setting are extremely rare due to the high impact mechanism of injury. Additional literature needs to be established to create a reliable method for diagnosis in the athletic training setting. **Relevant Evidence:** Evidence has found that computerized tomography scans are the gold standard for scapular fracture diagnosis. Additionally, 90% of scapular fractures are mildly displaced or not at all, and are therefore treated conservatively. As a result, these injuries have received insignificant consideration; limited research on this subject is available. Traumatic surrounding injuries requiring attention often causes a suspension in the diagnosis of scapular fractures. **Word Count:** 450
Mid-Substance Tear of the Latissimus Dorsi in a Collegiate Football Quarterback


Background: An 18 year old quarterback reported an insidious onset of right upper lateral back and shoulder pain in his dominant (throwing) arm one week into pre-season practice. On initial exam, he had full pain-free range of motion and 5/5 strength on all shoulder manual muscle tests. He denied any previous shoulder or back injury. He was able to throw but it caused him mild pain in the mid-region of his right latissimus dorsi muscle. He was referred to the team physician and was diagnosed with a mild latissimus dorsi strain. Over the next two weeks, treatment and rehabilitation consisted of pain management (ice, deep oscillation therapy, pulsed ultrasound) along with shoulder strengthening and scapular stability exercises. During the third week (the team’s bye week), he took a full week off of throwing and stated he felt pain-free prior to the next practice. He denied any pain or weakness until the last drill of practice, when he felt a sharp pain in his axilla during the follow-through of a five yard throw. He did not report this pain until the next day, when he also displayed a golf ball sized mass in his right axilla. Examination found point tender pain over the mass, but full pain-free shoulder range of motion, with only mild pain with resisted pull down and shoulder internal rotation. Differential Diagnosis: Latissimus Dorsi strain/tear, benign cyst, lymphoma. Treatment: Due to the unique presentation, and inability to throw pain-free, the athlete was referred to the team physician. The physician’s exam was consistent with the previous exam and a diagnostic ultrasound was ordered to identify the origin of the painful mass. The diagnostic ultrasound revealed a 50% mid-substance tear of his right latissimus dorsi with hematoma formation at the location of the axillary mass. Four days later, the physician performed an ultrasound guided injection at the hematoma site. The athlete had immediate pain relief. After one week of treatment and shoulder strengthening, he has been able to resume pain-free throwing. Uniqueness: The exact prevalence of an isolated latissimus dorsi injury is unknown. It is a more common injury in baseball pitchers with 75% of those athletes reporting a prior injury to the shoulder and elbow. Injuries to the latissimus dorsi are also more likely to occur at the tendinous insertion opposed to the muscle belly. In addition, the non-traumatic, low velocity nature of the mechanism of injury confounds the diagnosis in this case. Conclusion: Due to the complex anatomy and biomechanics of the shoulder, the proper diagnosis of injuries in a throwing athlete can be quite challenging. In this case, the insidious onset and seemingly benign presentation made the clinical presentation unclear. The location of pain and hematoma formation prompted imaging to diagnose this unique presentation of a latissimus dorsi tear. Relevant Evidence: Upon searching the evidence of latissimus dorsi injuries (PubMed, MEDLINE, and SportDiscus), no cases of mid-substance latissimus dorsi tears were found. This is a very uncommon injury with all reported cases occurring at the tendinous insertion. Word Count: 504
Rehabilitation of Persistent Quadriceps Muscle Weakness in a Female Collegiate Basketball Player Post-ACL Reconstruction: A Case Report

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**Background:** A 21 year old, female, division II basketball player suffered an anterior cruciate ligament (ACL) rupture and a lateral meniscus tear on October 26, 2013. The athlete underwent ACL reconstruction with a patellar tendon autograft December 10, 2013. The athlete completed a standardized ACL rehabilitation protocol throughout 2013-2014 season and had minimal complications with post-surgical patellar tendonitis, possibly due to graft site harvesting. Isokinetic testing on 9/23/2014 revealed a 21% quadriceps deficit of the involved compared to the uninvolved. Accordingly, a more vigorous rehabilitation program was implemented focusing on quadriceps strength. The athlete was then isokinetic tested again three weeks later revealing a 33% deficit of quadriceps strength. Despite the significant quadriceps deficit, she was cleared by the team physician for full return to play on October 16, 2014. The athlete suffered from visible atrophy, persistent knee pain, and quadriceps strength deficits of her affected knee eleven months postoperative. **Differential Diagnosis:** Iatrogenic patellar tendinitis, cartilage degeneration, chondromalacia, arthrogenic muscle inhibition. **Treatment:** Traditional rehabilitation protocols and exercises were not showing the necessary gains in quadriceps strength. Therefore, it was decided to treat the athlete with cryotherapy combined with traditional strengthening. For six weeks the athlete immersed her affected leg into a cold whirlpool set at 50 degrees for about 15 minutes (or until numbness occurred) prior to rehabilitation. Ice bags were then placed on the anterior and posterior aspect of her affected knee throughout rehabilitation, which included some quadriceps strengthening exercises from her traditional strength training and rehabilitation protocol (e.g., single leg knee extension, single leg lunges, squats). Three days per week, the athlete performed five sets of eight repetitions for each exercise at a high load with two minutes of rest between each set. The athlete was retested isokinetically after performing the new cryotherapy in conjunction with rehabilitation protocol on December 8th 2014. The results revealed a 12% deficit in quadriceps strength, an improvement of 21% . The athlete reported improvements in symptoms and function. She was instructed to resume normal strength training and a maintenance protocol over the summer. Upon return for the Fall 2015 season, she was 22 months postoperative with a 0% deficit and denies any symptoms or dysfunction. **Uniqueness:** Despite completion of aggressive rehabilitation protocols, this athlete had quadriceps weakness that persisted one year post reconstruction and resulted in relatively poor patient reported outcomes. Many athletes will have difficulty breaking through certain rehabilitation progressions and certain strengthening exercises with an unknown reason. Several postoperative ACL cases have persistent quadriceps deficits as a result of arthrogenic muscle inhibition (AMI). AMI is a reflex response to damaged joint structures that decrease motor unit recruitment resulting in strength deficits in the surrounding musculature. Using cryotherapy in conjunction with exercise can cause disinhibition and provide a time period where there is increased quadriceps motor neuron recruitment, helping to facilitate strength gains. **Conclusion:** AMI may be a cause of significant quadriceps strength deficits in athletes many months or years postoperative ACL. As an athletic trainer using cryotherapy in conjunction with exercise may be a rehabilitation protocol that could be very beneficial in addressing AMI. **Relevant Evidence:** AMI is an ongoing reflex response to an injured joint. This reflex can affect the sensory information from joint mechanoreceptors and decrease motor unit recruitment and input to the quadriceps muscle. This causes the quadriceps to be unable to completely activate. Cryotherapy application to the injured joint provides a time period in which there is a quadriceps motor neuron pool “distribution” which can allow more motor unit recruitment. This can enhance muscle function, strength, and help to break through rehabilitation plateaus. **Word count:** 597
Os Trigonum in a High School Soccer Player
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**Background:** A 16 year old female soccer player was evaluated in the Athletic Training Clinic following a preseason practice. The chief complaint was pain along the medial aspect of the right ankle. The athlete collided with another player resulting in the foot being forced into eversion. A medical history indicated that there was a previous fracture to the talus of the involved limb. Initial pain was described as a four out of ten with a one out of ten rating with activities of daily living and a one out of ten rating while at rest. The patient’s gait appeared normal at the time of the initial evaluation. However, there was mild edema and swelling over the deltoid and the medial malleolus. All fracture tests suggested there was no acute fracture to the tibia, fibula or other foot structures. All range-of-motion assessments were within normal limits; however, pain was elicited during active, passive, and resistive eversion, as well as resistive inversion and ankle plantarflexion. Manual muscle testing revealed weakness and pain of the Tibialis Posterior and Peroneus tertius. Talar tilt and Kleiger’s test were both positive for pain when moving the foot into eversion. There were no circulation or neurological deficits present. The initial diagnosis was believed to be a grade I eversion ankle sprain. However, following 2 weeks of unsuccessful rehabilitation, the patient was referred for an x-ray, which revealed the presence of bilateral Os Trigonum syndrome.

**Differential Diagnosis:** Os Trigonum can go unnoticed due to the location of pain and its association with achilles strain or ruptures. Talar fractures can be indicated if the mechanism of injury involved forced plantarflexion of the sub-talar joint. In this case, an eversion ankle sprain was the initial impression.

**Treatment:** Conservative treatment has taken place while maintaining patient comfort. Rehabilitation has included stretching exercises, range-of-motion exercises, isometrics, and neuromuscular control, followed by resistance exercises. All rehabilitation activities were done while avoiding terminal plantarflexion of the ankle joint to avoid irritation following the discovery of the Os Trigonum.

**Uniqueness:** The patient had previously suffered a fracture to the talus. Although an x-ray was used previously to diagnose the fracture, the Os Trigonum was not identified at that time. Knowledge of this injury was not available until the present injury occurred.

**Conclusion:** Although the patient presented initially with an eversion ankle sprain, concern began to arise when the patient was not recovering in a timely fashion. The presence of Os Trigonum in both ankles may be a contributing factor to the delay in recovery for this patient. This may be due to the fact that while participating in practices and games, there was constant irritation to the posterior aspect of the talus.

**Relevant Evidence:** Os Trigonum is often found accidentally during the time of a radiograph and is present in approximately 10% of the population. It is difficult for physicians to differentiate between a true Os Trigonum and a fracture to the lateral tubercle of the talus. Often observation of the fragment is helpful in identifying whether Os Trigonum is present. Os Trigonum will appear smooth and rounded while a fragment due to a fracture will present as jagged. Past literature has suggested conservative treatment initially for this pathology, including RICE therapy. NSAID’s can be utilized when pain is present. Stretching exercises and ankle rehabilitation programs should be initiated and performed as tolerated. Surgery is considered four to six months following unsuccessful conservative treatment.

**Word Count:** 592.
The presence of bilateral cervical ribs in a female high school tennis athlete - a case study
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**Background:** A 16-year-old female high school tennis athlete at a preparatory school in Massachusetts was complaining of neurological symptoms in the right lateral side of the hand. The patient has no pertinent past medical history. The patient complained of paresthesia down the medial side of the hand into the 5th digit. The patient also had a lack of neuromuscular control of the fifth digit. The fifth digit was fixed in a slightly flexed position. The hypothenar eminence was beginning to atrophy. Distal pulses and capillary refill were all within normal limits. **Differential Diagnosis:** Thoracic outlet syndrome, a partial tear of the ulnar nerve, stenosing tenosynovitis (trigger finger), or ulnar nerve palsy. **Treatment:** Evaluation of the shoulder and hand region did not show any signs of thoracic outlet syndrome through Allen’s, Adson’s, or the Military brace test. The distal radial pulse of the patient was not diminished. Radiographic imaging was completed on the upper chest and the shoulder. The imaging showed the presence of an extra cervical rib on both sides of the ribcage. The imaging showed compression on the ulnar nerve causing the symptoms. The patient only experienced neurological symptoms in the right hand though bilateral cervical ribs were present. The patient underwent an ostectomy to remove the cervical ribs and the first ribs bilaterally, to relieve nerve compression, and prevent any further compression. The patient was told full motor function of the fifth digit might never return. Rehabilitation was focused on re-establishing the motor function of the fifth digit as well as grip strength in the right hand. **Uniqueness:** Prevalence studies have shown that cervical ribs are present in 0.2-8% of the population (Walden et al., 2013). True neurogenic thoracic outlet syndrome that does not affect the blood supply to the upper extremity has been reported as one in one million persons (YILMAZ, KÜÇÜK EROĞLU, & BODUR, 2013). This patient only experienced neurological symptoms which made clinical assessment via normal clinical testing difficult. **Conclusion:** The cervical rib in the patient was compressing the neurovascular bundle in the thoracic outlet. The compression was affecting the ulnar nerve, in turn affecting the mobility of the fifth digit and causing the neurological symptoms radiating down the medial border of the right hand. Thoracic outlet syndrome is a common pathology affecting athletes in overhead sports. True neurologic thoracic outlet syndrome cannot be established through the normal clinical tests. Nerve pain and loss of motor function comes from up the kinematic chain. Examining the kinetic chain is important for the clinician to find the true diagnosis. **Relevant Evidence:** Research on the prevalence of cervical ribs has been done on small populations. Research on select populations has shown 0.2-8% of the population has a cervical rib. True neurologic thoracic outlet syndrome is very rare, one out of one million persons will have neurologic symptoms with objective neurologic or electrodiagnostic findings are available. **Word Count:** 476
Background: A 16 y.o. male high school football player with a negative reported history for knee injury or patella instability suffered a direct blow to the patella, causing him to twist and fall to the ground. Upon immediate observation the patella appeared laterally dislocated and he complained of acute and pronounced lateral knee pain. His patella was able to partially self reduce with active straightening of the leg, but the athlete was unable to weight bear and so immobilized and referred to ER for imaging.

Differential Diagnosis: Patella dislocation, patella fracture, femoral fracture, medial retinaculum tear, meniscus tear, ACL sprain, PCL sprain, LCL sprain. Treatment: MRI and X-ray reports indicated a consistency with recent patella dislocation with current lateral subluxation of patella. An avulsion fracture of the medial facet of the patella extending to the apex with full thickness cartilage loss in this region was evident, as were an impaction fracture of the lateral femoral condyle and a partial tear of the medial retinaculum. Imaging also showed multiple loose bodies in the joint capsule, suggesting a history of chronic subluxations. Also noted by the radiologist was a synovial plica in the medial suprapatellar bursa and a grade two signal abnormality in the body and posterior horn of the medial meniscus, however no occult meniscal tear was evident. The X-ray report indicated a possible fibrous dysplasia or endochondroma in the proximal tibial metaphysis, and that the athlete had shallow trochlear groove and lateralization of the tibial tuberosity. Surgery was required to wire the patella together and to repair the medial retinaculum. Athlete has attended 2 physical therapy appointments thus far, and has begun to partially weight bear, has achieved 20° of active knee flexion and is using electric-stimulation to help activate his VMO. Athlete is scheduled to continue with weekly physical therapy appointments.

Uniqueness: Imaging showed history of chronic patellar subluxations, even though our athlete denied prior episodes of instability or a history of knee pain. Acute traumatic patellar dislocations are rare and are increasingly rare when concomitant with associated patella and lateral femoral condyle fractures.

Conclusions: The athlete sustained an avulsion fracture to the medial facet of the patella and lateral femoral condyle fracture, a partial medial retinaculum tear and full thickness loss of cartilage on the medial border of the patella due to acute traumatic patellar fracture dislocation. Athlete also had two predisposing conditions such as a shallow trochlear groove and lateralization of the tibial tuberosity, leading to inherent patellar instability. Surgical correction was required to reattach the fractured piece of the patella as well as to reattach and repair the medial retinaculum. Post-surgical physical therapy is helping the athlete regain range of motion and begin to weight-bear. Relevant Evidence: According to multiple studies, a shallow trochlear groove and lateralization of the tibial tuberosity have been listed as predisposing factors for a LPD (lateral patella dislocation). Injury to the medial patellofemoral ligament is common with LPD. Acute Traumatic patellar dislocations account for 2-3% of all knee injuries and has a reported prevalence rate of 6 to 77 per 100,000 in adolescents. While lateral patellar dislocations are the leading cause of osteochondral fractures in young athletes, most of the time (66% of all patella dislocations in a collected study) the fracture only occurs at the medial facet of the patella. It is rare (21% of all patella dislocations in a collected study) to have both a medial facet fracture of the patella in addition to a lateral femoral condyle fracture. Word Count: 580
Grade II Hooked Acromion in Collegiate Softball Player
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**Background** A 20 year old female softball player suffered a shoulder impingement of the right shoulder due to a congenital grade II hooked acromion. The athlete complained of an aching pain in her shoulder and a “clicking” sound that she noticed whenever she hit. The athlete stated that she noticed this her sophomore year of high school, but did not start to feel pain until her junior year of college. Initial evaluation found she was point tender over her biceps tendon and had a tight posterior capsule. She had full ROM and strength in all motions, with a “clicking” sound at 90 degrees of flexion. The Athlete received treatment until the end of that semester, and then returned the following semester for another evaluation. The second evaluation found that she was point tender over the glenohumeral joint. The athlete stated that it had been bothering her over the summer, and any overhead motions would elicit pain. She still had full ROM along with the “clicking” sound with flexion, but her strength weakened for flexion and Abduction. The athlete was referred to get an MRI, there were no abnormal findings reported. At some point during her treatment she was also referred of to get an X-Ray of the right shoulder and the findings from the X-Ray was a grade II hooked acromion. **Differential Diagnosis** Bicipital Tendonitis, infraspinatus syndrome, clavicular injuries, Shoulder impingement syndrome, Superior labrum lesions. **Treatment** For the spring semester the goal for the athletes rehab was to decrease pain, this consisted of the UBE to maintain function, and warm up the shoulder. The athlete had less ROM with internal rotation, so stretching the shoulder, with more of a focus on the posterior capsule was implemented. Treatment ended with a combination of ice and pulsed E-stim through the glenohumeral joint for 20 minutes. A week later the athlete saw the physicians and was prescribed Dexamethasone sodium phosphate to be used with Iontophoresis for treatment. Different modalities were added, such as LLLT using the super luminous diode, and Ice cup. The athlete was then reevaluated the following fall semester and her rehab plan consisted of strengthening her shoulder. This included different TRX exercises, Rip Trainer marches, and resistive cables 6 ways. Throughout rehab the athlete complained of the same pain, it was non-progressive. **Uniqueness** A person with a grade II/III hooked acromion is at a very high risk of shoulder impingement. This is also an unlikely condition for such a young individual to have. What is interesting is the delayed onset of pain she was experiencing is not common for most people with a grade II hooked acromion. The athlete had been playing softball since high school, and had been hitting for years, and only during her junior year of college she started to feel pain. **Conclusion** As an ATC, you should to realize how important it is to pay attention to what the athlete tells you. This can reveal why there was such a delayed onset to the injury. If you thought the injury was a biceps tendinitis, you should know the differential diagnosis so all other possibilities can be ruled out, and if the Athlete wasn’t progressing the athlete could’ve gone for the MRI/X-Ray sooner. **Relative Evidence** According to J.G. Edelson, hooked acromions are not prevalent in individuals under the age of 30. Edelson examined 750 scapular dry bone specimens, 211 of which were less than 30 years of again revealed that there were no hooked acromions. **Word Count:** 600
Aneurysmal Bone Cyst on the Left Superior Pubic Ramus of a Collegiate Rower Treated with Sclerotherapy

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**Background:** This case presents a 21-year-old female crew athlete diagnosed with an Aneurysmal Bone Cyst (ABC) in her pelvis and a secondary pubic fracture. Patient has history of low back pain. In February 2010 patient was diagnosed with a herniated disc at L5/S1 in February 2010. Patient first noticed left hip pain while rowing in the Women's Henley Regatta, June 2012. After the event she took six weeks off from training. One morning during her break she woke with a sudden increase in pain, with no known precipitating event or trauma. The pain progressively worsened over the next three months. Despite her pain, patient resumed rowing in early August. With pain increasing she took three weeks off and met with her team's athletic trainer on August 30th 2012. Physical exam revealed pain in the hip flexor/adductor group with movement and palpation, decreased strength with hip flexion and adduction bilaterally, and a positive hip scouring test. Patient also presented with a positive Valsalva test and left hip pain with laughing and coughing. **Differential diagnosis:** Hip flexor or adductor strain, labral tear, pelvic tumor or cyst, hip impingement, herniated disk. **Treatment:** September 5th 2012 patient received a radiograph, arthrogram and MRI of her pelvis. Images revealed a small focus of nondisplaced partial-thickness anterior/superior left acetabular labrum tear, a 3.5x2.5x3 cm aneurysmal bone cyst of the left superior ramus and a mild right quadratus femoris strain. A follow up MRI a week later revealed an expansile lesion within the left pubis extending along the superior ramus with marked thinning of the overlying cortex and a narrow, non-sclerotic zone of transition. Sclerotherapy was chosen over surgery due to patient being in season. Sclerotherapy is typically used to shrink blood vessels or blood vessel malformations. Patient suffered a fracture of her left pubic ramus in November 2012. Between December and February 2013 patient received three sclerotherapy procedures; after two weeks of rest and rehabilitation athlete completed rowing season. Patient's pain returned in May. In June doctors discovered a new cyst. Patient received sclerotherapy procedure in July. Patient was asymptomatic immediately afterwards and resumed training. Patient’s MRI in February 2014 revealed a reoccurrence of ABC. Between March and August patient had three more sclerotherapy procedures with surgery to block blood flow to the region. This resulted in surgical complications; a fracture and leaking of sclerocent agent, inflaming surrounding tissue. Patient's MRI in November cleared her to start rowing in December. Patient’s most recent MRI in January 2015 revealed no active cysts. Patient has been training full time since. **Uniqueness:** Patient was selected due to severity and rarity of her injuries (.0004% of population). Sclerotherapy is a developing procedure for ABC. Patient had a high reoccurrence rate which is not typically seen. **Conclusions:** En bloc resection or amputation is the gold standard for treatment of an ABC. Although this patient’s treatment required nine procedures, sclerotherapy allowed for patient to continue rowing without significant time loss. **Relevant Evidence:** One study shows MRI and radiographs as preferred tests for diagnosing ABC’s. Sclerotherapy is a less invasive and newer procedure; it involves an injection of a solution into the vessels guided by ultrasound. According to a review done by Mankin et. al., there is a 5% recurrence rate with en bloc resection. In a study done by Sheils and Mayerson at Ohio State the reoccurrence rate with sclerotherapy was found to be <12%. **Word Count:** 598.
Atrioventricular Reciprocating Tachycardia in a High School Football Athlete
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**Background:** A 16 year old Caucasian interscholastic football athlete reported to the athletic trainer complaining of symptoms consistent with palpitations. The patient stated that he had been experiencing symptomatic episodes for a couple months but failed to report them. There was no history of sudden cardiac death or cardiovascular disease in his family however his personal history consisted of headaches, asthma and multiple concussions that occurred during sport participation. The patient stated that the palpitations would last as long as 20 minutes but would resolve without intervention. The patient was not experiencing palpitations at the time he reported his complaint, but stated that he decided to do so due to concern for his health and fear of a serious condition. He was completely asymptomatic at the time of his complaint with nothing remarkable to report upon assessment. However, given the description of his complaint, the patient was referred to his pediatrician who then referred him to a cardiologist. The cardiologist fitted the patient with a cardiac Holter monitor and instructed him to record any palpitation episodes over the next 48 hours. During this time the monitor registered a heart rate as low as 49 beats per minute and a maximum heart rate of 302 beats per minute. At the time when the greatest heart rate was recorded, the patient reported that he was experienced palpitation like symptoms and dyspnea while resting on a sofa. **Differential Diagnosis:** Atrial fibrillation, supraventricular tachycardia (SVT), atrioventricular nodal reentrant tachycardia (AVNRT), atrioventricular reciprocating tachycardia (AVRT), Wolff-Parkinson-White syndrome (WPWS). **Treatment:** The patient was originally diagnosed with SVT and prescribed Atenolol, a beta-blocker. The source of the tachycardia could not be determined from the electrocardiogram so a radiofrequency ablation procedure was performed to both diagnose and correct the condition. During the procedure, the patient was diagnosed with WPWS and AVRT. The procedure was successful for correcting the abnormal pathway between the left ventricle and left atrium. After ablation, the patient was kept overnight for observation and was released the next day. He was prescribed Aspirin at discharge and instructed to ingest 81-mg daily for one month. Three days following surgery, the patient was cleared for conditioning activities which he resumed without complication. Approximately eight months following surgery the patient experiences a palpitation like episode although not as severe as the previous episodes. The cardiologist diagnosed him with premature ventricular contractions (PVCs). He remained cleared for full participation and continues to be monitored closely by the athletic training staff. **Uniqueness:** WPWS is present in less than 1% of the general population and generally causes heart rates approaching 240 beats per minute. A heart rate over 300 beats per minute as recorded in our patient is extremely rare and can lead to sudden cardiac death. Our patient was at rest during this episode and also experienced dyspnea. **Conclusions:** Our patient failed to report his symptoms for two months. It is extremely important that athletic trainers educate their athletes as to the importance of being forthcoming regarding any changes in their health status. Many clinicians feel that electrocardiography should be included in a preparticipation cardiac screen for young athletes. We are unsure if this would have identified our patient’s condition. **Relevant Evidence:** Medications such as b-blockers, calcium channel blockers, and antiarrhythmic drugs are the most common first-line treatment option for AVRT. However, high-risk accessory pathway conduction like the one our patient was suffering from usually requires catheter ablation. The long-term success rate for catheter ablation of accessory pathways is well above 90%. **Word Count:** 582.
**Morel Lavallée Lesion In A Division 1 Lacrosse Player**

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**Background:** A twenty-one year old male, Division I Lacrosse defenseman, with no significant medical history, presented with a chief complaint of posteriolateral lower leg pain and fatigue. History revealed the athlete sustained injury during play of March 2015 when a shot grazed his lower leg. Initially, he self-treated with ice and continued to play. Five days later, he presented to the athletic training staff displaying lower leg edema ranging from the proximal to distal lower leg. Further presentation included a soft fluctuant mass, ecchymosis, and tenderness with palpation over the site of impact. The patient had full ROM and was full weight bearing, although did report slight pain during toe-off. Pain increased with MMT of gastrocnemius, soleus, anterior tibialis and peroneals, and he complained of lower leg fatigue. The athlete began treatment for a contusion with high volt stimulation, ice, elevation and a compression dressing. A pad was created for protection during play. One-week post-injury, he began complaining of calf cramping during a game. He was stretched and given electrolytes, but unable to continue. He was evaluated the following day, presenting with increased ecchymosis, erythematosus skin and was significantly warm to touch. The affected area also increased in range. During ROM re-evaluation the patient reported cramping sensation. **Differential diagnosis:** Contusion, cellulitis, hemorrhagic bursitis, compartment syndrome, and hematoma. **Treatment:** The athlete was referred to the team physician who performed diagnostic ultrasound, which identified a Morel Lavallée Lesion (MLL). The athlete took two days off and was treated with Kinesiotape, padding, electrical stimulation, and ice. After two days, the edema and warmth decreased, and play was permitted as tolerated, assuming symptoms did not increase. It was believed tissue edema created the urge to cramp. Two weeks after the MD visit, the athlete presented with no signs or symptoms and returned to play. A MLL is a rare cause of subcutaneous swelling created by traumatic shearing of the hypodermis from the underlying fascia. This creates space that fills with a combination of hemorrhage, fat and lymphatic fluid. If untreated, an inflammatory reaction creates a peripheral capsule, preventing reabsorption of the contents and self-perpetuation. The lack of self-perpetuation leads to the potential for open debridement. Treatment of such lesions is not well established due to limited occurrences. In this case, conservative treatment was successful. **Uniqueness:** The case is unique due to mechanism, incidence rate, duration and evaluation findings. A MLL would typically be seen following a car accident, or a low-velocity crushing injury, often in combination with an underlying fracture. In our case, a lacrosse ball produced enough shearing force to cause the lesion. Research has found that only 1.5% of all MLL incidences occur within the calf, and the more common sport-related cause of MLLs are within football from knee-turf contact. The lesion our patient suffered only presented with symptoms for two weeks rather than the average of thirteen months. **Conclusions:** This case has been presented involving an atypical site, mechanism and patient population. Delayed diagnosis, usually causes chronic MLL recurrence and peripheral capsule formation, which would have prevented successful conservative treatment. Untreated MLLs often go unidentified and can result in infection, fat necrosis, and/or chronic problems. Initial skin bruising can mask significance of the underlying soft tissue injury. Additionally, research findings regarding shearing forces on turf, and the common use of turf as a playing surface, should keep MLLs in the bank of differential diagnoses when presented with similar signs and symptoms. **Relevant Evidence:** None. **Word Count:** 600
Fibromuscular Dysplasia in a Collegiate Female Athlete

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Background: A nineteen-year-old female Division I volleyball and track athlete, with no prior personal or family medical history reported to the athletic trainer during volleyball season complaining of a “cold.” The athlete described treating herself with OTC nasal spray and decongestant. Objective findings included runny nose, sore throat, fatigue, cough, and sinus-pressure. Differential Diagnosis: The signs and symptoms were consistent with sinusitis, influenza, strep infection, allergic rhinitis and upper respiratory infection. Treatment: While the Physicians findings did include signs and symptoms of sinusitis, the most significant finding was a blood pressure of 180/110. Her pre-participation blood pressure was 120/70. The physician immediately put her on two antihypertensive medications. After four days on medication, her blood pressure had not decreased, she developed a severe headache and was referred to the emergency department. As part of a secondary hypertension examination, an ultrasound indicated diminished blood flow to the right kidney and the right kidney was smaller. The athlete was referred to a nephrologist who performed an angiogram, which indicated a severe narrowing of the right renal artery consistent with fibromuscular dysplasia, and provided a final diagnosis of renal artery stenosis secondary to fibromuscular dysplasia, an abnormal development or growth of cells in the walls of arteries. After consultation, the athlete decided to undergo renal angioplasty due to her concerns about the potential long-term effects of ACE-inhibitors. Balloon angioplasty and stent placement were successful, and allowed the athlete to progress toward full athletic participation. Initially the athlete was allowed aerobic activity as tolerated, but weight training was limited. She was also instructed to monitor her blood pressure frequently. The athlete has been cleared by the physician for return-to-play with one restriction; she is not allowed to lift more than 50 lbs. She continues to monitor her blood pressure, maintain a BP journal and will continue to follow up with her physician. Uniqueness: This athlete presented to the athletic trainer with signs and symptoms that may or may not have been related to her final diagnosis. Renal artery stenosis accounts for approximately 1-5% of patients with hypertension, and of those, fibromuscular dysplasia is responsible for less than 10% of renal artery stenosis cases. Conclusion: An athlete participating in collegiate athletics with no history or high blood pressure or related problems presented with signs and symptoms of a “cold.” During normal assessment of patient’s vital signs, the physician determined the patient had severe hypertension. This case stresses the importance of monitoring vital signs periodically throughout the season, as well as in pre-participation screening, and especially when signs and symptoms may indicate a change in an athlete’s general health status. Relevant Evidence: Renal artery stenosis is a cause of secondary hypertension affecting approximately 1-5% of the hypertensive population. The two main causes of renal artery stenosis are atherosclerosis (90% of all cases) and fibromuscular dysplasia (<10% of cases). Fibromuscular dysplasia is an abnormal development or growth of cells in the walls of arteries that may cause the vessels to narrow or bulge. Word Count: 494
Pediatric Autoimmune Neuropsychiatric Disorder Associated with Streptococcal Infection in an Adolescent Football Athlete
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Background: A 16 year-old male football athlete reported to the athletic trainer complaining of involuntary tics causing his head to rotate unilaterally to the right. The patient stated that the symptoms began the previous day however he had been feeling better since the initial episode. However, he reported the symptoms after having to leave football practice as a result of the repeated involuntary head movements. He also complained of a headache and back pain, but did not report any chills, nausea, vomiting or dizziness. His personal medical history included a bout of pneumonia and a concussion he suffered two years prior. The patient denied any alcohol, drug or performance enhancing drug use. His father stated that he has never acted like this before and has no previous history of psychological disorders. Upon assessment, the patient appeared fidgety and could not remain still while he was symptomatic. There were no remarkable findings during assessment other than the obvious tics that were observed. The patient was referred to the emergency department due to the continued tics. 

Differential Diagnosis: Stress related disorder, Lyme disease, Tourette’s syndrome, Sydenham chorea, allergic reaction, reflex sympathetic dystrophy, focal seizure. Treatment: At the emergency department, cardiovascular, respiratory, neurological, gastrointestinal, genitourinary, musculoskeletal, and pain assessments were all negative. Plain film radiographs and computed tomography without contrast were negative. Elevated leukocyte levels were noted following urinalysis and elevated plasma levels of potassium and creatinine were observed. A drug screen was also performed and found to be negative. The patient was diagnosed with a tic disorder and prescribed .5-mg of Xanax. He was cleared to return to sports even though the tic was still consistent. The athletic training staff used heat and manual therapy on the upper trapezius and sternocleidomastoid in an attempt to relax the muscles and diminish the tics. They also performed passive static stretching on the same muscles. When the patient relaxed, the tic would diminish for the duration of the therapy. The athletic training staff decided that it would be safer to wait to return to participation until the tics had resolved completely. At the suggestion of another parent, the patient was referred to his pediatrician who identified a high strep level following an overnight strep test. The pediatrician diagnosed the patient with pediatric autoimmune neuropsychiatric disorder associated with streptococcal infection (PANDAS) and prescribed amoxicillin. The tics cease within a few days and he returned to full participation without complication. Uniqueness: Although PANDAS commonly affects younger children, it also can occur in the older teenage population. It is easily missed or confused with other diseases as it was with this particular case. It would be very easy and useful to add a strep test to the variety of tests done when an adolescent presents with symptoms with an unknown cause or etiology. It also has a variety of signs and symptoms associated with it. 

Conclusions: Sudden onset of obsessive compulsive disorder (OCD) or a tic should raise suspicion for PANDAS and the need for referral. More research is needed to discover the true etiology of this condition. Relevant Evidence: A child may be diagnosed with PANDAS when OCD and/or tic disorders suddenly appear following a strep infection or if the symptoms of OCD or tic symptoms suddenly become worse following a strep infection. Word Count: 546.
RUPTURE AND FAILED REPAIR OF THE DISTAL BICEPS TENDON IN A COLLEGIATE CHEERLEADER
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Background: A 21 year-old, male, cadet cheerleader complains of pain over his anterior elbow after catching a flyer while practicing stunts. The patient reports that the traumatic impact was primarily absorbed by his left arm which was flexed at a 90 degree angle at the time of injury. The patient reports immediately feeling a “pop” and sharp pain in his cubital fossa. The patient also complains of having a “dead arm”, inability to actively flex his elbow, following the injury. Initial evaluation by an Athletic Trainer (AT) identifies obvious deformity just proximal to the cubital fossa. Assessment of range of motion, strength testing, and special tests are deferred due to this obvious deformity. Neurological and circulatory assessment are grossly within normal limits. Differential Diagnosis: Differential diagnosis in this patient includes cubital bursitis, bicipital tendinosis, entrapment of lateral antebrachial cutaneous nerve, elbow dislocation, radial head or tuberosity fracture and biceps tendon rupture. Treatment: The initial diagnosis of the AT is a distal biceps tendon rupture. The patient is immediately referred to an orthopedist for evaluation. Physician assessment reveals the same findings as the AT evaluation. An MRI is ordered, which confirms the diagnosis of a distal biceps tendon rupture. The patient is scheduled for a surgical repair ten days following the injury. Following the surgical repair, the patient is immobilized in a sling for 2 days before beginning PROM exercises in elbow and wrist flexion / extension. Rehabilitation is then progressed to include AAROM exercises of the elbow, forearm and wrist without limitation of motion. The patient is also instructed not to lift greater than two pounds with the involved upper extremity. Following several weeks of rehabilitation, the patient suffers a second mechanism of injury when he trips and falls with his left arm outstretched. The patient is again evaluated by the AT and the patient is again referred to an orthopedist for follow-up care. During the second physician visit, the Hook Test is performed, revealing a ruptured distal biceps tendon. Repeat MRI confirms a second distal biceps tendon rupture, which is again surgically repaired. A more conservative rehabilitation plan is implemented, including the use of a ROM brace locked at 90 degrees elbow flexion for four weeks. ROM limitations are then reduced to 45 degrees from full elbow extension during weeks 5-8 post-surgery; progressing to full elbow extension 12 weeks following surgery. Uniqueness: Distal bicep tendon ruptures are uncommon; constituting between 2-10% of all biceps tendon injuries. The incidence of injury is 2:100,000 in the general population. The injury occurs most commonly in males aged 50-70 years due to a sudden eccentric contraction of the biceps brachii. Post-surgical complications occur in 31-36% of cases. However, re-rupture is extremely rare, occurring in only 2% of cases. Conclusion: The patient continues his rehabilitation, beginning a progressive resistive exercise program of isometric strengthening (weeks 8-10), single plane AROM (week 10-12), and progressive resistive, isotonic exercise (beginning 20 weeks post-surgery). The patient is expected to return to unrestricted sport-specific activity 6-8 months following the second surgical repair. Relevant Evidence: In a study by O’Driscoll and colleagues, the Hook Test demonstrated a sensitivity and specificity of 1.00. By contrast, MRI results in a sensitivity of 0.92 and a specificity of 0.85 for identifying distal biceps tendon ruptures. Word Count: 542
Background: A 21-year-old collegiate male lacrosse player reported red streaking up his right arm, starting mid-forearm, extending proximally into the axillary fossa, and the lateral chest. The athlete had no other symptoms of infection (e.g., fever, chills). He was referred to the local emergency room on March 18th, where he was diagnosed with cellulitis. The emergency room physician cleared him to return to play. Ten days later (March 28th), during a game, the athlete suffered a direct blow to the right side of his head by an opponent's knee. He went down on the field, complaining of unilateral radiating sharp pain from his neck to his fingertips and was tender to palpate at cervical vertebrae 5/6. The athlete had range of motion, strength, and sensory deficits in the affected side and was not allowed to return to play. At this time, we discovered the athlete failed to report sustaining a similar injury fifteen days prior to this. The next day, March 29th, the athlete's chief complaint was surprisingly not the brachial plexus injury, but the return of red streaking on his right arm. He was referred back to the hospital, where they completed a metabolic panel and blood culture. Results came back positive for cellulitis yet again and he was prescribed a different antibiotic. Differential Diagnosis: Viral infection, cellulitis, cervical nerve root irritation, Parsonage Turner syndrome (aka acute viral brachioplexopathy).

Treatment: The college team physician examined the athlete on March 30th and suspected idiopathic erythema of his upper medial arm and observed visible muscle atrophy of his deltoid and paraspinal musculature on the affected side. The physician also suspected that the athlete may have Parsonage Turner syndrome (PTS) and referred him to a neurologist who ordered an MRI on April 7th. The results displayed mild spondylosis with a minute osteophyte formation on the right C5/6 vertebrae. After a month, the shoulder musculature was still atrophied, so the physician then referred the athlete to a new neurologist for a baseline electromyography (EMG) test on May 22nd. He suspected an injury to the C5/6 disc. The neurologist reviewed the EMG and diagnosed the athlete with acute denervation to the muscles innervated by the C5/C6 nerve root. The athlete was excluded from competitive sports until he regained normal function. After multiple diagnostic tests, the exclusionary diagnosis was PTS. PTS is a neurological disorder that attacks the brachial plexus and results in wasting and weakness of muscles. At a follow-up appointment on August 28th, the athlete underwent another EMG that showed the muscles innervated by the C5/C6 nerve root had regained normal strength, size, motor and sensory function. The athlete has resumed weight training and functional activities with the team this Fall. He will officially compete in lacrosse in the upcoming Spring. Uniqueness: Most practicing clinicians are not familiar with PTS and the many ways it can present itself clinically. The pathology is usually an exclusionary diagnosis that normally appears as an infection with abnormal signs and symptoms and acute muscle weakness. Conclusions: The final diagnosis was PTS that first presented itself as a viral infection because of an abnormality of the immune system. Due to ongoing muscle degeneration, the impact during the game significantly affected the athlete, which led to noticeable symptoms. Relevant Evidence: Although 89% of patients with PTS notice improvements in pain, sensation and atrophy over the course of three years, 33% of patients report the presence of chronic pain and functional deficits at a six-year follow-up.† There is currently little to no evidence on PTS in the athletic population because it is such an uncommon condition. Word Count: 599
Osteoid Osteoma in a Female D1 Soccer Player  
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**Background:** A nineteen year old, female division 1 soccer player complained of shoulder pain on September 13, 2014 that started the night before. Athlete had no known mechanism or history of shoulder injury. Athlete had pain actively raising her arm above 90 degrees. Passive range of motion was full and pain free. Athlete was tender on the proximal lateral humerus. Athlete had pain at night and would notice it when she laid on the involved side. **Differential Diagnosis:** Possible diagnoses included contusion, rotator cuff strain, impingement and biceps tendonitis  

**Treatment:** Shoulder pain did not inhibit athlete from playing due to uninvolvement of limb in patient’s sport. Athlete took part in a shoulder rehab program focusing on scapular strength and posture along with rotator cuff strengthening. When no improvements of symptoms were seen, the athlete saw the team physician five days later. The physician ordered for radiograph imaging to be taken. Four days after the appointment, radiographs were taken in the AP and transthoracic views. Radiographs revealed a lucent lesion in the mid shaft of the right humerus that was extracortical. It was believed to be a possible osteoid osteoma and a CT scan was suggested. Athlete began taking a non-steroidal anti-inflammatory drug. Two weeks after the initial appointment, the athlete had a follow up appointment with the physician. Treatment plan included continuing NSAIDs and not getting additional imaging due to patient goals and effectiveness of ibuprofen. Athlete continued NSAIDs until pain went away. Athlete is now completely pain free with no other symptoms or side effects from treatment. **Uniqueness:** This case is very unique due to the location of the tumor and the gender of the athlete. Osteoid osteoma makes up 2.6% of all bone tumors and 11% of all benign bone tumors (Katz et al., 1997). There is a 3:1 to 4:1 male to female ratio of cases. Over 50% of cases occur in the femur and tibia with another 30% occurring in the spine, foot and hand. The humerus is considered to be an atypical location for osteoid osteoma (Chai et al., 2010). One study that looked at 803 cases of osteoid osteoma found that only 13 cases presented in the proximal humerus (Rouhani et al., 2012). **Conclusion:** In mid September of 2014, the athlete had insidious onset of right shoulder pain on the lateral mid shaft of the humerus with no known mechanism or history of shoulder pain. After conservative rehab and treatment were unsuccessful, radiographs revealed an osteoid osteoma in the mid shaft of the humerus. Athlete saw a reduction of symptoms soon after starting NSAIDS 3x a day and needed no further interventions. This patient had a rapid reduction of symptoms after onset due to the referral and imaging after failed conservative rehab. This case is important because it exemplifies how constant re-evaluation as well as expanding your differential diagnoses should be done if the patient is not responding to initial treatment. **Relevant Evidence:** Most cases of osteoid osteoma need minimally invasive surgical interventions to remove the lesion (Cohen et al., 1983). The average period of 2 to 3 years abolishes the symptoms in most patients with an osteoid osteoma (Ilyas et al., 2002). There is no published case of an osteoid osteoma in the humeral shaft of a female, let alone a female Division 1 athlete. **Word Count:** 569
PIGMENTED VILLONODULAR SYNOVITIS IN A 19 YEAR OLD MALE COLLEGIATE FOOTBALL PLAYER

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**Background:** A 19-year-old male collegiate football player reported to the Athletic Training Room first complaining of tightness inside the left knee with an insidious onset. Patient complained of no pain during rest but felt pain when attempting to completely extend the knee. After attempting to stretch the patient's quadriceps and hamstrings, we were able to conclude that the patient lacked range of motion with terminal 20 degrees of knee flexion. However, the patient had full range of motion with knee extension. Patient reported severe pain while reaching the terminal part of knee flexion. Manual muscle testing showed full strength in knee flexion and extension along with full strength at the hip. Patient had a pain level of 6/10 when jumping during practice. Patient had a previous history of pigmented villonodular synovitis (PVNS) during his junior year in high school. To test the patient's ligaments, we performed both Anterior and Posterior Lachman's along with the Varus and Valgus Tests. Special tests were negative, the patient only had point tenderness in the popliteal fossa and was neurologically intact. **Differential Diagnosis:** Bone contusion, medial/lateral meniscal tear, PVNS, anterior cruciate ligament sprain, baker’s cyst. **Treatment:** We referred the patient to his physician, who recommended a magnetic resonance imaging (MRI). MRI results showed villonodular synovitis, a medial femoral condyle contusion and mild patellar tendonitis. Patient was allowed to play as tolerated. Physician instructed the patient that he should receive arthroscopic surgery immediately after the last game of the season. To relieve pain, the patient took non-steroidal anti-inflammatories and iced after every practice. Until surgery, we stretched the patient’s quadriceps and hamstrings to relieve pain before playing. This patient had a very large mass during the first case and had to be opened on the posterior aspect of the knee to remove the mass. During this surgery, the patient received arthroscopic surgery since the mass is smaller than the first one and had no complications. **Uniqueness:** PVNS is considered a benign proliferative disorder of the synovial tissue even though the pathology has not been classified. PVNS is rare, occurring mostly in the younger population. Loriaut et al reported this injury is estimated to be 1.8 per million in the general population. In most cases of PVNS, the physician will perform either a radiograph or MRI in order to successfully diagnose the patient. PVNS occurs most in young adults and the symptoms are often non-specific. PVNS can further be categorized into two sections; diffuse and localized. Although this is the patient's second case of PVNS, a study showed that the reoccurrence rate could be reduced from 38% to 1% with repeated surgeries. **Conclusion:** PVNS can be very difficult to diagnose using only clinical skills. In some cases, the mass can be palpated within the joint, but this is not always true. To successfully diagnose this injury, Athletic Trainers need to recognize the signs and symptoms along with the history of the patient. Patients with this injury should always be referred to a physician for the appropriate care. Secondary to patient history, our diagnosis was apparent, but this is not the case for some patients. Although some athletes are able to push through this injury, surgery is usually required in order to successfully treat this injury. **Relevant Evidence:** PVNS is rare, but an injury AT’s are capable of seeing. Within this particular case, early diagnosis and referral to a physician allowed for a shorter recovery time after surgery. If the mass is caught early enough, arthroscopic surgery can be very beneficial for the patient. **Word Count:** 586
Labral Refixation with Femoroacetabular Impingement
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**Background:** A 20-year-old male baseball player suffered a partial tear of his left anterior superior acetabular labrum. Athlete stated that while warming up for a game the previous day he felt a pull as he pushed off to turn and run. Athlete worked through the pain but the pain increased when he got home that night. The initial injury report stated that the athlete had heard a pop at the anterior superior iliac spine (ASIS) when stretching. ROM: missing the end range of hip flex, pain with end of knee ext and end of hip flex passively. Strength was diminished with all hip motion and knee flexion. Further evaluation showed that his ASIS and PSIS were not in alignment. The initial assessment stated he had a possible strain and/or tendinitis of his hip flexors or extensors with a possible labrum injury. The initial treatment mainly included flexibility and myofascial release of the lower extremity. He was also advised to see the team doctor. The doctor ordered an x-ray and an MRI. MRI showed a torn left anterior superior acetabular labrum. The doctors’ first approach was to try a strengthening program to make surgery the last option. After six weeks of the strengthening treatment the doctor decided surgery was his only option.

**Differential Diagnosis:** A possible strain or tendinitis was the original assessment because of his complaints during hip movement. It was very difficult to say he suffered a strain specifically because it was difficult to test his strength due to pain. Once an MRI arthrogram was done, a torn left anterior superior acetabular labrum with a femoroacetabular impingement was found. **Treatment:** First six weeks he completed a rehab program that focused on strengthening his lower extremity and his core while improving flexibility. After six weeks it was decided that surgery was the best option. After surgery specific guidelines were followed in the upcoming weeks. Treatment mainly included biking, scar massages, stretching, ROM exercises, proprioception exercises, core strengthening, and lower body strengthening. The SwimEx and different exercises using the TRX apparatus were implemented later in his treatment along with hip joint mobilization. The modalities used were ice and cryocuff. During the thirteenth week of treatment he began jogging on the treadmill and performed side lunges with the TRX. He is currently in his fourteenth week of treatment and his upcoming treatment will include plyometric exercises with the TRX and different jumping exercises, along with treadmill running. **Uniqueness:** The athlete had a cam impingement with a chondral flap tear. Femoroacetabular impingement can be caused by either a cam or pincer impingement or both can be present at the same time. Cam impingement leads to constant acetabular chondral and labral injury. In his case, the shape of his acetabular not only caused a labral tear but also a femoroacetabular impingement. **Conclusion:** Labral tear with femoroacetabular impingement is an injury that does not occur often. The athlete was first assessed with a strain and tendinitis possibly in his hip labrum. Further investigation revealed a cam impingement that caused a labral tear in his left hip due to the size of his acetabular. **Relevant Evidence:** A study by Knee Surgery, Sports Traumatology Arthroscopy showed that having the athlete perform a maximal squat could be used as a screening exam to see if they could be susceptible to a cam-type femoroacetabular impingement. Even though intra-articular injuries represent only a small percentage (5% in the NFL) of hip injuries, they account for the largest number of days out of sport. **Word Count:** 601
**Background:** Athlete is an 18 year old Division 1 football defensive lineman. During preseason camp, the athlete was stepped on and stepped awkwardly immediately after. The athlete stated that he heard a pop in his Achilles Tendon. Findings included a (-) Thompson test, (+) dropfoot (but at some points actually dorsiflexed the foot slightly), unable to dorsiflex or plantarflex when asked to, and a decrease in sensation in foot or distal Achilles tendon. Stated that he could not move foot at all, but when distracted actually fired his FHL and EHL well. Babinski Test normal. **Differential Diagnosis:** Achilles tear, neuropraxic injury, Gastrocnemius rupture/ Grade 3 strain, conversion disorder. X-Ray, MRI and EMG were work ups were completed. **Treatment:** All results with X-Ray, MRI, and EMG study were negative. Nothing was found to be structurally wrong with the athlete. However, the athlete still presented with severely decreased sensation, drop foot and lack of range of motion within the ankle. Athlete was referred to a psychologist, who eventually diagnosed the athlete with conversion disorder. A diagnosis of Conversion Disorder takes into account social, biological and psychosocial factors as well as comorbidities present. The athlete was prescribed triweekly visits with the mental health specialist, which was ongoing as of the end of December 2014. In the Athletic Training Room, the athlete was taken through light range of motion and slow progression of walking when the athlete felt up to it. He was given light rehab exercises dealing with walking and range of motion until his departure from the University in May 2015. The athlete is no longer attending the university or playing football. However, he does have full use of his foot with full strength and range of motion. **Uniqueness:** a wide variety of statistics exist, with incidence from 1.1 in 10,000 to 1 in 200 cases. Either way, the disorder is often linked to childhood abuse and mood disorders. In this case, it was a combination of moving away from home for the first time, the athletes relative being a star linebacker on the team and the possibility of something from his childhood. **Conclusions:** Athlete presented with symptoms of an Achilles rupture, although everything structurally was in tact and functioning as shown with three different diagnostic imaging studies. Upon consultation with a psychologist, the athlete was diagnosed with conversion disorder. Even through re-evaluation in the ATR, the athlete continually presented with all symptoms associate with an Achilles rupture without the imaging to back it up. Clinically, this is important on a higher level. An Athletic Trainer needs to always realize and take into account an athlete’s psychosocial state of mind in an evaluation or presentation of symptoms. This is not to be construed to mean that every athlete is faking symptoms or has a diagnosable neurologic disorder. However, when aspects of an evaluation do not support underlying differential diagnoses, a referral to additional specialists may be warranted, as was the case with this athlete. **Relevant Evidence:** No research at this time. **Word Count:** 520
Os Trigonum Syndrome and Excision in a Collegiate Football Player
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Background: A 19-year-old male football player underwent Os Trigonum excision surgery after conservative treatment of Os Trigonum Syndrome was unsuccessful in relieving posterior ankle pain. Athlete first reported pain in the posterior ankle after football practice, describing a sharp, pinching pain when pushing off and “kick stepping”. Initial evaluation found point tenderness on distal Achilles tendon at its insertion and in retrocalcaneal space. Swelling and mild ecchymosis was noted around distal Achilles tendon. ROM was full; pain reported last 10° of active and passive plantarflexion; strength normal. Talocural and subtalar joint stability intact bilaterally. Chief complaint was increased pain in posterior ankle during passive and active plantarflexion that increased during repetitive stepping when blocking. Differential Diagnosis: Achilles tendinitis, retrocalcaneal bursitis, flexor hallucis longus tendinitis and/or strain, tibialis posterior tendinitis, peroneal tendon subluxation, posterior talofibular ligament sprain, tarsal tunnel syndrome. Treatment: Initial treatment for Achilles tendinitis included rest, ice cup, prone calf stretch, calf foam rolling, friction massage, and electrical stimulation. Swelling decreased but athlete still complained of pain when pushing off toes, specifically during “kick step” motion performed during pass blocking on the offensive line. Fluoroscope x-rays showed accessory bones on posterior aspect of both right and left tali indicating bilateral os trigonum. Athlete participated as tolerated and limited repetitive foot work during practice. He was taped with arch tear-drop taping and dorsiflexion strapping to reduce end range plantarflexion during activity. Therapy continued throughout season, treating for pain and ankle mobility. After season, athlete was referred to a podiatrist. An MRI revealed an os trigonum bilaterally of the synchondrosis between accessory ossicle and talus, indicating posterior ankle impingement and OS Trigonum Syndrome. Surgery was performed to remove accessory bone. Athlete was placed in a non-weight bearing splint post-operative initially, then into a cam walking boot for 3 weeks. Treatment three weeks post-op included moist heat pack, heel-toe walk on treadmill, joint mobilization, towel drags, and stork stance. After pain-free aggressive rehabilitation, subject was cleared for participation. Uniqueness: Os trigonum is a small accessory bone on posteriolateral aspect of talus and os trigonum syndrome results from inflammation of tendons in posterior ankle joint and refers to pain in the posterior ankle joint2,3. Os trigonum is most often bilateral2 however, the athlete’s right ankle was acutely symptomatic for posterior ankle pain, most probable from the forceful, repetitive hyperplantarflexion. The “kick step” is a unique technique for offensive linemen, essentially performed as the lineman pushes and slides repeatedly off of the instep and heel of foot. Conclusion: Os trigonum is rare, occurring in approximately 7% of the population2. Athletes are at a higher risk of injuring this structure due to forced plantar flexion, dorsiflexion and repetitive microtrauma. Both conservative and surgical treatment can be effective in treating os trigonum syndrome. Relevant Evidence: Diagnosis of os trigonum syndrome can be difficult as symptoms and clinical findings often mimic those related to tendon pathologies of the flexor hallucis longus, posterior tibialis, and peronal longus tendons. Corticosteroid injection is often administered as initial treatment for os trigonum syndrome, evident by decreasing pain, while excision has shown to provide complete resolution of symptoms1. Word Count: 539
Background: A 19-year-old Division I collegiate female lacrosse mid-fielder reported to the athletic training room with deep, left hip pain noticeable during squatting. The patient presented the “C-sign” when asked about location of pain. Femoral impingement tests were negative and range of motion and manual muscle testing were strong and painless on initial evaluation with no presence of neurological symptoms. An acetabular labral tear with possible femoroacetabular impingement was suspected and treated conservatively. The objective examination was unremarkable and only squatting was painful, so the athlete was permitted to continue practicing and playing in games. Differential Diagnosis: Acetabular Labral Tear, Femoroacetabular Impingement, Hip Flexor Strain, Athlete Pubalgia.

Treatment: The athlete was initially evaluated by the team’s certified athletic trainer (ATC) and sent to the team physician for further investigation. The athlete, after seeing the physician, was told to keep playing with modified activity, but the ATC maintained that diagnostic imaging was necessary. Between the initial evaluation and MRI (magnetic resonance image), the athlete heated and stretched before practice and iced after practice, continuing to play in games as normal. From the MRI, the radiologist indicated an observable Grade II stress reaction of the proximal diaphysis of the left femur centered 11cm below the left greater trochanter. The team physician immediately removed the athlete from practice and put her on crutches due to pain while walking. Uniqueness: Femoral stress fractures are uncommon, specifically in multi-planar sport athletes, with only 7-10% occurring in the femur. Femoral stress fractures are most commonly seen in the femoral neck and are difficult to diagnose due to non-specific findings during evaluation and the many possible differential diagnoses to consider. Females have unique risk factors contributing to an increased likelihood of stress fracture, i.e. the female athlete triad. Femoral pathologies may refer pain to the hip, making a definitive diagnosis challenging. Recommended treatment is conservative, beginning with non-weight-bearing (NWB) or partial weight-bearing for the first 2-4 weeks, 2-4 weeks of NWB cardiovascular activity and 2-4 weeks of gradual return to activity. Conclusion: It is important for ATCs to recognize atypical case patterns and to be able to complete the most comprehensive evaluation to avoid missing key features. Because femoral stress fractures are often not initially recognized, it is important to fully investigate injuries and hip pain. If diagnosis of a stress fracture is delayed, potential worsening of the condition may result in poor outcomes. Relevant Evidence: MRIs have a sensitivity, specificity, and positive predictive value of 100% and are considered the gold standard for diagnosing stress fractures. With sufficient rest and return to activity protocol athletes are able to make a full recovery in about 12-14 weeks after diagnosis of a stress fracture. Word Count: 447
Background: A 19 year old, male college football player complained of deep anterior left thigh pain during practice. The athlete stated that the pain began about two weeks prior and had since gotten worse. He denied any direct trauma or mechanism of injury. He described pain while standing, walking, and jogging but less when sprinting. When asked to point to the pain, he pointed in the middle of the muscle belly of the rectus femoris. On examination, no palpable pain could be found. The athlete had full pain-free range of motion of the hip and knee and all manual muscle tests were strong without pain. Fulcrum test was positive for pain, along with pain when asked to jump on the involved leg and while squatting.

Differential Diagnosis: Femoral stress fracture, quadriceps strain, osteosarcoma.

Initial Treatment: The primary focus of the initial treatment was pain management. The athlete was placed on crutches and was instructed to be pain-free while weight bearing. Referral was made to the team physician. The physician’s exam was consistent with the previous exam and diagnosis of femoral stress fracture was confirmed. X-ray was ordered and showed no pathology at this time and the physician recommended continued rest and pain free partial weight bearing (PWB). The athlete noted a significant decrease in pain over the first week of PWB. A gradual return to full activity will commence once walking is pain-free for one week.

Uniqueness: Femoral stress fractures are not commonly seen in athletics. They are even rarer in collision sport athletes. The highest occurrence is found in runners and sports such as track and cross-country. Femoral stress fractures can be difficult to diagnose, as the femur is not easily palpated making the physical exam results to be sometimes inconclusive.

Conclusions: While femoral shaft stress fractures are uncommon injuries in the sport of football, complaints of insidious onset deep thigh pain should make a clinician suspicious of a stress injury. While challenging to diagnose, the clinician should be familiar with the clinical presentation of a femoral stress fracture. Weight-bearing pain, positive fulcrum test, and inability to palpate/locate the pain should warrant referral to the team physician to confirm stress fracture pathology.

Relevant Evidence: Upon searching the evidence of femoral shaft stress fracture (PubMed, MEDLINE, and SportDiscus), four cases were found in football players. The femoral neck was the most commonly site for stress injury, making the femoral shaft much less common. Stress fractures to the shaft are far more prevalent in the military population and runners. Once the onset of symptoms begins, stress fractures can take up to four weeks to show up on an x-ray or MRI. This delay in radiographic evidence makes the recognition of these injuries on clinical exam much more critical for positive outcomes.
Biceps Femoris Rupture & Acute Compartment Syndrome in Male Athlete
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Background: A 21 year-old male football player suffered a biceps femoris rupture and acute compartment syndrome to his right thigh while playing recreational basketball. Two weeks prior, the athlete felt a “pop” in the back of his right thigh while running sprints in football practice and was treated conservatively by the Kean University Athletic Training staff for a strained biceps femoris muscle. On ER presentation the athlete described playing basketball when he bent down and felt a snap in the back of his thigh. He reported immediate and severe pain in his posterior thigh, which was far worse than the pain he experienced with the injury 2 weeks prior. He reported a burning pain that was more than 10 out of 10; stating it was “the worst pain I have ever felt.” He denied any numbness or tingling, but stated it “feels tense” and “very swollen.” He was given 1mg Dilaudid IM, 60mg Toradol IM, and Percocet PO in ER for pain with no relief. Physical exam found point tenderness, edema, and ecchymosis on the distal aspect of the posteriolateral thigh. **Differential Diagnosis:** Biceps femoris strain/rupture, avulsion injury, ischial bursitis, compartment syndrome.  

**Treatment:** An MRI revealed an acute hematoma with large amounts of edema and hemorrhage within the biceps femoris muscle and extending along fascial planes; hamstrings insertion on ischial tuberosity insertion intact. The athlete was emergently taken to operating room for excisional debridement of the wound and fasciocutaneous flap closure of defects. Following the procedure, wet dressings were applied, followed by a negative pressure wound vacuum. He was given pain medication and antibiotics, placed in a loose knee immobilizer, and instructed strict bed rest with the right leg elevated. **Uniqueness:** A biceps femoris rupture leading to compartment syndrome is extremely rare with only one documented case found in the literature\(^1\). Additionally, biceps femoris ruptures more commonly occur as an avulsion at the ischial tuberosity and compartment syndrome in the thigh is more commonly seen in the anterior compartment from direct trauma\(^1,2,3\).  

**Conclusion:** The compartment syndrome in this individual likely resulted from excessive bleeding following the biceps femoris rupture. However, extensive work-up by vascular surgery did not reveal a source or reason for the amount of bleeding that occurred. Now, approximately 18 months out from the injury, the athlete has successfully returned to full activity without complications. **Relevant Evidence:** The most common mechanism for hamstring injury occurs during dynamic sport specific activity, usually involving high-speed running when the hamstrings actively lengthen to decelerate during the swing phase\(^4\). However, this injury occurred from static stretching, meaning the muscle was passively lengthened and is unusual that this mechanism caused the muscle to tear. This could indicate muscle weakness from the previous injury was still present. Additionally, 1/3 of all hamstring injuries will reoccur and have the greatest risk of re-injury during the initial 2 weeks following return to play\(^5\). Lastly, acute compartment syndrome resulting from a biceps femoris rupture is unique and further research is required to determine optimal prevention, diagnosis, and management techniques. **Word Count:** 528
DIAGNOSIS OF COMPLEX REGIONAL PAIN SYNDROME IN A 19-YEAR-OLD SWIMMER: A CASE STUDY

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Background: The case presents a 19-year-old female swimmer with a prior medical history of inversion ankle sprains, a distal fibula fracture, and surgery to remove a bone fragment in the foot. The patient reported an ankle inversion injury sustained during conditioning and complained of pain along the medial and lateral aspects of the ankle mortise. The patient had substantial amounts of ecchymosis and edema around the joint. The patient was unable to walk and range of motion of the ankle was limited in dorsiflexion, plantarflexion, eversion, and inversion that resulted in severe pain. The patient’s ankle, foot, and toes were extremely sensitive to touch. The patient reported sharp pain upon palpation along all areas of the foot and ankle. The patient had extreme sensitivity to temperature changes while performing exercises in water. The patient experienced cold and numbing sensations in her distal phalanges and midfoot. After four weeks of rehabilitation, little to no improvement was apparent. The patient’s symptoms became increasingly worse as the months progressed despite a conservative approach to treatment.

Differential Diagnosis: Grade 3 anterior talofibular ligament sprain, peroneal strain, tarsal fracture, fibular fracture, lymphatic obstruction, Complex Regional Pain Syndrome (CRPS).

Treatment: The patient was referred out to the orthopedic doctor who suspected CRPS as the definitive diagnosis. The symptoms did not regress and another team physician gave a second opinion and confirmed the diagnosis of CRPS. The treatment of CRPS is unique for each patient. Treatment should include pain management, functional rehabilitation, and psychological rehabilitation. Intensive inpatient rehabilitation is effective for children with CRPS (Fukushima, Bezerra, Villas Boas, Valle, & Vidal, 2014). Holistic approaches to rehabilitation and treatment have been found to be the most beneficial (Kishner, Rothaermer, Munshi, Malalis, & Gunduz, 2011). Treatment initially included range of motion exercises of the foot to reduce swelling. The later stages of rehabilitation focused on familiarizing the patient with correct gait and psychological confidence to ensure the injury was healing. To reduce pain, various distraction methods were used such as watching videos, listening to music and talking to other people during treatments. To increase confidence, the patient was encouraged to view her long-term improvements as opposed to the very slow short-term progress that she was making. The patient responded well to the distraction methods. Uniqueness: Complex regional pain syndrome has been found in 5.46 cases out of 100,000 people per year in the United States. The peak incidence of cases was seen in males and females aged 50-70 years old, making this diagnosis even more rare among college-aged individuals. The pain and loss of mobility associated with CRPS is usually disproportionate to the initial injury as was the case with this particular patient. Conclusions: The patient is no longer able to participate in swimming. After three and a half months of rehabilitation, the patient is pain free, has full range of motion, and is fully weight-bearing. The onset of the condition was thought to be triggered by memories of her previous foot surgery. The patient was able to return to full functioning activities of daily living. Aggressive rehabilitation allowed the patient to regain the functional movement lost due to injury. Relevant Evidence: The research regarding complex regional pain syndrome proposes aggressive rehabilitation to be effective (Kishner et al., 2011). Further evidence is needed to enhance evidence-based treatment of CRPS. The current rehabilitation suggestions incorporate both physical and psychological interventions. Both the physical and psychological interventions have been shown to be extremely important when rehabilitating a patient back from CRPS (Kishner et al., 2011). Word Count: 584
Non-Operative Treatment of Ulnar Collateral Ligament Sprain of a Collegiate Baseball Player
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**Background:** A 21-year-old male collegiate baseball catcher sustained an injury to the medial aspect of his right elbow while throwing. The athlete denied any feelings of elbow instability, or hearing or feeling a pop. Objective findings included mild swelling over the medial epicondyle and tenderness to palpation over the flexor-pronator musculature and anterior bundle of the ulnar collateral ligament (UCL). Valgus stress tests were positive for laxity. Manual muscle testing of the flexor carpi ulnaris was graded as 3/5, eliciting pain and weakness. **Differential Diagnosis:** Signs and symptoms were consistent with a right elbow UCL sprain and flexor-pronator mass strain. **Treatment:** The physician’s findings included flexor carpi ulnaris weakness and pain with manual muscle testing, and valgus stress tests were positive for laxity. MRI revealed a partial tear of the UCL of the elbow, resulting in a final diagnosis of a 2º UCL sprain. Initial treatment consisted of rest, ice and compression to control pain and decrease inflammation. Two days post injury; treatment consisted of moist heat pack, ultrasound/electrical-stimulation combination therapy, massage and ice. At the one-week follow-up, the athlete stated there was no real change, but no longer had pain while putting on his backpack. Twelve days post injury; upper body ergometer (UBE) and wrist flexion/extension, radial/ulnar deviation, and pronation/supination strengthening exercise were added to his rehabilitation program and he was allowed to play as the designated hitter (DH). Thirty-three days post injury, signs and symptoms had subsided and he began a progressive interval-throwing program (ITP). Forty-nine days post injury; the athlete felt close to preinjury status, had full range of motion and strength, but still had signs and symptoms of inflammation. As a result, the physician decided to inject the medial aspect of his elbow with cortisone, and the athlete’s only treatment consisted of icing. Fifty-three days post injury; the athlete returned to his ITP and reported a decrease in pain while throwing. Fifty-six days post injury; the athlete had full strength and pain-free range of motion, no increased laxity of the UCL, and was allowed to return to play catcher. For the remainder of the season, the athlete continued strengthening exercises and treatment to control pain as needed. **Uniqueness:** Wilk et al. (2004) stated that a typical return-to-throwing with conservative treatment of a UCL sprain is between 12 and 14 weeks. Signs and symptoms indicated that this athlete tolerated the accelerated progression compared to published norms. We have no speculation as to why this athlete tolerated the seemingly accelerated progression. **Conclusions:** This athlete sustained a partial UCL tear of his right elbow and responded well to conservative treatment; beginning an ITP approximately 5 weeks post injury and returning to competition 8 weeks post injury. Signs and symptom throughout the rehabilitation process indicated he was tolerating the rehabilitation program. Upon having full and pain free strength and ROM, and no UCL laxity, a cortisone injection was administered to help with inflammation. The athlete had a full return to play, completed the season through the College World Series and is now on active duty in the Navy. Although published norms are helpful guidelines for treatment and rehabilitation programs, this case report stresses the importance of monitoring the patient’s signs and symptoms as indicators of how they are tolerating program. **Relevant Evidence:** Rettig et al. (2001) stated that 42% of throwing athletes who had signs and symptoms of UCL tear or insufficiency and were treated non-operatively, which included a minimum of three months rest with rehabilitation exercise, returned to their previous level of competition. Of those that did return, they did so at an average of 24.5 weeks after diagnosis. **Word Count:** 600
High intensity functional movement (HIFM) protocol improves movement patterns and work capacity in an offensive lineman/USMC veteran with an arm length discrepancy.


**Background:** 25 year old male, US marine corps veteran and NCAA D2 college football player with diagnosed mechanical imbalances of the upper and lower body. Pathologies include right shoulder impingement syndrome and tendinitis of the distal head of the bicep, left knee patellar tendinitis and right leg hip flexor tendonopathy. Patient served 6 years active duty prior to participation in college football. Prior history of humeral fracture involving the growth plate, resulted in 1 ½ inch greater right arm length when compared to left. A 95lb weight gain over past 2 years was observed. **Differential Diagnosis:** Upper extremity pathologies: impingement syndrome, Labral tear, Rotator cuff strain, Erb’s Palsy, chronic regional pain syndrome. Lower body pathologies: chronic regional pain syndrome, quadriceps tendonitis, proximal quadriceps strain, labral tear and bursitis. **Treatment:** A 6 week high intensity functional movement (HIFM) protocol was prescribed for this patient 1 month after spring practice ended. Four consecutive, 90min workouts were completed weekly (M-Th) followed by one day of rest and two days of active recovery. Workouts structured as follows: foam roll (10min), stretch (10min), dynamic warm-up (20min); technique work (20min), metabolic conditioning (20min), and static stretches (10min). Initial technique work focused on core stability, scapular muscle endurance transitioning into movement proficiency with total body exercises: Turkish get-ups, over-head squats, thrusters, single-leg squats, inverted rows and single-arm dumbbell snatch. Metabolic conditioning was anaerobic, maximal exertion bouts lasting between 8 and 20minutes and included measureable tasks like weighted wall balls for time, 20 min AMRAP, EMOM, and TABATA style workouts. Static power band stretches, held for a 45 sec count targeting lower extremity flexibility and shoulder mobility completed each workout. **Uniqueness:** HIFM exercise helped dramatically improve the overall work capacity and movement proficiency for this patient as measured by anaerobic strength endurance task (timed wall balls) and the functional movement screen (FMS). Many service men and women experience a difficult transition back to civilian life, and participation in a team sports might ease this transition. Being prepared physically and mentally for battle does not translate well for maintaining life-long healthy lifestyles. This intervention was successful in improving this patient's physical work capacity which in previous years might have been hindered by training for hypertrophy. **Conclusions:** Athletic Trainers must be prepared to treat patients who are transitioning back to civilian life after careers in the armed forces. People exposed to extremely stressful events are at a higher risk for developing post-traumatic stress (PTS). Research on US war veterans shows those suffering with (PTS) experience a lower quality of life, poorer mental and physical health. These patients have a greater need to adopt healthy lifestyle behaviors. In this case traditional hypertrophy training provided an increased opportunity for this patient to load an inefficient movement pattern exacerbated by an arm length discrepancy and repeated sub maximal repetitions. A more functional, high intensity core to extremity approach allowed muscular adaptation through explosive single arm and leg movements which improved balance, core stability and overall work capacity. **Relevant Evidence:** Pre and post conditioning data showed a 4 minute improvement in 100 rep wall ball assessment, FMS data shows a 6 point improvement in FMS composite scores (15/21). A 57% reduction in treatments requiring modalities (42/24) was found when comparing treatment frequency data between 2014 and 2015. Initial DPAS scores were: 39 (2013), following traditional treatment 33 (2014); and in-season s/p HIFM training 18 (2015). DPASS MCID for chronic injuries is 6. Pre intervention pain at worst was reported at 6/10, pain at best was 2/10. Post intervention pain at worst was 1/10, pain at best was 0/10. **Word Count:** 594
Effectiveness of Strengthening or Stretching Interventions on Hamstring Strain Incidence in the Physically Active Population
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Focused Clinical Question: Is there an effect of strengthening or stretching programs on the prevention of hamstring strains among competitive adult athletes? Data Sources: The literature was searched through the PubMed database for studies of level 3 or higher that investigated the effect of stretching or strengthening programs on hamstring muscle injuries in competitive adult athletes. Key words included competitive athlete or professional athlete or college athlete, strengthening or stretching or prevention or prevention program, intervention, hamstring strain or tear or injury and incidence. Inclusion criteria included level 3 evidence or higher, publication in the past 10 years (2004-2014), English language with human subjects who were active in a competitive season of athletics at the time of study, and injury rates as a key outcome. Two investigators reviewed abstracts of articles retrieved independently to assess if all criteria had been met. These investigators came to consensus through discussion for any initial disagreements. Data Extraction: Studies were examined for the hamstring muscle injury rates among participants, as well as injury severity based on lost playing time. Summary Measures: Data of each study incorporated were organized into a table including study design, participants, intervention investigated, outcome measures, main findings, level of evidence, and conclusions in order to be compared and evaluated. Evidence Appraisal: All selected studies were appraised using the PEDro scale. Search Results: The literature search returned 72 possible studies of which 10 had a primary focus of hamstring muscle injury rates. Of these 3 studies were selected which met the inclusion criteria to be examined further. Data Synthesis: The first study examined the effects of the Nordic Hamstring exercise program on professional male rugby athletes, compared with traditional strengthening and stretching programs. The strengthening group experienced 1.1 hamstring muscle injuries per 1000 player hours (95% CI, 0.74-1.4). The strengthening and stretching group experienced 0.59 hamstring muscle injuries per 1000 player hours (95% CI, 0.34-0.84). The strengthening, stretching, and Nordic strengthening group experienced 0.39 hamstring muscle injuries per 1000 player hours (95% CI, 0.25-0.54). The second study looked at the effects of balance strengthening exercises on hamstring injury rate in female soccer players. Results showed a hamstring injury rate during the control period before the intervention program of 12.4/1000 hours of training and match exposure. After 6 months of the intervention program, hamstring strain occurrence was 11.9 injuries/1000 playing hours. After a full soccer season, hamstring injury rates were significantly reduced to 9.0 injuries/1000 hours (P=.009). The following season hamstring injury rates were further reduced to 4.8 injuries /1000 hours of exposure (P=.001). Overall mean injury rate of hamstring strains during all intervention periods was reduced by 43% when compared with the control (P=.048). The final study examined the effect of the Nordic Exercise Program and found overall acute hamstring injuries per 100 players for 1 season was 3.8 versus 13.1 in the control group (P<0.001) over the course of one season, with a number needed to treat to prevent 1 acute hamstring injury was 13. Evidence Quality: There is Grade B evidence that supervised preseason and in-season stretching and strengthening prevention programs are effective in reducing the rate of hamstring injuries in competitive athletes. Conclusions: There is strong evidence to support the use of a stretching or strengthening prevention program that focuses on the use of eccentric exercises and static stretching to build hamstring strength and control as well as increase flexibility, alongside balance exercises to work on proprioception. Word Count: 568
Effectiveness of an open capsular shift with rehab in reducing MDI incidence in college female athletes: A Critically Appraised Topic

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Context: Multidirectional Instability (MDI) of the shoulder is a ligamentous laxity in more than one direction, most predominantly in the inferior and anterior directions; the glenohumeral capsule having the ability to sublux/dislocate in more than one direction (Cody et al). Neer and Foster created the open capsular shift procedure in 1980 upon finding that typical unidirectional surgical techniques did not fully eliminate the incidence of re-instability. It allows precise soft tissue balancing on all sides of the glenohumeral joint (Cordasco et al). Turkel et al, reported that the open capsular shift was found to offer stability in varying functional positions, while maintaining motion. Conservative rehab for MDI consists of PRE targeted at the rotator cuff and scapular stabilizers, while also containing neuromuscular exercises (Longo et al). Lephert et al found that athletes with chronic shoulder instability have increased deficits in proprioception and surgical stabilization normalizes proprioceptive sensibility (Longo et al).

Focused Clinical Question: Is an open capsular shift combined with rehabilitation more effective in reducing re-instability than rehabilitation alone in collegiate female athletes diagnosed with MDI?

Data Sources: The literature was searched for studies of Level of Evidence IV or higher that investigated the effectiveness of an open capsular shift to reduce the occurrence of re-instability. A search was conducted using databases via the Quinnipiac University online library, including: PubMed, Cochrane Library, CINAHL, SPORTSDiscuss, ScienceDirect. Additional resources obtained via reference list review and individual searches. Keywords and search limits included, MDI, female athletes, open capsular shift, conservative rehab.

Study Selection: Searches were filtered so that only articles with their full text available were shown.

Evidence Appraisal: The Oxford Centre for Evidence-based medicine (CEBM) was used to grade the level of evidence presented.

Search Results: Three systematic reviews looking at the effectiveness of open capsular shifts and conservative treatments options were included. A Level II Prospective Cohort Study, looking at biomechanical analysis of conservative rehabilitation was included. One additional systematic review was also considered.

Data Synthesis: Longo et al found that 21% of patients undergoing rehabilitation required subsequent surgery to correct their MDI. 7.5 % of patients who underwent an open capsular shift had re-instability. Jacobson et al found 11.7% who underwent an open capsular shift had re-instability. Poor conservative rehabilitation outcomes were found in two of seven studies Warby et al investigated. Of the two studies, one found that 44% underwent surgery and the other found that 66% had poor outcomes to rehabilitation and 70% underwent surgery. Nyiri et al found that open capsular shifts normalize the muscular activity pattern of the shoulder and were maintained for at least 4 years compared to rehabilitation alone. Bak et al reviewed 26 shoulders, where 23 were scored excellent on the Rowe Score post surgery (88%).

Evidence Quality: The level of evidence for this conclusion based on the CEBM was graded as a B.

Conclusion: All articles considered looked at the effectiveness of an open capsular shift and conservative rehabilitation in reducing the incidence of an MDI episode. With conservative rehabilitation, normal kinematic parameters cannot be obtained, nor is there enough research to validate the effect that conservative rehab has on a shoulder diagnosed with MDI (Nyiri et al and Warby et al). According to the research, the open capsular shift remains one of the best surgical options for MDI. The surgery along with its rehabilitation has shown to help normalize kinematic parameters along with normalizing muscular activation patterns (Nyiri et al). According to the evidence reviewed, an open capsular shift is more effective than rehabilitation alone to reduce re-instability.

Word Count: 587
A Comparison of Ankle Strapping and Spatting on Range of Motion and Performance

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Context: Ankle injuries are common in sport and tend to reoccur. To decrease the risk of reinjury, ankle strapping is commonly used to limit range of motion (ROM), specifically plantarflexion (PF) and inversion (INV). The loosening characteristics of taping over the skin have prompted clinicians to use other restrictive techniques such as spatting. However, the efficacy of spatting and comparisons to traditional strapping have not been extensively researched. Objective: To examine and compare the effects of traditional ankle strapping and spatting and their combination on ankle ROM and performance. Design: A randomized cross-over design. Setting: Research laboratory. Participants: Ten healthy varsity athlete and recreationally active males (age=20.5±.97 y, height=181.02±6.45 cm, mass=87.05±10.02 kg) volunteered. Interventions: Each participant reported to the laboratory on one occasion and participated in four conditions; no tape (C), ankle strapping (T), spatting (S), and combined strapping and spatting (TS). The order of conditions was randomly assigned and all tape application was performed by a Certified Athletic Trainer using 3.81-cm Jaybird® tape. The T condition consisted of a Gibney closed-basket-weave with heel-lock and figure-eight strips directly applied to pre-wrapped skin. The same Gibney technique was used over the sock and shoe for the S condition. The TS condition consisted of a combination of both techniques, while no tape was used during the C condition. Main Outcome Measures: PF and IV ROM were assessed immediately prior to and following application of each condition using Saunders® digital inclinometers and were assessed passively and actively using standard methods. Passive ROM was also assessed with overpressure as the clinician applied a force equivalent to 10% of the participant's body mass using a hand-held dynamometer (Hoggan Scientific, Salt Lake City, Utah). Immediately following ROM assessment, participants were assessed for maximum vertical jump height (Vert max) and agility using a three cone drill. The tape was then removed and identical procedures were followed under the remaining conditions. Results: All three taping conditions significantly decreased passive (F 3,27=17.03, p=.001), active (F 3,27=8.29, p=.001) and overpressure (F 3,27=16.28, p=.001) PF with the TS condition providing the greatest restriction. All three conditions also decreased passive (F 3,27=4.35, p=.013), active (F 3,27=6.48, p=.002) and overpressure (F 3,27=4.73, p=.009) INV however no differences between techniques were observed. Vert max during the C condition was significantly greater than the taping conditions while no differences were noted when comparing taping conditions (F 3,27=5.90, p=.003). Time to complete the three cone drill was significantly greater during the TS condition as compared to the C condition (F 3,27=3.61, p=.026), while no other differences were noted. Conclusions: The results suggest that all taping conditions decreased ROM with the combination of ankle strapping and spatting providing the greatest restriction. While the taping conditions impaired performance, neither was found to impair performance more than the others. Word Count: 450.
Influence of dorsiflexion range of motion on Star Excursion Balance Test reach distances


**Context:** The Star Excursion Balance Test (SEBT) is a clinical balance test that has been shown to be a valid outcome tool for identifying dynamic balance deficits associated with lower extremity injury. SEBT performance is a combination of strength, neuromuscular control, and joint ROM; however it is unclear how these individually contribute to performance. Of all the factors investigated in SEBT performance, ankle dorsiflexion ROM (DROM) appears to be critical in at least one of the reach directions. DROM deficits are a risk factor for LE injuries, and clinicians have begun to use the SEBT to assess such risk factors. **Objective:** The purpose of this study was to validate the evidence associated with the relationship between ankle DROM and reach direction within the SEBT. **Design:** Cross-sectional study. **Setting:** Research Laboratory **Participants:** Twenty-eight healthy adults (15 males, 14 females, age: 19.8 ± 1.0 years, height: 171.4 ± 12.3 cm, weight: 78.7 ± 22.6 kg) participated in this study. All subjects were free of any musculoskeletal and neurological injuries, and reported no disability that would impair their balance. Prior to participating in the study, all subjects provided written informed consent. Similar subject size and demographics were seen in other studies. **Intervention:** All subjects performed 3 trials of the anterior (ANT), posteromedial (PM), and posterolateral (PL) directions of the SEBT on both the dominant (preferred kicking limb) and nondominant limbs. As well, all subjects performed 3 trials of the weight-bearing lunge test (WBLT) to measure the maximum weight-bearing DROM on each limb. The mean of the 3 trials for each variable was used for analysis. **Main Outcome Measure:** Pearson’s product moment correlation coefficients were calculated between the WBLT and the three directions of the SEBT. Alpha was set a priori at p<0.05. Because there were no differences between the dominant and nondominant limbs on any of the dependent variables, the right and left reach distances were pooled for analysis. **Results:** There was a moderate correlation between the WBLT (9.6±3.4cm and the ANT reach (69.4±6.8cm, r=0.55, r²=0.30, p<0.01). However, weak correlations were found between WBLT and the PM (82.0±8.8cm, r=0.29, r²=0.08, p=0.14) and the PL (74.8±10.4cm, r=0.29, r²=0.08, p=0.14) reaches. **Conclusions:** Weight-bearing dorsiflexion explained approximately 30% of the variance in ANT reach direction whereas it only explained 8% of the variance in the posterior directions. Our findings directly support the previously published evidence and help to further the validity of the relationship between weight-bearing dorsiflexion and performance on the anterior reach of the SEBT. Since decreased DROM has been shown to be a contributing factor to other LE injuries, our study provides additional evidence to support using the SEBT as a clinical tool to assess lower extremity injuries. **Word Count:** 446
A Comparison of Cooling Times with and without Football Equipment Following Exercise Induced Hyperthermia

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Context: Exertional heat stroke (EHS) is one of the three leading causes of sudden death in sport however it is 100% survivable when proper recognition and management protocols are implemented. When managing EHS, core body temperature (T\text{core}) should be lowered to less than 39°F within 30 minutes of collapse and cold water immersion (CWI) is the most effective way to accomplish this. Current protocols recommend removal of all equipment and clothing prior to immersion to enhance cooling. This can be a tedious process and could possibly affect patient morbidity and mortality by causing a delay in cooling. However, comparisons in total cooling time with and without equipment removal have not been assessed. **Objective:** To compare time to immersion and overall cooling times with and without football equipment removal following exercise induced hyperthermia. **Design:** A randomized and counterbalanced cross over design. **Setting:** Research laboratory. **Participants:** Six healthy collegiate football athletes (age=21.2 ±0.75 y, height=187.5 ±7.08 cm, mass=106.4 ±21.5 kg) without a history of diagnosed EHS or any contraindication to CWI participated. **Interventions:** Each participant reported to the laboratory on two occasions separated by seven days. On each occasion they performed a bout of exercise on a stationary cycle in a climate controlled chamber maintained at 35°C while wearing a typical football uniform with full equipment until they achieved a T\text{core} of 39.5°C. Once the target temperature was achieved, the participants were fully immersed in water maintained at 10°C either with or without the clothing and equipment removed by a clinician until a T\text{core} of 38.4°C was achieved. The helmet was removed in both conditions to allow for immediate airway access. When the participants returned for the second session, identical procedures were followed using the remaining condition. **Main Outcome Measures:** T\text{core} was assessed using a rectal thermometer (DataTherm® II Continuous Temperature Monitor) and was used to determine baseline temperature, achievement of target temperatures and to determine cooling rates. The time from exercise target temperature (diagnosis) to immersion, from immersion to cooling target temperature and total times were used to compare cooling times and rates between the two conditions. **Results:** A significant difference (t5=16.32, p=.001) in the time it took to immerse the subjects in the cold tub was observed as it took longer to immerse the subjects during the equipment removal condition (170.87 ±13.93 s) than during the non-removal condition (63.02 ±18.84 s). However, no differences were noted when comparing the cooling time (t5=.840, p=.439), overall treatment time (t5=.516, p=.628) and the cooling rate (t5=1.41, p=.217). **Conclusions:** The results do not suggest the need to change current protocols. However, if there is difficulty in equipment removal, CWI should not be delayed and the patient should be immersed with the equipment on. **Word Count:** 449.
The Effect of Continuous Shortwave Diathermy on Hamstring Flexibility
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Context: Continuous shortwave diathermy (CSWD) is a deep heating modality found to increase tissue temperature greater than 4 degree Celsius at a depth of 4 centimeters. Little research regarding the effectiveness of CSWD has been conducted. Objective: The objective of this study was to determine the effectiveness of a single session of CSWD and passive stretching (PS) to increase the flexibility of the hamstring (HS), as measured by an active straight leg raise (SLR) test, immediately post-treatment and 24-hours post-treatment as compared to a single session of PS alone. Design: The design of this study included a pre-intervention measurement of HS flexibility, a treatment intervention (CWSD with PS or PS alone), a post-intervention measurement of HS flexibility and a 24-hour post-intervention measurement of HS flexibility. Setting: The study was conducted in a University research laboratory. Patients or Other Participants: Subjects consisted of 60 healthy, student volunteers with decreased hamstring flexibility as measured by active SLR test of less than 70 degrees. Subjects were required to be free of any lower extremity pathologies at the time of participation. Subjects were divided into two groups for treatment intervention; CSWD and PS (n=40) or PS alone (n=20). Interventions: Pre-intervention hamstring flexibility measurements were taken three times and an average was calculated. Each subject was then treated with either CSWD for 20 minutes at an intensity of 50 watts followed by passive hamstring stretching three repetitions for 30 seconds each or with passive stretching alone. After the therapeutic intervention, subject’s SLR was again measured three times and averaged. Subjects in the CSWD group were also asked to return 24 hours after treatment intervention to determine possible carry-over effects. Main Outcome Measures: The main outcome measure of this study was the change in HS flexibility pre and post-treatment intervention and 24-hours post-treatment intervention. Data was analyzed using T-Tests to examine differences between groups. Results: Both CSWD coupled with PS and PS alone resulted in a statistically significant change in flexibility between pre and post-intervention measures (p < 0.001). CSWD coupled with PS showed a greater increase in flexibility (13.7 degrees) when compared to PS alone (8.1 degrees) (p < 0.01). CSWD coupled with PS demonstrated a statistically significant change in flexibility 24 hours after intervention when compared to pre-intervention results (p < 0.001). No change was noted when comparing flexibility immediately after CSWD coupled with PS and measures 24 hours post-treatment. Conclusions: Both CSWD coupled with PS and PS alone are effective methods for increasing hamstring flexibility in healthy subjects. CSWD coupled with PS demonstrates greater increases in flexibility than PS alone. Additionally, improvements in flexibility noted with CSWD coupled with PS were found to be present 24 hours after application. Word Count: 446.
Postural control strategies are dependent on reach direction in the Star excursion balance test.

Context: The Star Excursion Balance Test (SEBT) is a common clinical measure of dynamic balance. It is unclear how each reach direction challenges the sensorimotor system in maintaining single limb balance. Calculating center of pressure (COP) area and velocity during the 3 reach directions of the SEBT may provide insight into how single limb balance is maintained in the context of reach direction.

Objective: The purpose of this study was to examine differences in COP area and velocity among three SEBT reach directions. Design: Cross-sectional study. Setting: Research laboratory. Patients or Other Participants: Twenty-eight college-aged students participated (15 males and 13 females, age: 19.8±1.0 years, height: 171.4±12.3 cm, mass: 78.7±22.6 kg). All participants were healthy with no recent history of lower extremity injury or conditions that affected balance. Interventions: All participants performed the anterior (ANT), posteromedial (PM), and posterolateral (PL) directions of the SEBT on their non-dominant limb (preferred stance limb during kicking motion) while standing on a force plate with a sampling rate of 200Hz. Subjects were instructed to balance on their non-dominant limb, maximally reach the opposite limb in one of the three directions (ANT, PM, PL), and then return to balance while COP data was recorded. Participants completed 4 practice trials in each direction prior to performing the 3 reach trials. Main Outcome Measures: Dependent variables included the average COP velocity (cm/s) and the area of a 95% confidence ellipse of the COP (cm²) in each of the 3 reach directions. The mean of the 3 trials of each direction was used for creating the COP velocity and area dependent variables. Separate 1x3 ANOVAs were used to determine the influence of reach direction on COP velocity and area. Paired t-tests were used for post hoc analyses. Alpha was set a priori at p>0.05 for all analyses. Results: Significant reach direction effects for both COP velocity (p=0.02) and area (p<0.01) were found. The ANT direction (8.4±1.6cm/s) resulted in lower COP velocity compared to the PM (9.1±1.5cm/s, p<0.01) and the PL (9.1±2.0cm/s, p=0.04) directions. There was no difference between the posterior directions (p=0.99). The ANT direction also demonstrated higher COP area (28.1±9.7cm²) compared to the PM (22.5±7.0cm², p<0.01) and PL (22.4±7.4cm², p<0.01) directions. There was no difference between the posterior directions, p=0.95). Conclusions: The ANT direction requires a different balance strategy (larger COP area with lower COP velocity) compared to the posterior directions of the SEBT, however the posterior directions do not differ from one another. Understanding how healthy individuals control their dynamic balance during the SEBT enhances framework for building a relationship between clinical- and laboratory-oriented measures of balance and their implications as rehabilitation outcome tools. Word Count: 438
A Comparison of Cryotherapy and Intermittent Compression Therapy and Their Effect on Muscle Recovery Following Exercise

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**Context:** Optimizing recovery during training is beneficial for performing successive bouts of training or competition over a season without associated fatigue or overtraining effects. The inability to repeat the same level of performance in the days following intense training is frequently attributed to peripheral fatigue involving metabolite accumulation and muscle damage. Thus, various techniques have been suggested to accelerate the clearance of muscular damage or metabolite accumulations and optimize recovery. Cold water immersion (CWI) and intermittent pneumatic therapy (ICT) using extremity compression sleeves are two modalities commonly used to enhance recovery. However, at this time their efficacy is not fully understood and comparisons between the two have not been investigated.

**Objective:** To examine and compare the effects of CWI and ICT on recovery following a bout of intense exercise. **Design:** A randomized and counterbalanced single blind cross over design. **Setting:** Athletic training facility. **Participants:** Twelve healthy varsity athletes and recreationally active males and females (age=20 ±0.7 y, height=166.2 ±16.9 cm, mass=70.9 ±12.6 kg) who did not suffer from any contraindication to CWI or ICT volunteered. **Interventions:** Each participant reported to the facility for three sessions separated by a period of at least one week. At each session, the participants completed a drop jump protocol consisting of 100 drop jumps (5 sets of 20). The participants dropped off a 0.61-m platform with both legs and performed a maximal vertical jump in place immediately upon landing. A 10-s rest was provided between jumps and a 2-min rest between sets. Immediately following exercise, the participants completed one of three treatment conditions, CWI, ICT or control. The CWI condition consisted of immersion in 10°C water to the level of the iliac crests for 20-min. The ICT condition utilized the NormaTec MVP Recovery System (Normatec, Newton Center, MA) that was applied using manufacturer's instructions for a 20-min treatment. The control condition consisted of seated recovery with no modality for 20-min. **Main Outcome Measures:** General muscle soreness using a visual analogue scale (VAS), maximum vertical jump height (Vert\text{max}), 54.9-m shuttle time, and Yo-Yo intermittent recovery test (Yo-Yo IR1) performance were assessed immediately prior to and 24-h following the bout of exercise. **Results:** Muscle soreness was greater 24-h after exercise (F\text{1,11}=55.06, p=.001), however no treatment effect was observed. Likewise, Vert\text{max} (F\text{1,11}=10.28, p=.008) and 54.9-m shuttle time (F\text{1,11}=8.65, p=.013) performance declined 24-h following exercise however the treatment had no effect on these measures. In contrast, a significant decline in Yo-Yo IR1 (F\text{2,22}=4.77, p=.019) performance was observed following the CWI and control conditions, but not following ICT. **Conclusions:** While CWI and ICT did not appear to affect short duration anaerobic performance, ICT did provide improved recovery for aerobic performance. Thus, this treatment can be considered beneficial for training recovery. **Word Count:** 450.
Handheld Tablets are A Viable Tool for Analyzing Frontal Plane Motion in Drop Vertical Jumps


**Context:** Drop vertical jumps (DVJ) are commonly used to evaluate athletes for lower extremity injury risk. While the use of handheld devices to observe and evaluate movement patterns is increasing, little is known about the measurement error of these tools, particularly when used by varying observers in slightly different positions. **Objective:** To determine the reliability and measurement error of frontal plane projection angle (FPPA) on 2 handheld tablets capturing simultaneous DVJ data in slightly different positions and analyzed by a series of randomly assigned investigators. **Design:** Cross-sectional. **Setting:** Laboratory setting. **Patients or Other Participants:** 30 healthy volunteers participated (24 females, 6 males; age:20.0±1.0yrs; height:164.9±13.0cm; mass:69.0±15.4kg). **Interventions:** Participants performed 3 trials of DVJ from a 31.0cm box. Of the 6 investigators, a rotating schedule allowed for two investigators to be randomly assigned to capture a participant’s trials. These 2 investigators stood side-by-side at 3.7m in front of the participant. The side to which the investigators stood (left or right) was randomly assigned. Each investigator held a tablet at a self-selected chest height, perpendicular to the ground in portrait view orientation. Each DVJ trial was captured simultaneously on 2 tablets. The same 6 investigators were randomly assigned to measure left limb FPPA using a free video analysis tablet application. **Main Outcome Measures:** For each captured video, the frame selected for analysis was at the instant of maximum downward displacement during the landing phase of the DVJ. FPPA was measured as the acute angle created by the intersection of 2 lines: one line from the anterior superior iliac spine to the midpoint between the femoral condyles, and a second line from the midpoint between the tibial and fibular malleoli to the midpoint of the femoral condyles. No investigator analyzed the same trial on both tablets. In total, 180 trials were analyzed; 90 trials were randomly selected for which intraclass correlation coefficients (ICC2,1) and standard error of measurement (SEM) were calculated between the two tablets. For the other 90 trials, a paired samples t-test was used to determine the difference in FPPA between the tablets. **Results:** Means±SD are presented for descriptive results. The reliability analysis revealed good agreement between the left (163.5°±9.2) and right (160.1°±9.4) tablets (ICC2,1=0.8; SEM=2.4°; p<.001). For the differences analysis, there was no significant difference between FPPA angles for the left (164.8°±9.0) or right (162.9°±9.1) tablets, p=0.1. The difference (1.9°±10.5) between the two tablets did not exceed the SEM. **Conclusions:** Evaluating FPPA during DVJs can be consistently performed by different observers stationed in slightly different positions while maintaining a frontal view using handheld tablets and standard biomechanical measurement applications. These findings provide evidence supporting the use of tablets in clinical and field settings for evaluating FPPA during DVJs for biomechanical profiles related to lower extremity injury. **Word Count:** 450
A Comparison of Athletic Training Student and Preceptor Perceptions on Mentorship in Clinical Education
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**Context:** Mentoring occurs when an individual with more experience assists in the development and guidance of an individual with less experience; this has been shown to help promote learning of one’s professional role. The clinical education setting places athletic training students and preceptors in an environment where mentoring may occur. Though numerous studies have identified beneficial elements and outcomes of mentoring few have directly compared student and preceptor perspectives on mentoring as it relates to clinical education. **Objective:** Compare the perceptions of preceptors and athletic training students on mentorship in clinical education. **Design:** Mixed methods study. **Setting:** Commission on Accreditation of Athletic Training Education (CAATE) programs. **Patients or Other Participants:** 12 preceptors affiliated with and 17 athletic training students enrolled in 7 different CAATE accredited programs. Preceptors, (5 males and 7 females), had an average of 5±5 years experience as a preceptor. Students, (3 males and 14 females), represented a variety of academic levels: 1 sophomore, 9 juniors, and 7 seniors. **Data Collection and Analysis:** All participants completed the validated (α .85) Athletic Training Perceptions of Effective Mentoring Survey (ATSPME) and 14 open-ended interview questions regarding their perceptions of mentoring in clinical education. Independent t tests were performed to compare mean scores on the ATSPME. Qualitative data was analyzed using an inductive approach to identify codes, categories and themes. Trustworthiness was established through data source triangulation, multiple analyst triangulation, and peer review. **Results:** There were no significant differences found between the mean scores of athletic training students and preceptors’ perceptions of mentoring on the ATSPME. However, comparison of the mean scores elicited the emergence of several trends, which corresponded to qualitative data responses from the interview. Preceptors and athletic training students identify many of the same values as important for their mentoring relationships. Preceptors and athletic training students identify athletic trainers in supervisory positions (head or assistant athletic trainers) as their mentors. Mentoring relationships in clinical education, for both preceptors and students, rely on three consistent themes: 1.) Ongoing support (understanding and encouragement), 2.) Role modeling (professional behaviors and attitudes) and 3.) Interpersonal characteristics (empathy, compassion, communication). **Conclusions:** The theme of support was evident for continued learning and development of both preceptors and students. Preceptors learn the role of mentor by emulating their previous mentors and rely on their continued support in the formation of their own mentoring strategies. Students view their preceptors as mentors and rely on them for teaching clinical skills as well as learning their role as an athletic trainer. Both groups identify similar interpersonal and professional characteristics such as trust and communication to assist them in connecting with their mentor and forming meaningful relationships. **Word Count:** 441
Sex Differences in Anthropometrics and Heading Kinematics Among Division I Soccer Players
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Context: A direct or indirect blow to the head or body transmitting resultant acceleration, deceleration and possibly rotational forces to the brain may cause a concussion. In soccer, heading to redirect the ball is inherent to the sport and has been identified as a potential mechanism of injury for concussion. It is theorized that stronger neck musculature may reduce such kinematics, by co-activating opposing muscle groups. Objective: To evaluate the relationship between anthropometrics and soccer heading, with an emphasis on differences between male and female collegiate soccer players. Design: Cross-sectional. Setting: Laboratory. Patients or Other Participants: A total of 5 male (age = 19.2 ±1.09 years, height = 177.40±8.79 cm, mass = 70.45±3.96 kg) and 8 female (age = 20.25±0.70 years, height = 158.73±36.12 cm, mass = 66.98±5.25 kg) Division I soccer players with at least five years of soccer heading experience, with no history of head or neck injury in the last six months. Interventions: Anthropometric and neck strength measurements were taken in six directions (i.e., flexion, extension, right and left lateral flexion and lateral rotation). Participants headed the ball ten times while wearing an accelerometer secured to the back of their head. Soccer balls were projected from a JUGS machine at varying speeds (i.e., 25 mph, 40 mph). Kinematic measurements were recorded for each header using a GForce tracker. Data were analyzed using descriptive and inferential statistics. T-tests were used to identify differences in anthropometrics, strength, and head impact kinematics between sexes. Pearson correlations were used to assess associations between ball speed, anthropometrics, and kinematic measures. All analyses were evaluated using SPSS (version 22; SPSS Inc., Chicago, IL), with a significance level set at an alpha level of $p \leq .05$ for all analyses. Main Outcome Measures: Dependent variables included anthropometric measurements and head impact kinematics (i.e., linear acceleration, rotational velocity) at two ball speeds. Results: Sex differences existed in neck girth ($t = 5.09, p < .001$), strength ($t = 3.006, p = .012; t = 4.182, p = .002$), and kinematic measurements ($t = -2.628, p = .024; t = -2.227, p = .048$). Neck girth had negative correlations with both linear acceleration ($r = -.599, p = .031$) and rotational velocity ($r = -.551, p = .012; r = -.652, p = .016$). Also, stronger muscle groups had lower linear accelerations at both speeds ($p < .05$). Conclusions: These findings deepen the understanding of the role of the head-neck segment during a head impact. For this subject demographic, sex differences existed between isometric neck strength, neck girth, and head impact kinematics. Neck girth and neck strength are factors that may limit head impact kinematics. Word Count: 442.
GROUND REACTION FORCES ARE PREDICTED WITH FUNCTIONAL AND CLINICAL TESTS IN A HEALTHY COLLEGIATE POPULATION
Cacolice PA, Garcia CR, Scibek JS, Phelps AL: Duquesne University, Pittsburgh, PA

Context: Injuries to the Anterior Cruciate Ligament (ACL) are common, costly and debilitating. Increased vertical and posterior ground reaction forces are associated with ACL injury. Without sophisticated laboratory measures, it is not possible to accurately predict these ground reaction forces. If a practical means to predict ground reaction forces existed, ACL injury risk could be identified and thus attenuated. Objective: This study aimed to generate models predicting ground reaction forces, an established predictor of ACL injury incidence, from practical functional and clinical tests. Design: Descriptive design. Setting: University motion analysis laboratory. Patients or Other Participants: Forty-two healthy, active college age individuals (21 females, 20.66±1.461 years; 70.70±2.363cm; 82.20±7.606kg; 21 males, 21.57±1.28 years; 65.52±1.874cm; 64.19±9.05kg) participated. Intervention: After assuring all participants met inclusion criteria and provided consent, lower extremity dominance was determined with drop landings. Individuals then had Fat Free Mass [FFM] determined from skinfolds and ankle joint dorsiflexion passive range of motion taken with a standard goniometer [DPROM]. Quality of lower extremity movement was evaluated using the overhead deep squat test [ODS]. Participants then performed the following tests in a counterbalanced order: Margaria-Kalamen [MK], Single Leg Triple Hop [SLTH], and isometric peak force for lateral hip rotation [HipLR], knee flexion and knee extension. The knee flexion and extension peak force data was used to calculate a flexion:extension peak force ratio [H:Q]. Stepwise linear regression models to predict the ground reaction forces were calculated using FFM, DPROM, ODS, MK, SLTH, HipLR, H:Q and sex as the predictors. Alpha levels for all analyses were set a-priori at P≤.05. Main Outcome Measures: Peak vertical (GRFz) and posterior (GRFy) ground reaction forces were obtained from five, signal-averaged LE drop landings from 35cm height onto a forceplate. These forces were then normalized to the participant’s Fat Free Mass [nGRFz and nGRFy]. Results: Step-wise linear regression analysis indicated that a significant nGRFz model occurred utilizing all independent variables (P=.048), but was most parsimonious with only SLTH and DPROM as predictor variables (Adjusted R²=.274; P=.001). Use of all eight-predictor variables for nGRFy also resulted in a statistically significant result (P=.001) but the most parsimonious model occurred with only H:Q, FFM and DPROM (Adjusted R²=.476; P<.001). Conclusion: Two models significantly predicted ground reaction forces from practical clinical measures and functional tests. One model predicted nGRFz from SLTH and DPROM, while one model predicted nGRFy from H:Q, FFM and DPROM. If validated, a practical method of predicting ground reaction forces would be available to identify those at elevated ACL injury risk. Word Count: 417
Relationships between quality of life and concussion testing at baseline
DiFabio, MS, DeWolf, RM, Oldham, JR, Stant, M, Bednarek, AL, Buckley, T: University of Delaware, Newark, DE

Context: Individualized baseline concussion testing is essential for concussion evaluation and recovery in athletics. There is evidence suggesting that a number of factors can influence these scores, which include gender, sleep, and pre-existing medical conditions such as ADHD. However, it is not clear if there is any relationship between an individual’s subjective ratings of quality of life and concussion baseline test scores. Objective: To examine the relationship between self-reported quality of life and concussion baseline test scores. Design: Cross-sectional. Setting: Laboratory. Patients or other participants: 80 NCAA Division 1 athletes (Age 19.4±1.2, height 186.9±6.8, weight 105±18.5). Interventions: Each participant completed the Brief Symptom Inventory 18 (BSI-18), the Hospital Anxiety and Depression Scale (HADS), the Satisfaction with Life Scale (SWLS), and a fatigue rating to rate their self-perceived quality of life. All subsequently performed a physical testing battery consisting of the ImPACT test, Standardized Assessment of Concussion (SAC), King Devick (KD) test, and ruler drop test. Main Outcome Measures: Scores on each of the self-reporting items and physical test measures were analyzed for correlation using Spearman's ρ. An independent t-test was performed to note any differences between subjects with and without history of concussion. Results: Weak to moderate correlations were found between all variables. Of the physical tests, the KD test had a significant weak correlation with the SWLS (-.235, p<.05). The cognitive efficiency index (CEI) calculated by the ImPACT test had significant weak correlations with the depression and anxiety subscores of the HADS (-.247, -.243, respectively, p<.05). No significant differences were found between subjects with and without a history of concussion on any of the measures. Conclusions: Overall, self-reported quality of life measures do not seem to be related to outcomes on physical concussion baseline testing overall in this study cohort. There were only two significant relationships found, both of which were weak. One of the two relationships found was between the CEI and the HADS. The CEI is calculated based on speed and accuracy from the responses determined by the ImPACT computerized test, which is a test that takes about 20-30 minutes to complete. An individual who scores high on the HADS, particularly on questions relating to focus, may perform worse on this test, resulting in a lower CEI score. Other tests included in the battery only last between two and five minutes, so an individual would not have to focus as long to complete the tests, which may help them perform better. However, it is important to note that this was found to be a weak relationship; in general, there were no true relationships between the scores of self-reported inventories and baseline physical test measures. Word Count: 437
Understanding Gender and Cultural Norms in Athletic Training: Validating a Short Scale
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Context: Within athletic training, professional turnover has the potential to negatively impact patient care. There are many hypothesized factors that influence the attrition of athletic trainers, including sociocultural factors. Due to existing societal gender norms, women typically have a more difficult time maintaining both work and life responsibilities. Retention among athletic trainers is well researched topic; however there is no known survey instrument that measures the perceived impact gender and cultural norms play on athletic trainers’ workplace interactions and outcomes. It is important to assess sociocultural factors to have a better understanding of the complexities of career intentions. Objective: Validate a short Gender and Cultural Norm Survey (GCNS) within an athletic training population and determine if gender differences exist. Design: Cross sectional design Setting: Participants were recruited from all NATA practice settings. Patients or Other Participants: Participants were recruited utilizing convenience and snowball sampling procedures. A total of 102 athletic trainers from 8 NATA districts participated; 38 (37.3%) males and 64 (62.7%) females representing a 34% response rate. The majority were white (88.1%), employed at the collegiate setting (53.9%) and held a Master’s Degree (67.6%). Our participants worked on average 51+14 hours a week, had 8+7 years of experience, and were 31+7yrs old. Interventions: Data were collected via Qualtrics, a web based survey instrument and consisted of two sections: 1) Demographics, and 2) 10 item GCNS. The survey was designed to assess athletic trainers’ perceptions of how their gender impacts specific workplace and life dimensions and questions were developed specifically for this instrument. The 10 items were scored in a content adequacy test to determine the degree to which each question matched the defined workplace and life dimensions. The Cronbach’s alpha =0.76. Main Outcome Measures: Likert responses (1=strongly disagree, 5=strongly agree) for the GCNS questions were summed to provide a score for each participant. Scores could range from 10-50. A score of 30 represents a neutral response, below 30 indicates a perception of gender negatively impacting workplace and life dynamics, while a score above 30 would indicate a positive perception of gender. A Mann-Whitney U test was run to determine if there were any gender differences. Results: The mean GCNS score for all participants was 25.8+4.9 ranging from 10–34 (males =24.4+5.6, females =26.7+4.3). Mann-Whitney U testing revealed that males scored significantly lower than females (U=848, p=0.039). Conclusions: Regardless of gender, we found that our participants felt as though their gender negatively impacted their work and life dimensions. Interestingly, males felt that their gender impacted them more negatively than females in our study. Future testing will need to be completed in order to better determine which specific outcomes males and females perceive are impacted by their gender. Word Count: 450
A Descriptive Analysis of Lower Extremity Flexibility and Strength in Collegiate Men’s and Women’s Soccer Athletes

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Context: Lower extremity (LE) injury is a serious concern for soccer athletes, with injury affecting the long-term well-being of the athlete in addition to their short-term playing status. Gender is a well-established risk factor for LE injury at the knee and ankle. By linking musculoskeletal characteristics, including flexibility and strength, to gender, a better appreciation of the connection between gender and injury is established. Establishing gender specific musculoskeletal characteristics promotes more specific and effective injury prevention initiatives. Objective: To identify differences in flexibility and strength, as risk factors for LE injury, in men’s and women’s soccer athletes. Design: Descriptive cohort study. Setting: Athletic Training Room. Participants: A total of 80 collegiate male and female soccer athletes (age: 19.3±1.4 years, height: 173.7±9.0 cm, weight: 69.5±9.5 kg) participated. All athletes were cleared for full participation and had no history of LE injury in the four weeks prior to testing. Interventions: Testing occurred prior to the initiation of the competitive soccer season. Flexibility was assessed bilaterally using a standard goniometer and digital inclinometer. Flexibility tests included: weight-bearing ankle dorsiflexion mobility (DFM), active ankle dorsiflexion, active knee extension (AKE), and passive hip flexion (PHF). Strength testing was performed using a handheld dynamometer. Strength tests were performed bilaterally as isometric “make tests”; held for a total of 5 seconds in a standard grade 5 manual muscle testing position. Strength tests included: ankle inversion/eversion, ankle dorsiflexion, knee flexion/extension, hip abduction/adduction, and hip internal/external rotation. All data analysis was completed utilizing the average of three trials. Main Outcome Measures: Flexibility tests including, ankle dorsiflexion, AKE, and PHF were expressed as a mean value in degrees. Mean value in centimeters was analyzed for DFM. Isometric strength was expressed as mean peak force normalized to body weight (%BW). All data were assessed for normality. If normally distributed, gender differences were calculated using an independent samples Student’s T-test; if normality was violated, gender differences were calculated using a Mann-Whitney U test. Significance level of <0.050 was established a priori. Results: Flexibility tests yielded significant differences between genders for both AKE (Right:p=0.007, Left:p=0.045) and PHF (Right:p<0.000, Left:p=0.001). Females demonstrated greater flexibility for both the AKE and PHF compared to males. Strength tests yielded significant differences between genders for hip internal rotation on the left leg (p=0.001). Females demonstrated greater left hip internal rotation strength compared to males. Conclusions: Gender differences are present in LE flexibility and strength, with females demonstrating greater flexibility and left hip internal rotation strength compared to males. These results implicate that flexibility may be better linked to gender than strength, suggesting that it may be a better indicator of injury risk. Future research should explore the implications of these gender differences and how they affect risk of LE injury. Word Count: 449
Shoulder Strength Profiles in Those With and Without Scapular Dyskinesis
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Context: Muscular weakness of the shoulder has been demonstrated in individuals with scapular dyskinesis (SD). The majority of studies have focused on symptomatic patients; however, little is known regarding muscular performance in healthy individuals with SD. Objective: Our objective was to compare strength measures of the shoulder complex between healthy individuals with and without SD. We hypothesized that strength differences would exist between the groups. Design: Descriptive laboratory study. Setting: Biomechanics laboratory. Patients or Other Participants: Forty healthy, college-aged participants (22.20 ± 2.37 years; 169.85 ± 8.70 cm; 68.74 ± 12.98 kg; 23.68 ± 3.09 kg/m²; 12 males, 28 females) without any history of dominant shoulder pathology were recruited. We elected to conduct a matched-pairs analysis due to disparity in the number of individuals that presented with SD versus those without SD. Participants were matched based on sex and BMI resulting in 13 matched-pairs (22.00 ± 2.06 years; 168.77 ± 8.07 cm; 70.98 ± 13.14 kg; 24.75 ± 3.04 kg/m²; 6 males, 20 females). Interventions: Participants completed the PAR-Q and the ASES Standardized Shoulder Assessment to confirm general health fitness and a healthy shoulder status. The presence of SD was determined using the scapular dyskinesis test. We utilized a dichotomous method (yes/no) to categorize those with and without SD. Strength of the scapula stabilizers and rotator cuff was assessed via manual muscle testing using a handheld dynamometer (ICC² = .92–.97) for the upper trapezius (two methods: UT1 and UT2), middle trapezius (MT), lower trapezius (LT), serratus anterior (SA), supraspinatus (SS), and the medial (MR) and lateral (LR) rotators. Main Outcome Measures: For each manual muscle test, mean peak force (kg) of three trials were normalized to body mass (kg) and used for data analysis. Additionally, strength ratios (UT/LT, UT/MT, LT/MT, SA/UT, SA/MT, SA/LT, and LR/MR) were calculated and analyzed. Differences in strength and strength ratios between those with and without SD were compared using separate two-way mixed ANOVAs with repeated measures with an alpha level of .05. Results: A majority (68%) of subjects were found to have SD. No significant differences or interactions were observed for strength between SD groups (F1,83,43.92 = 1.10, P = .34) or strength ratios and SD groups (F1,83,44.02 = 1.93, P = .16). A significant main effect (F1,83,43.92 = 239.32, P < .001) was revealed for strength indicating differences between several of the muscles tested across both groups. Post-hoc analysis revealed trends that resulted in a generalized order of the muscles from strongest to weakest: UT, followed by SA and MT, LT, SS, MR, and LR. Conclusions: Our results indicate that differences in shoulder muscle strength do not exist in healthy subjects with and without SD. Additionally, SD appears to be commonly found in healthy populations. Word Count: 450
Patient Reported Outcomes Over the Course of a Competitive Basketball Season in Participants with and without a Previous Knee Injury History
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Context: Athletes who participate in sports with rapid acceleration and deceleration movements, and high impact biomechanical forces are at an increased risk for developing osteoarthritis (OA). Furthermore, prior joint injury is also a recognized risk factor for knee OA. While sport participation and joint injury are separate risk factors, the combination of the two determinants may further confound OA development and progression. Patient reported outcomes (PRO) utilization can potentially identify early symptoms prior to OA development. There is limited research in the sports medicine field regarding prospective PROs, specifically in athletes who have sustained a previous joint injury and have returned to continuous high impact sports. Objective: To examine knee PROs over a competitive basketball season, and to compare PROs between basketball athletes with a knee injury history (INJ) versus no previous injury (CON). Design: Prospective Cohort Study. Setting: Division II University Participants: Twenty-nine NCAA Division II men’s and women’s basketball players between the ages of 18 to 24 participated in the study. INJ participants (n=10; M=3/F=7) self-reported a history of a significant knee injury, and CON participants (n=19; M=10/F=9) denied any significant knee injury history. Interventions: The independent variables were knee injury history (INJ vs CON). Participants completed the Knee Osteoarthritis Outcome Score (KOOS) on a biweekly basis throughout the season. The primary aims were analyzed using separate 2 (group) x 8 (time) analysis of variance (ANOVA) with repeated measures for time, as well as multiple independent t-tests. A priori statistical significance was defined as P≤0.05. Main Outcome Measures: Dependent variables were PRO scores in the 5 KOOS subscales (pain, activities of daily living [ADL] function, symptoms, sports and recreation function, and knee related quality of life [QOL]) at 8 biweekly time points during the season. Covariates that were considered were height, weight, and participation minutes (i.e. practices and games). Results: Significant group-by-time interaction effects were found for KOOS sport/recreation (F_{4,2,114,4}=3.326, P=0.011) and QOL (F_{2,9,80,6}=3.076, P=0.032). Significant main effects for time were found for KOOS symptoms (F_{4,5,122,8}=2.448, P=0.043), sport/recreation (F_{4,2,114,4}=6.103, P<0.001), and QOL (F_{2,9,80,6}=4.767, P=0.004). INJ participants reported significantly poorer scores for all KOOS subscales (pain:73.1±20.2; symptoms:63.9±25.9; ADL:81.6±19.0; sport/recreation:58.0±24.9; QOL:56.9±24.8) in comparison to CON participants (pain:93.7±8.4; symptoms:90.0±11.7; ADL:96.7±4.6; sport/recreation:89.2±11.6; QOL:89.9±11.3) when competitions started (P<0.002). Conclusions: These findings indicate that athletes with a knee injury history are reporting poorer outcome scores at various points over the course of the season. These scores affect them both with basketball activity and with their overall QOL. This may be related to an increased risk for possible OA development. These findings suggest that athletes with a previous knee injury history may benefit from interventions like rest or modified activity to help prolong the health of their knees. Word Count: 443
Effect of Foot Rigidity on Tibial Rotation, Rate of Loading, and Landing Mechanics in an Active Population

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Context: Anterior cruciate ligament (ACL) injuries are a common and debilitating injury among an athletic population. Previous research would suggest that arch stiffness may alter tibial rotation, rate of loading, and landing mechanics, possibly increasing ACL injury risk during landing and deceleration tasks. ACL injuries are multifactorial in nature. However, the relationship of arch stiffness on these lower extremity kinetics and kinematics in regards to ACL injury is currently unknown. Objective: To determine the tibial rotation, landings mechanics, and rate of loading differences based on arch stiffness categorization (i.e. rigid vs. supple) in a physically active population while performing a stop jump landing task. Design: A two-group cross-sectional design Setting: Biomechanics research laboratory.

Participants: A physically active convenience sample from a college aged student population was used for this study (n = 27; mean age = 20±1.09 years, mean height = 172.71±9.48 cm; mean weight = 71.89±11.07 kgs; male = 12, mean age = 19.83±0.90 years, mean height = 179.57±4.56 cm; mean weight = 80.74±7.42 kgs; female = 15; mean age = 20.13±1.20 years, mean height = 167.22±8.79 cm; mean weight = 64.81±7.97 kgs). Interventions: Independent variable of interest included arch stiffness values. Arch stiffness was calculated in the dominant foot by utilizing arch height index (a previously found valid and reliable measure, ICC values above 0.939 for intratester reliability and 0.811 for intertester reliability; above 0.844 validity), a measure of dorsal height normalized to foot length. Groups were defined using arch stiffness values separating participants into a rigid arch and supple arch group. Inclusion into the rigid arch group required a value ≥ 1,850 and the supple arch group value required an arch stiffness value ≤ 1,250. Main outcome measures: Dependent variables of interest included the Landing Error Scoring System (LESS) (a previously found reliable and valid measure; \( \kappa = .459–.875, \text{ICC} \ 2.1 = .835, P < .001 \)), degrees of tibial rotation, and rate of loading. Results: Independent t-tests were used to assess differences in tibial rotation, rate of loading, and LESS scores in differing arch stiffness groups. Statistical significance was found when comparing arch stiffness with rate of loading (rigid rate of loading mean=54.23±55.16, and supple rate of loading mean = 23.80±15.61, t= 1.864, p = 0.043). The rigid arch group had a significantly higher rate of loading than the supple arch group. Conclusion: Our results showed that there were significant differences among rigid and supple arch stiffness groups in rate of loading. No other significance was found. We suggest that having a rigid arch stiffness value may contribute to increased rate of loading, possible increasing potential force placed on the ACL. Word count: 435
Effect of an 8-Week Static and Dynamic Exercise Program on Older Adults in Reducing Fall Risk
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Context: Older adults in the United States have a high morbidity and mortality rate due to a high incidence of falls. Rising rate of falls and the subsequent injuries and medical costs are a growing public health problem that needs to be addressed. More preventable treatment options need to be provided to older adults to reduce the rate of falls and resulting injuries. Athletic Trainers whose traditional setting is working with athletes have transferable skills that they can use with this non-traditional population of older adults. Studies have assessed various exercise interventions to preserve proprioception, balance and increase strength in older adults. However, few studies have assessed the effects of static and dynamic balance exercises in older adults using a stable surface. Objective: To assess the effect of an 8-week static and dynamic balance-training fall prevention program on older adults in reducing risk of falls.

Design: A single group pre-post test study. Setting: This study was performed at two local community senior centers. Participants: 25 older adults (4 males, 21 females) with a mean age of 77.05 years, SD=6.74 years. Intervention: 15 minutes of static and dynamic balance exercises; standing bilaterally, standing tandem, calf raises, standing unilaterally, standing leg abduction, ball toss (standing bilaterally and unilaterally); 3 sets of 10 repetitions or 3 sets of 30 seconds and progressively increased repetitions, progression from exercises performed with eyes open (EO) to eyes closed (EC). Main Outcome Measures: Fall risk was measured using the Berg Balance Scale (BBS) containing 14 items each scored from 0-4 for a total score of 56. Total scores of 0-20=high fall risk, 21-40=medium fall risk and 41-56=low fall risk. Pre-test and post-test measurements were taken 1-week pre-intervention and again at 1-week post-intervention. Paired t-tests were conducted on BBS with statistical p-value set at less than .05. Results: Participants’ BBS (total) were significantly higher post-test (M=53.32, SD=2.824) compared to pre-test (M=50.04, SD=5.248), t(24)=−2.818, p=.010. Participants’ scored statistically higher for three of the fourteen items of the BBS post-intervention compared to baseline. Turning 360 degrees, pre-test (M=3.72, SD=.458), post-test (M=4.00, SD=.000), t(24)=−3.055, p=.005; Placing alternate foot on stool, pre-test (M=3.44, SD=.917), post-test (M=3.92 SD=.277), t(24)=−2.613, p=.015; Standing with one foot in front, pre-test (M=2.64, SD=1.186), post-test (M=3.36 SD=.952), t(24)=−2.979, p=.007. Conclusion: Fall prevention is an opportunity for athletic trainers to expand their professional role in the healthcare arena. The 8-week static and dynamic balance training fall prevention program was effective in reducing fall risk in older adults. Future research should be done focusing on strengthening the muscles about the hip to see if improvements in hip strength decrease fall risk in older adults after a static and dynamic balance training program. Word Count: 442
CONCUSSION HISTORY DOES NOT AFFECT DUAL-TASK GAIT

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Context: Impairments in postural control are a hallmark occurrence following concussion. A history of multiple concussions has been associated with numerous neurological impairments, but the relationship between concussion history and gait has been minimally examined. A recent investigation demonstrated that any history of previous concussion resulted in an altered gait strategy during a single-task protocol. However, the effect of a dual-task challenge has not been explored. Objective: To examine the effect of dual-task challenges on gait parameters in individuals with and without history of concussion. Design: Cross-sectional. Setting: Research laboratory. Patients or Other Participants: 26 NCAA Division I student-athletes: 13 with history of at least 1 or more concussions (Age: 19.7±1.1 years, Height: 69.0±4.8 cm, Weight: 79.0±24.4 kg, Concussion History: 1.3±0.6) and 13 with no self-reported concussion history (Age: 19.6±1.4 years, Height: 69.2±4.6 cm, Weight: 76.5±23.6 kg). Interventions: All participants were fitted with three wearable APDM accelerometers (1 on each foot, 1 around the lumbar region) and asked to perform 5 standard gait trials, while simultaneously completing cognitive mini-mental style tasks. A standard gait trial consisted of the participant traversing a 10m walkway, turning, and returning to the original position. Each participant was instructed to begin the cognitive challenge as soon as he or she started walking and continue until returning to the starting line. The order was randomized for each participant. Main Outcome Measures: The dependent variables included gait velocity, percentage of gait cycle spent in single support and step variability. Data were recorded from the APDM accelerometers and exported through the Mobility Lab and Mobility Clinic software. An independent sample t-test was used with an alpha level of p≤0.05. Results: There was no difference between the no concussion group and the concussion group for gait velocity (1.04±0.17 m/s and 1.09±0.15 m/s respectively, p=0.376), percentage of gait cycle spent in single support (31.95±1.54% and 30.75±3.01% respectively, p=0.415) or step variability (6.08±1.57 cm and 5.55±1.57 cm respectively, p=0.782). Conclusions: In this small, preliminary study, there appear to be no significant differences between dual-task gait parameters in student-athletes with and without history of concussion. It is possible the participants were relying on compensatory strategies to maintain gait stability. Future studies should examine individuals with a history of 3 or more concussions, which has demonstrated to be a risk factor in possible long-term impairment. Additionally, possible differences between the specific mini-mental cognitive tasks should be explored. Word Count: 394
Associations Between Ultrasound Muscle Thickness and Anthropometric Measures
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**Context:** Ultrasound imaging is a noninvasive way to assess muscle function by measuring muscle thickness, and changes in muscle thickness. These measures of the transversus abdominis (TrA) and lumbar multifidus (LM) have been used to identify dysfunction in low back pain individuals. However, factors exist that affect muscle thickness indicating that normalization methods should be utilized for accurate comparison across groups or individuals. **Objective:** To identify the association of resting muscle thickness measures of the TrA and LM muscles with anthropometric measures. **Design:** Cross-sectional study. **Setting:** Clinical laboratory. **Participants:** Fifty-eight participants (34 healthy, 24 history low back pain; 39 Female, 19 male; age: 23±8 years; height: 170.0±8.8cm; mass: 69.4±12.5kg; body mass index (BMI): 23.9±2.9 kg/m²). **Interventions:** Ultrasound imaging of the TrA and LM muscle during tabletop and standing measures. **Main Outcome Measures:** Resting muscle thickness of the TrA and LM muscles recorded at the end of normal respiration during tabletop and standing positions, and anthropometric measures including height, mass, BMI, hip circumference, waist circumference, waist-to-hip ratio and product of height and mass (heightxmass). Pearson’s r correlation coefficients were conducted to assess relationships in muscle thickness and anthropometric measures. Stepwise linear regression models were conducted to determine the amount of variance explained by each significant correlation. **Results:** Both tabletop and standing TrA resting muscle thickness were positively associated with height (Table: r=.440, P<.001, Stand: r=.410, P<.01), mass (Table: r=.671, P<.001, Stand: r=.673, P<.001), BMI (Table: r=.621, P<.001, Stand: r=.661, P<.001), Hip circumference (Table: r=.600, P<.001, Stand: r=.525, P<.001), waist circumference (Table: r=.639, P<.001, Stand: r=.571, P<.001), waist-to-hip ratio (Table: r=.361, P<.01, Stand: r=.334, P=.01), and heightxmass (Table: r=.643, P<.001, Stand: r=.637, P<.001). Resting tabletop LM muscle thickness was positively associated with height (r=.328, P=.01), mass (r=.434, P<.01), BMI (r=.363, P<.01), hip circumference (r=.296, P=.02), waist circumference (r=.369, P<.01), waist-to-hip ratio (r=.262, P=.05), and heightxmass (r=.425, P<.01). Standing LM resting thickness was only associated with height (r=.317, P=.02) and heightxmass (r=.262, P=.05). Mass was the single anthropometric measures that explain variance in resting LM table thickness (R²=.188, P<.01) and both resting TrA table and standing thickness (Table: R²=.450, P<.001, Stand: R²=.452, P<.001). Height was the only predictor that explained variance in standing LM thickness (R²=.101, P=.02). **Conclusions:** Resting TrA and LM muscle thickness is associated with a number of anthropometric measures. Body mass explained the most variance in resting tabletop LM thickness and both TrA table and standing measures, while height explained the most during standing LM measures. These two anthropometric measures may be appropriate normalization factors when comparing resting muscle thickness measures of clinical populations to healthy individuals. **Word Count:** 426
Emergency Medical Services’ Perceptions of the Roles and Responsibilities of Athletic Trainers on the Athletic Field.
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**Context:** Miscommunication between Athletic Trainers (ATs) and responding Emergency Medical Services (EMS) and can exacerbate life threatening situations endangering the lives of those being cared for. By gaining an understanding of what EMS’ perceptions are ATs will be well prepared and able to educate local EMS personnel - ultimately providing better care during emergency situations on the athletic field. **Objective:** To gain a better understanding of how EMS perceives the abilities of an AT and what they feel an AT can and cannot do on the field in an emergency situation. **Design:** Open Ended Survey **Setting:** Online **Patients or Other Participants:** One hundred fifteen participants. ATs were excluded. Training levels: EMR (n=2), EMT-Basic (n=28), EMT-Advanced (n=25), and EMT-Paramedic (n=60). Years of experience: 49% of respondents had over 20 years of experience, 34% had 10 – 20, 17% had 10 years or less. **Data Collection and Analysis:** An online survey system was utilized. The survey was divided into two sections; a demographic questionnaire and open-ended questions regarding EMS’ perceptions of ATs. Interview questions were designed in consultation with a qualitative research expert to ensure accuracy of questions, flow, and to eliminate potential bias. Peer review was done by 12-15 ATs, and was piloted twice by the same group of 10 EMS to ensure test-retest reliability. The general inductive approach was utilized for data analysis to uncover the most dominant themes from the data. In order for a theme to be established, 50% of the participants needed to fall within a code. Data credibility was maintained using multiple analyst triangulation and peer review. The response rate was 48.3%. **Results:** Of 238 surveys opened, 118 surveys were completed and 115 survey responses were analyzed after exclusion criteria. Emerging themes included: (1) EMS’ sound understanding of AT but lack of knowledge regarding the emergency care domain, (2) protocols are a guiding factor in how EMS responds to and handles situations on the field and (3) experiences with ATs guide trust of the profession. Responses concerning knowledge of AT included: fifty respondents (43%) had an accurate understanding of the profession, 36 respondents (31%) showed a general understanding, and 35% of respondents stated ATs only possess basic CPR training. Fifty percent reported positive interactions with ATs while 20% reported negative experiences. Overwhelming responses were received whereas EMS responded that once EMS is activated EMS protocols take precedence regardless of the AT’s training. **Conclusions:** ATs and EMS work closely in many instances, most importantly during an on field emergency. A better mutual understanding of both professions is warranted. Additionally, the creation of similar protocols may also enhance professionalism and communication between the two professions. **Word Count:** 440 words
Clinical Reasoning Abilities of Entry Level Athletic Training Students and Certified Post Professional Students Using the Diagnostic Thinking in Athletic Training Inventory: Does Educational Program Matter?


**Context:** Clinical reasoning (CR) is an aspect of medical cognition recognized as essential for clinical problem solving, yet measuring it has been difficult because valid tools for assessing CR in various practitioners, especially ATs and students are scarce. The Diagnostic Thinking Inventory for Athletic Training (DTI-AT) measures CR abilities in athletic trainers but has not yet been tested in different populations of ATs to discern potential differences due to educational background, clinical experiences, or concept familiarity. **Objective:** To administer the DTI-AT to different levels of AT students in order to assess differences in clinical reasoning based on formal educational and experiential preparation mode (entry-level or post-professional). **Design:** Cross sectional. **Setting:** Senior students in CAATE accredited bachelor’s programs; last year master’s students in CAATE accredited entry-level programs, and last year students in post-professional master’s programs. Only undergraduate programs with current 3 year, >90% first time BOC pass rate were invited to be part of the undergraduate group. **Patients or Other Participants:** We invited directors of entry-level and post-professional AT education programs in the United States to invite their final year students to complete an online, 41-item Likert scale inventory of diagnostic thinking. Participation was voluntary, and was sought via program director invitation after random program selection and geographic representation. **Main Outcome Measures:** The DTI-AT produces 3 scores relative to clinical reasoning skills: Total diagnostic thinking (DT, max score = 246), structure of memory (SOM, max score = 120) and flexibility in thinking (FIT, max score = 126). The independent variable was group (entry-level vs. post-professional). Separate independent t-tests were used to assess group differences on the 3 DTI-AT scores. Alpha level was set a priori at p≤0.05. **Results:** 89 students (76 entry-level, 13 post-professional) completed the DTI-AT inventory. Post-professional students scored significantly higher on overall DT (post-professional: 187.2±15.2, entry-level: 179.0±13.7, p=0.05) and FIT (post-professional: 95.0±7.8, entry-level: 87.7±8.2, p<0.01), but not on SOM (post-professional: 92.2±8.4, entry-level: 91.2±8.3, p=0.73). **Conclusions:** Both SOM (organized, linked and experiential case knowledge) and FIT (ability to problem solve using different strategies) are strong indicators of higher-level clinical reasoning and hallmarks of more expert clinicians. Of the 2 subscales, FIT is more dependent upon clinical exposure and experience, particularly as they regard independent problem solving and reflection, while SOM is more dependent upon how knowledge is learned, organized and made meaningful. Given their increased clinical experiences, our certified post professional students showed higher overall levels of DT and higher FIT than did entry level students, yet almost identical SOM scores as their younger counterparts; indicating that independent and more intensive clinical exposures may be more important for developing DT & FIT, and that educational content and delivery may be similar amongst the different programs. **Word Count:** 448
Examination of the Relationship between Passive and Dynamic Measures of Lower Extremity Stability in Division III Athletes

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Context: Within the body of literature surrounding the measurement of “dynamic” and “passive” joint stability, little research exists which compare the two as to their usefulness in screening and injury prevention. Independently, both have been demonstrated to be useful in the assessment of pre-injury risk identification, but research on their relationship to one another and their effectiveness as standardized assessment tools performed during pre-participation examination (PPE) of Division III athletes is limited. Objective: Passive joint stability is generally evaluated during the orthopedic screening portion of the PPE. Clinical tests are utilized to examine ligamentous laxity and make determinations of “passive” joint stability. A functional movement screen (FMS) assesses an individual’s functional and dynamic capacity to perform systematic movement patterns. The FMS performed at the PPE creates a functional movement baseline, allowing for the observational ranking of an individual’s capacity and stability during dynamic movement. Therefore, the purpose of this study was to examine the relationship of traditional “passive” measure of joint stability with “dynamic” measures of stability with movements involving the lower extremities (LE) in Division III student-athletes. Design: Retrospective cohort-study. Setting: All data was collected in a University clinical setting following the annual, routine, pre-season assessment processes for athletics participation. Patients or other participants: De-identified data was collected retrospectively from chart review. Data collection and analysis: 308 student-athletes completed the PPE, and the evaluation data included in this review. Results of LE joint mobility assessments and special tests for ligamentous laxity were recorded. Scores for individual 3 LE movement screening patterns (Deep Squat, Hurdle Step, In-Line Lunge) performed during FMS were recorded, and a total score calculated. Pearson correlation coefficients were calculated, and nominal regression analysis utilized to examine the strength of relationship between variables, and to determine the ability of passive measures of LE joint stability to predict dynamic stability during LE movement patterns. Results: Significant relationships were found between performance during both a Deep Squat pattern and In-Line lunge and passive measures of medial-lateral knee stability (Valgus stress p<0.018 and patellar apprehension p<0.010). A significant relationship was also found between passive measures of anterior knee stability with a Lachman’s Test and dynamic performance during a Hurdle Step movement pattern (p<0.030). Conclusions: There appears to be a significant relationship between passive measures of anterior-posterior and medial-lateral stability of the knee, and ability to perform certain LE-biased movement patterns during an FMS screen. Future research should be focused on the improved utility of FMS screening and the utilization of “dynamic” stability measures during PPE processes. Word Count: 416
The Impact of a Competitive Lacrosse Season on BESS Scores in Athletes Who Did Not Reportedly Sustain a Concussion

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Context: Concussions can disrupt the integrity of the vestibular system, and dysfunction within the vestibular system is the proposed etiology for balance deficits associated with a concussion injury. Balance disturbances are self-reported in approximately 30% of concussion cases, and balance deficiencies can last for up to 30 days after initial injury. Evaluation of sub-concussive impacts on neurological function is currently in its infancy, but it is theorized that cumulative sub-concussive impacts will result in neurological deficits including balance. Objective: To determine the effect of a competitive men’s lacrosse season on BESS scores, and to determine if a change in scores correlated to head impact data received from accelerometers placed within the players’ helmets. Design: Prospective Longitudinal Study Setting: Athletic Training Room Participants: 34 Division I Men’s Lacrosse players (age = 19.59 ± 1.42 years) Interventions: Competitive men’s lacrosse season Main Outcome Measures: Subjects performed pre and post-season BESS tests, and score differentials were correlated to their head impact data (average linear acceleration, HIC, GSI scores, and total number of head impacts for the season) received from the accelerometers. Results: There was not a significant correlation found between BESS scores and head impact data. The number of errors from pre to post season increased during the double leg stance on foam (p < .001), tandem stance on foam (p = .009), total number of errors on a firm surface (p = .042), and total number of errors on a foam surface (p = .007). Errors committed during the double leg stance on foam: pre = .029, SD = ± .171; post = .559, SD = ± .86. Errors committed during the tandem stance on foam: pre = .029, SD = ± .171; post = .559, SD = ± .86. Total number of errors committed on a firm surface: pre = 3.6, SD = ± 2.5; post = 4.69, SD = ± 2.5. Total number of errors committed on the foam surface: pre = 9.4, SD = 2.68; post = 11.46, SD = ± 3.99. Conclusion: There does not appear to be a correlation between head impact data collected over the course of 1 season (total number of head impacts, average linear acceleration/impact, average HIC score/impact, and average GSI score/impact) and the change in BESS scores observed from pre to post-season. The BESS test may not be sensitive enough to detect balance deficits associated with cumulative sub-concussive impacts. However, the significant increase in the number of errors committed from pre to post season gives support to the recommendation for frequent assessment of baseline levels. Word Count: 423
A Helmet-Less Tackling Training Intervention to Decrease Head Impacts in American Football
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Context: In an attempt to reduce acute and chronic brain injury risk in American football, researchers and stakeholders have sought improvements in helmet technology, limiting the number of contact practices, and altering game rules. However, these do not directly address the fundamental cause of injury; impacts to the head. In addition, the concept of risk compensation suggests that wearing a helmet contributes to the behavior of engaging the head in tackling and blocking. Objective: To study the effectiveness of a novel helmetless-tackling intervention to reduce head impact exposure in college football players. Design: Prospective, randomized controlled investigation. Setting: NCAA FBS Division I collegiate football. Participants: Fifty subjects with at least two years eligibility were stratified by position (offense, defense) and randomized equally (n=25) to treatment or control groups. Interventions: The treatment consisted of Helmetless Tackling Training (HuTT™) drills performed twice per week during the pre-season (3 weeks) and once per week throughout the competitive season (16 weeks). Drills involved executing tackling techniques against an upright pad or padded shield held by a teammate at 50-75% effort without helmets and shoulder pads. The control group underwent non-contact football skills at the same frequency and duration. Both treatment and control activities were supervised by the football coaching staff following standardized instruction. Subjects were assigned an xPatch™ impact sensor which was worn to record head impacts sustained during each practice and game. Subject attendance was recorded for all team activities associated with risk exposure. Main Outcome Measures: Frequency of all impacts ≥10g threshold of linear acceleration were filtered and exported into spreadsheet format. Frequency of head impacts per athlete exposure (AE) were compared between groups at three time-points (pre, mid, and end of season) using repeated measures analysis of variance (ANOVA). Significant interactions and main effects ($P<.05$) were followed with dependent and independent t-tests. Results: The HuTT™ intervention resulted in a 28% reduction in head impact frequency/AE (13.84±7.27 versus 9.99±6.10) at the end of the season, while the control group frequency remained the same ($P=.009$). By the end of the season, the intervention group experienced an average of 30% fewer impacts/AE (9.99±6.10 versus 14.32±8.45) compared to the control group ($P=.045$). Conclusions: While a helmet is necessary during full contact practices and games, it also imparts a false sense of security that enables impacts to the head. These data suggest that practicing tackling and blocking under a controlled, supervised environment improved tackling behavior by reducing head impact frequency in collegiate football players after one season. Future research is necessary to determine the effect with football participants on other levels of play (youth, high school). Funding: NATA Research and Education Foundation. Word Count: 437.
Dynamics of Athletic Training Students Grouped by Personality Type for a Class Presentation
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**Context:** Purposefully grouping students based on personality type for a class presentation may hold pedagogical implications for teaching. The dynamics of student work groups may differ when students are grouped homogeneously versus heterogeneously based on personality type. Specific dominant personality attributes within a group may affect group dynamics. **Objective:** To evaluate group dynamics of athletic training students (ATSs) grouped homogeneously and heterogeneously based on personality type for a class presentation. Also to evaluate the influence of dominant personality characteristics on group dynamics. **Design:** Quasi-experimental with repeated measures. **Setting:** Classroom and college campus. **Participants:** 12 second-year ATS from a CAATE accredited pre-professional athletic training program enrolled in ATRN 200 and ATRN 202 for fall 2014 and spring 2015 semesters, respectively. **Interventions:** Participants took part in a True Colors Personal Success Seminar facilitated by the researcher. Participants completed the True Colors Word Sort to determine a personality profile. Participants were grouped homogeneously by personality type into four groups of three as part of ATRN 200 during the fall semester. The same twelve participants were re-grouped into four heterogeneous groups of three for ATRN 202 during the spring semester. For both ATRN 200 and ATRN 202, student groups were assigned the group task of delivering a 50-minute interactive presentation on pre-assigned human anatomy related content. **Data Collection & Analysis:** A qualitative approach was utilized to best understand how grouping students according to personality type affected group dynamics. Qualitative data were collected through questionnaire responses, field observations, and video analysis. A triangulation design was used to analyze data. Homogeneous and heterogeneous groups were analyzed separately using open and axial coding to determine emerging themes and categories. Comparative analysis was then performed using selective coding to evaluate patterns and differences. **Results:** Heterogeneous groups were identified to display more effective group dynamics overall than homogeneous groups. Primary elements conducive to effective group dynamics were identified for homogeneous groups (collaboration and independent work balance, communication, and leadership) and heterogeneous groups (collaboration and independent work balance, communication, leadership, and cooperation). Dominant personality attributes were found to influence group dynamics. **Conclusion:** Implications include the use of personality type theory as a pedagogical tool in higher education and athletic training education. **Word Count:** 388.
A Comparison of Static and Dynamic Stretching on Functional Performance  
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**Context:** Static and dynamic stretching techniques are commonly employed prior to activity in order to improve functional performance in athletes. Although research exists examining the effect of stretching on injury prevention and muscle strength, little research is available comparing various stretching interventions on functional performance using agility tests. **Objective:** The objective of this study was to compare the effects of no stretching (NS), static stretching (SS) and dynamic stretching (DS) on functional performance, as measured using the T-Drill Agility Test, in healthy subjects. **Design:** The study was a randomized controlled trial with subjects acting as their own control. **Setting:** The study was conducted in a University research laboratory. **Patients or Other Participants:** Subjects consisted of 27 healthy, college-aged, student volunteers (21 female, age=19.67 +/- 1.07 years). Subjects were required to be free of lower extremity pathology at the time of participation. **Interventions:** Each subject attended three data collection sessions involving warm-up on a stationary cycle, a pre-test stretching intervention and a timed agility test. Subjects underwent three different, randomly assigned stretching interventions (NS, SS or DS) prior to completion of two T-Drill Agility Tests, with the best time of the two trials being recorded. The T-Drill Agility Test requires subjects to sprint forward ten meters, laterally shuffle 5 meters to the left, laterally shuffle ten meters to the right, laterally shuffle five meters to the left and back-pedal ten meters to the start/finish line. This agility test simulates the functional requirements of many sports. **Main Outcome Measures:** The main outcome measure of this study was time to complete the T-Drill Agility Test following each of the three treatment interventions. Data was analyzed using T-Tests and ANOVA testing to examine differences between groups. **Results:** The average time to complete the T-Test Agility Drill following static stretching was 13.92 seconds, following dynamic stretching was 14.38 seconds and in the absence of stretching was 14.07. Comparison of the groups found a statistically significant difference between the performance of the static stretching and dynamic stretching groups (p<0.05). No other statistical differences were found between the groups. **Conclusions:** The findings of this study demonstrate the value of pre-activity static stretching in order to improve performance. These results do not support the use of dynamic stretching prior to physical activity in order to improve athlete performance. The findings of this study suggest that static stretching is superior to dynamic stretching as a warm-up to agility activity. Furthermore, the findings indicate that dynamic stretching is no better than no stretching prior to agility activity. The findings of this study conflict those of previous research investigating the effect of various stretching protocols on athletic performance. Due to numerous limitations associated with this study, additional research is needed. **Word Count:** 450