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Sports Review Journal, NFP is produced and edited by Fellowship Trained Sports Medicine Physicians. The reviews and summaries included in the publication are intended solely for the education of medical professionals as assistance in reviewing the large volume of literature that exists in the sports medicine field. The summaries are not to be used as the basis of clinical diagnosis, management, side effects, or complications, and are not a substitute for analyzing the original research. Reviews may include subjective components, and are not entirely objective, thus, it remains noteworthy to refer to the original research in the journal cited. All journal reviews and summaries include citation to the journal with the original research. Publication and funding is provided by the publisher himself. No profits or money are collected.
In This Issue

Thomas Best Biography 6
Tracy Ray Biography 7
John Cianca Biography 8
Glenn Fleisig Biography 9
Andrew Gregory Biography 10
Britt Marcussen Biography 11

Shoes or no shoes? A comparison of type and frequency of running injuries between shod and barefoot runners 12

Does cervicovestibular rehabilitation improve outcomes in sport-related concussions? 14

The architecture of the long head of the biceps femoris after injury 16

Prevalence of UCL surgery among major league and minor league baseball players 18

Review of plica as a source of knee pain in adolescents and young adults 20

Low vitamin D levels and stress fracture: A systematic review and meta-analysis 22
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Due to the overwhelming presence of cancer in the community, I would like to raise awareness each issue for a different cancer. As the month of December represents “Hope,” we honor and raise awareness for all cancers that impact our community.
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Dr. Best is the Pomerene Endowed Chair of Primary Care and Vice Chair of Academic Affairs in the Department of Family Medicine at the Ohio State University. He holds joint appointments in the College of Engineering and the School of Allied Health Medical Professions. His research on muscle inflammation and repair has been NIH-funded for 15 consecutive years and has resulted in over 100 peer-reviewed publications. He is co-editor of the book ‘Evidence-Based Sports Medicine’, now in its 2nd edition. Other research areas include; effects of the quadriceps on knee osteoarthritis, benefits of core training on injury prevention, and cytokines and low back pain. Dr. Best has presented over 200 lectures, including invited presentations to 9 international countries. He is past recipient of several honors for his research including the Kappa Delta and the Arnold Siegal Stapp research awards. He has been involved with the training of 15 Sports Medicine Fellows and 7 PhD students, along with over 20 Master’s students.

An active member in the American College of Sports Medicine (ACSM) for 21 years, Dr. Best is a fellow and the 2010-2011 President of ACSM. He is the Associate Editor-in-Chief of Medicine and Science in Sports and Exercise as well as an Associate Editor of Current Sports Medicine Reports. Recently he was re-elected to a three-year term on the Board of Directors for the United States Bone and Joint Initiative. He also serves on the Board of Directors for the National Youth Sport and Safety Institute as well as the Advisory Board for the National Space Biomedical Research Institute. Dr. Best has served as a team physician at the high school, college, and professional athlete levels.
Tracy R. Ray, MD is an Associate Professor in the Department of Orthopedic Surgery and in the Department of Family Medicine at Duke University. He directs the Primary Care Sports Medicine Fellowship Program. He serves as a Team Physician with Duke Athletics and supervises the outreach program to multiple local high schools. He currently serves on the Board of Trustees for the American College of Sports Medicine and is a former member of the Board of Directors for the American Medical Society of Sports Medicine. He is board certified in Family Medicine and holds a Certificate of Added Qualification in Sports Medicine. He is a graduate of the Medical College of Georgia and completed his Family Medicine at the College of Community Health at the University of Alabama in Tuscaloosa, AL. He completed his medical training with a fellowship in Sports Medicine at the Cleveland Clinic in Cleveland, OH.
Expert Author

John Cianca, MD

Dr. Cianca is in private practice in Houston, Texas. He is founder of the Human Performance Center, established in 1994. He treats musculoskeletal disorders in all age groups. His practice is based on sports medicine treatment principles. He utilizes traditional western medicine as well as acupuncture in his treatments. Musculoskeletal ultrasound, biomechanics, and running medicine are his primary clinical interests. He has developed and maintained a cash practice since 2004 which allows him to treat patients with sufficient time and energy to maximize his clinical effectiveness and his devotion to teaching his patients how to enable their own recovery.

Dr. Cianca completed a fellowship in sports and performing arts medicine at the The Institute for Rehabilitation and Research (TIRR) in 1992-93. He served as fulltime faculty at the Baylor College of Medicine for 11 years. During this time he was director of the sports medicine fellowship. He trained numerous fellows from several countries. He continues to teach residents and fellows as a clinical associate professor of PM&R for the Baylor College of Medicine / University of Texas PM&R Alliance.

He has been the medical director of the Houston Marathon since 1998. He also served on the board of directors for the Houston Marathon Committee for several years. Participant safety and public safety in mass participation events has become an integral part of his work as a medical director. He is one of the founding members and a past president of the American Road Race Medical Society, now the International Institute of Road Race Medicine (IRRM). Educating other medical directors, race directors and runners in general has been his passion and is the mission of IRRM.

Dr. Cianca has directed numerous courses and presented numerous lectures locally and nationally. He has been involved in the AAPMR for many years in a variety of roles. He was the program co chairman of the 2004 PASSOR annual meeting. He served on the 2002 Study guide committee, and as the PASSOR liaison to the AAPM&R Practice guidelines committee. Currently he serves as on the Medical Education Committee and the MSK US Task Force. He reorganized and developed the curriculum of the practice track of the 2015 AAPMR Annual Assembly in Boston, MA. He has been the Course director for the MSK US precourse at the annual assembly of the AAPM&R from 2010 - 2014. He has been on the faculty of numerous other MSK US courses for the AAPM&R and other organizations. He has authored numerous abstracts, articles and book chapters.
Glenn S. Fleisig, Ph.D., is the Research Director of the American Sports Medicine Institute (ASMI). Much of ASMI's research under Dr. Fleisig has focused on throwing injury prevention and treatment. Dr. Fleisig is the recognized leader in baseball pitching biomechanics, identifying mechanics for minimizing elbow and shoulder loads while maximizing ball velocity. He has also published biomechanical studies on the softball pitch, football pass, volleyball spike, volleyball serve, baseball swing, and golf swing. Dr. Fleisig has analyzed thousands of baseball pitchers, from youth leagues to Major Leagues, providing individualized recommendations for safety and performance.

Dr. Fleisig also has numerous publications in sports medicine epidemiology and clinical outcomes. Much of the epidemiologic work has focused on elbow and shoulder injuries in baseball pitchers. His clinical studies have shown the efficacy of surgical treatments, such as return to play after ACL reconstruction or UCL reconstruction. To date, Dr. Fleisig has authored more than 140 scientific articles, book chapters, and books in sports medicine.

In addition to his work at ASMI, Dr. Fleisig currently serves as chair of the USA Baseball Medical & Safety Advisory Committee, injury research advisor for Major League Baseball, safety consultant for Little League Baseball, and adjunct faculty at UAB. He is a member of Major League Baseball's elbow task force, National Pitching Association's board of advisors, and MomsTEAM's board of advisors. Dr. Fleisig is working with Motus Global in the development of consumer technologies for measuring and monitoring an athlete's biomechanics.

Dr. Fleisig’s career in sports medicine began as an undergraduate mechanical engineering student at the Massachusetts Institute of Technology, where he conducted research on the biomechanics of the golf swing. Upon graduation, he served as a research intern at the United States Olympic Training Center in 1984. The USOC afforded Fleisig the opportunity to participate in the development of biomechanical software and testing, as well as to meet Dr. James Andrews. In 1987, while pursuing his master's degree from Washington University in St. Louis, Fleisig was offered the opportunity to head up research at Dr. Andrews' new institute, ASMI. Dr. Fleisig completed his education with a Ph.D. in biomedical engineering at the University of Alabama at Birmingham.
Andrew Gregory, MD

Dr. Gregory completed his undergraduate training in Chemistry at Indiana University and his medical training at the University of Alabama School of Medicine. He then finished a pediatric residency at the University of Alabama in Birmingham before his fellowship in Primary Care Sports Medicine at the American Sports Medicine Institute. He joined the Vanderbilt Faculty in August 2001 where he sees young sports medicine patients in the Vanderbilt Sports Medicine Center and the Pediatric Orthopedic Clinic at Vanderbilt Children’s Hospital. He currently serves as an associate professor for Orthopedics, Pediatrics, & Neurosurgery at the Vanderbilt University School of Medicine. He also serves as the Program Director for the Vanderbilt Pediatric Sports Medicine Fellowship. He is also the Co-Director of the Vanderbilt Sports Concussion Center. Lastly, he is a Team Physician for USA Volleyball, Nashville Sounds, Vanderbilt & Belmont Universities, along with Nashville Christian High School.
Britt Marcussen, MD is a Clinical Assistant Professor of Family Medicine at the University of Iowa College of Medicine. He received his Masters and Medical Degrees from the University of Iowa. He did his residency in Family Medicine at St Francis-Mayo in La Crosse Wisconsin before returning to the University of Iowa where he completed his fellowship in Sports Medicine. He is currently a faculty in the Department of Family Medicine and Program Director of the Sports Medicine Fellowship. He serves as team physician at the University of Iowa and for the USA Ski and Snowboard Association.
Shoes or no shoes? A comparison of type and frequency of running injuries between shod and barefoot runners

Nicole Kornder\textsuperscript{a,b,d}, Thomas Best\textsuperscript{a,c}

\textbf{Level of Evidence:} Prospective Cohort Study

\textbf{Introduction:} Attracting attention and slowly gaining momentum, barefoot running has peaked curiosity amongst the running world and steadily increased its shoeless following. Injuries remain relatively common in shod runners so one of the proposed benefits of barefoot running has been decreased injuries secondary to differences in foot strike, impact and force patterns, shorter stride, higher cadence, and increase sensory proprioception. However, absence of cushioning, support, and plantar protection would theoretically increase certain injuries in the barefoot runner. The purpose of this study was to compare the incidence, rate of injuries, and types of injuries between barefoot and shod runners.

\textbf{Methods:} A year long prospective web-based survey was conducted among 201 American and international runners, of which 107 were barefoot and 94 were shod. Participants were between 18-50 years old, running more than 10 miles per week, and had at least 6 months of current running prior to entry. Barefoot runners were also required to run at least 50% of their yearly mileage completely barefoot with the remaining mileage in minimalistic shoes. Monthly surveys collected monthly mileage, any running related injury, location of the injury, diagnosis of the injury, and whether the injury was diagnosed by a clinician. Relative proportion of injuries was compared between groups with \( \chi^2 \) analysis. Injuries per person and injury rate were compared with an independent \( t \) test.

\textbf{Results:} There were 346 running related injuries of which 164 were in shod runners and 182 in barefoot. Of these, MSK injuries were 281 of the 346 (156 shod and 125 barefoot) with 48% clinically diagnosed. The foot was the most commonly injured body part in both groups (43% shod, 41% barefoot). There was no statistically significant difference between relative number of runners reporting MSK injury between groups. There were fewer (\( p=0.05 \)) MSK injuries per barefoot runner compared to shod (1.17 barefoot, 1.66 shod). However, when normalized for mileage, there was no statistically significant difference in injury rates for the two groups. With regards to clinician diagnosed specific injury location, shod runners had more hip and knee injuries while barefoot runners had more lower leg injuries. Plantar injuries such as cuts, blisters, and bruises were sustained by 30% of barefoot runners but only 6% of shod runners.

\textsuperscript{a}Nicole Kornder, MD and Thomas Best, MD, PhD reviewing Altman AR et al. Prospective comparison of running injuries between shod and barefoot runners. Br J Sports Med. 2015 Jun 30.
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Strengths: The authors were able to get a diverse group of shod and barefoot American and international runners. They maintained acceptable compliance of 84% with email and telephone reminders to participants. With this compliance level, the number of study participants was just enough to reach the number needed for adequate power to calculate differences in combined MSK injuries between groups. Body part distribution of injuries was an interesting comparison between groups although the study was not powered to give statistical significance.

Weaknesses: Study groups were not similar, and there were multiple statistically significant differences between self-reported characteristics of the barefoot and shod runners. The barefoot running group was older (p=0.001) by four years, more male dominated (p=0.000), taller (p=0.010) by 1.1 inches, heavier (p=0.000) by 15.6 lbs, running less miles per week (p=0.000) by 13.5 miles, and running slower paces (p=0.000) by a difference of 3 min 34 sec in their 5 km times. Injury severity (e.g. time loss from running) may have provided additional insights as to the difference between barefoot and shod runners. Finally, 63% of the barefoot runners had only begun running barefoot in the preceding 6-12 months.

Conclusion: While anthropometric and performance differences between the study groups limits the conclusiveness of the results, the study suggests fewer overall MSK injuries in barefoot runners compared to shod runners. However, this difference disappears when mileage is taken into consideration. Preliminary data also suggest that incidence and type of injury appear to be different but the study was not powered to assess these potential differences.

Practice Pearl: Possibly due to a recent transition to barefoot running or the experience itself, the barefoot running group in this study ran less mileage and at a slower pace compared to shod runners. While fewer overall injuries occurred in barefoot runners compared to shod runners, this difference may be related to differences in the runners’ mileage as well as pace. Nevertheless, a larger cohort with control of confounding variables such as mileage/week and running pace seems an important next step.

References:
Does cervicovestibular rehabilitation improve outcomes in sport-related concussions?

Tracy Raya,b,c,d, Bradford Mitchella,b

Level of Evidence: Randomized Controlled Trial

Introduction: The treatment of concussive and postconcussive symptoms is an area of growing interest and research. Schneider et al. performed a moderate to high quality randomized controlled trial to evaluate the hypothesis that a combination of vestibular rehabilitation and cervical spine physical therapy decreases the time until medical clearance to return to play in patients with postconcussive dizziness, neck pain, and/or headaches.

Methods: The study consisted of 30 patients diagnosed with sport-related concussion with dizziness, neck pain, and/or headache lasting longer than 10 days. Exclusion criteria were other neurologic conditions or medications and certain distracting injuries. The 18 male and 13 female participants, ranging from 12-30 years of age, were randomly allocated to either the control or intervention group. Participants in both groups followed the current standard of care protocol of rest until symptom free followed by a gradual return to play protocol and received weekly cervical range of motion exercises, stretching, and postural education. In addition, the intervention group received cervical and thoracic spine manual therapy, joint mobilizations, cervical neuromotor retraining exercises, as well as vestibular rehabilitation (i.e. habituation, gaze stabilization, standing and dynamic balance exercises, etc.).

The primary outcome measure was the time from initiation of treatment until the date of medical clearance to return to sport. Clearance to return to sport was determined by a sports medicine physician who was blinded to the treatment group. Baseline measures and secondary outcome measures were recorded on standardized forms at baseline and at the time of medical clearance or 8 weeks following initial intake.

Results: The treatment and control groups were similar in their average age, time since injury, and symptomatology; all participants had cervical findings, though a higher percentage of participants in the control group had vestibular findings. The control group had a higher proportion of both females and participants with a previous concussion. Given the study size, the minimal difference in time to medical clearance that would be discernible with 80% power was 16 days.

All of the individuals who were medically cleared reported no symptoms of headache or
dizziness; 64% of patients who were medically cleared reported no neck pain. A much higher proportion (73.3%) of individuals in the treatment group were medically cleared to return to sport before eight weeks compared to 7.1% in the control group (p<0.001). Participants in the treatment group were 10.27 times more likely to be medically cleared by eight weeks (p<0.001).

**Strengths:** The study was a randomized controlled trial, and the treating physician was blinded to which group the participants were a part. Data was collected in a prospective manner, reducing recall bias. The findings were clinically relevant and statistically significant.

**Weaknesses:** Though the control and treatment groups were similar in most of their baseline characteristics, the control group had a higher proportion of females, higher proportion with prior concussion, and higher proportion with vestibular findings on exam. Also, the authors point out that an expectation bias may have occurred if patients perceived they may have been in the treatment group.

**Conclusion:** This well-designed, randomized controlled study of 30 participants between the ages of 12 and 30 who had persistent cervical, headache, and/or vestibular symptoms following a sports-related concussion found, with statistical significance, that a cervicovestibular rehabilitation regimen significantly improved time to clearance to return to play. However, it is unclear whether this is applicable for the acute treatment of concussion, concussion suffered outside sport, or in patients outside that age range. Future studies could be aimed at identifying the optimal timing for initiation of treatment.

**Practice Pearl:** In addition to the standard of care period of rest, cervicovestibular rehabilitation should be considered for patients with persistent headache, cervical, and/or vestibular symptoms following a sports-related concussion.

**References:**
The architecture of the long head of the biceps femoris after injury

Lindsay N Rameyn,b,d, John Ciancaa,c

Level of Evidence: Level 3

Introduction: Hamstring injuries are common in athletes and recur frequently. While reports show that previously-injured hamstring muscles have decreased strength and torque development, none have directly demonstrated a change in muscle architecture. Timmins et al. completed a level 3 case–control study comparing the muscle architecture and eccentric strength of the long head of the biceps femoris muscle in athletes with and without a history of muscle injury.

Methods: Thirty-six male athletes (20 uninjured recreational athletes and 16 elite athletes with prior unilateral biceps femoris injury) were included. Ultrasound architecture assessment included muscle thickness, pennation angle, and fascicle length at rest and at 25%, 50% and 75% maximal isometric contraction. Evaluation was repeated three times for control patients to assess test-retest reliability. Eccentric strength was tested using previously-validated Nordic hamstring exercises. ANOVA comparisons of within-subject variability (left/right in the control group and injured/uninjured in the previously-injured group) and between-subject variability (control/ previously-injured group) were performed.

Results: Fascicle length was significantly shorter, pennation angle was significantly greater and eccentric strength was significantly lower in the injured biceps femoris during within-subject analysis of the previously-injured group at all intensities. No significant difference was identified for within-subject comparison in the control group or during between-subject comparison. The ultrasound assessment technique was highly reliable.

Strengths: This is the first study to use ultrasound to evaluate the architecture of the biceps femoris muscle at rest and during isometric contraction in vivo with data to support the reliability of this technique. The architectural measurements were completed by clinicians blinded to patient history to prevent observer bias. The study is well-designed and well-executed. It gives way to many additional research opportunities with the potential for practice-changing outcomes.

Weaknesses: It is difficult for a reader to understand how the measurements for fascicle length, pennation angle and muscle thickness were made using ultrasound. A figure depicting this process, as has

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been used in other studies, would be helpful and allow for easier reproduction. There are no ultrasound images for the reader to visualize which is perhaps the biggest flaw of this study. Patients were not recruited randomly and details regarding recruitment were not discussed, permitting sampling bias. Only male, elite-level athletes were included in the previously injured group, raising the question of generalizability. Information comparing patient characteristics between groups was lacking. The authors acknowledged a difference in athleticism between groups but suggest the groups are homogenous as no difference was found between the control group and the uninjured leg of the previously-injured group. However, there may be other unrecognized heterogeneity between groups confounding these results. Only 36 subjects were included. More subjects would further support the results. Limited details on the rehabilitation protocol were provided. The management of the injured athlete was done independent of the study, so the authors cannot assure similar or appropriate rehabilitation protocols were followed.

Conclusion: Despite these weaknesses, the authors’ conclusions appear appropriate based on the data presented. The study was well-designed to address their unique research question without assuming a causal relationship. We agree that the data collected supports the conclusions of this study.

Practice Pearl: Ultrasound is a reliable way to assess the architecture of the long head of the biceps femoris at rest and during isometric contraction, and it can be repeated with confidence by a skilled clinician. In addition, a previously-injured long head of the biceps femoris muscle has shorter fascicle length, increased pennation angle and decreased eccentric strength in comparison to the uninjured leg of a male athlete following healing and return to play. While this information has not led to a practice change yet, earlier and more aggressive eccentric exercises may minimize these changes, with the potential for decreased recurrence. Further research exploring this issue is needed.

References:
Prevalence of UCL surgery among major league and minor league baseball players

Connor R. Read\textsuperscript{a}, Glenn S. Fleisig\textsuperscript{a,b,c}

Level of Evidence: 2c descriptive epidemiology study

Introduction: Elbow injuries represent approximately 20% of all professional baseball injuries. In an effort to provide enhanced medical understanding to improve the care of high-performance athletes, it is imperative the prevalence of specific injuries be quantified and risk factors be identified. Conte et al. recognized the impact of such knowledge, and completed a study documenting the prevalence of UCL surgery among professional baseball players, particularly pitchers.

Methods: Data were collected by an online questionnaire that contained 8 to 26 questions. The number of questions was based on the player’s history of UCL surgery: no surgery (8 questions), 1 UCL surgery (20 questions), or multiple UCL surgeries (26 questions). The questionnaire was available in a choice of two languages (English or Spanish) based on player preference and was administered by certified athletic trainers from each team. The questionnaire was administered to all minor league and major league players from all 30 MLB organizations.

Demographic data were then compiled and statistical analysis performed on continuous variables (age, years of play, etc).

Results: Responses were received from 5088 professional players (722 major league; 4366 minor league). The total response rate was 89%.

The prevalence of history of UCL surgery was much higher in pitchers (16%) than in non-pitchers (3%). Moreover, there was a higher prevalence in major league pitchers (25%) than minor league pitchers (15%), correlating to more years of professional experience with the major league group. It was also noted that major league pitchers were more likely to suffer UCL injury during professional play and at an older age when compared to minor league pitchers who are more likely to suffer UCL injury during high school or college. There was found to be no association between nationality or throwing hand (left vs. right-handed) and prevalence of UCL surgery.

Strengths: An obvious strength to this study is the large sample size of 5088 professional baseball players, and a strong response rate of 89%.

This study was the first to document the actual prevalence of UCL surgery in professional baseball. Previously, no baseline existed and controversy surrounded the ostensible increase in UCL injury.


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However, in the coming years new data can be compared to the work of Conte, et al in order to accurately assess changes in prevalence of UCL surgery.

The work of Conte, et al. was also significant for identifying statistically significant populations that are more vulnerable to UCL injury, adding to the medical understanding of UCL prevalence and helping advance the care of athletes.  

**Weaknesses:** One limitation is the study was a self-reported questionnaire available in only two languages. However, the certified athletic trainer helping to administer the questionnaire helped eliminate misunderstanding. Another limitation is the study only documented prevalence, not incidence. In other words, athletes who had undergone UCL surgery and did not return to play were not documented.

**Conclusion:** The prevalence of UCL surgery among professional baseball pitchers (16%) is significantly higher than among non-pitchers (3%). Interestingly, the prevalence of UCL surgery increases further among major league pitchers (25%) when compared to minor league pitchers (15%); this increase is associated with a higher number of years of pitching for the major league group.

**Practice Pearl:** Coaches, players, athletic trainers, and medical staff should be more cautious of UCL injury in professional pitchers, especially major league pitchers with many years of experience in professional play. Results from this study can serve as a baseline for determining future prevalence of UCL surgery.

**References:**

Review of plica as a source of knee pain in adolescents and young adults

Kelly Chain\textsuperscript{a,b,c}, Andrew Gregory\textsuperscript{a,b}

Level of Evidence: IV (case series)

Introduction: A retrospective study using chart review to identify patients who underwent an arthroscopic surgery for isolated plica resection. The aim of this study was to perform a chart review and collect follow up data to determine the relationship of arthroscopic plica resection and relief of anterior knee pain.

Methods: Between January 1997 and July 2002 surgical charts were reviewed for a diagnostic code of release of plica or simple debridement. Patients who presented with knee pain and underwent arthroscopic treatment for an isolated infrapatellar plica resection without any other diagnosed pathology were included in the study. Charts of selected patients were reviewed and each patient underwent a telephone interview with a standardized set of questions. Outcomes were measured on two scales, the clinical grading scale and the 2002 KOOS subjective knee evaluation form.

Results: Twelve patients with 13 knees were included in the study. One patient was lost to follow up. Of the remaining 11 patients (8 female, 3 male) the mean age was 24.4 (13-44 years old) at time of surgery. Mean follow up was 39 months. All patients had the primary complaint of knee pain. Seven of twelve had an injury prior to the onset of pain. Eight were diagnosed with a torn or partially torn infrapatellar plica. Four had a plica that was inflamed, thickened, or fibrotic and had impingement with knee extension and tethering with knee flexion. 92% of the patients had “excellent” or “good” results on the subjective knee clinical grading scale and only one patient reported a “poor” score. The mean KOOS scores were 97 for pain, 96 for symptoms, 99 for activities of daily living, 99 for sports activity, and 87 on quality of life. None of the patients were worse at time of follow up compared with preoperatively.

Strengths: The study sheds light on a cause of anterior knee pain that is not often recognized. The study isolates the plica as the source of the patient’s pain and does a good job eliminating other cofounders of knee pain such as meniscal tears. There is good information provided in the chart review of these patients describing their pain and mechanism of injury. The study has good post surgical follow up (91%) and all patients were at least 16 months postoperative prior to the phone interview.

Weaknesses: This is a retrospective study, with a relatively small sample size and no comparison

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group. The small sample size limits the statistical power of the study, and thus the ability to detect a true difference. There is also a selection bias. The patients are not from a random sample. All patients were chosen from one physician’s practice. The lack of a random sample of patients limits the generalizability of the data. Data collected was in the form of pain questionnaires and comparison of preoperative and postoperative activity levels. Pain is a difficult outcome to measure given that individuals experience pain differently. When comparing pre and postoperative abilities, the questionnaire format is also susceptible to recall bias and does not take into account the baseline activity of the patient prior to the onset of knee pain. The non-operative interventions the patient underwent prior to surgery are not standardized nor described.

**Conclusion:** Arthroscopic surgery to relieve knee pain secondary to a torn or inflamed plica is a reasonable intervention for patients that are not improving with non-operative therapy. This study is a small retrospective study, but is the highest level of evidence currently available. A randomized control trial comparing arthroscopic plica debridement versus less invasive treatment options, such as physical therapy, anti-inflammatories, or corticosteroid injections and their outcomes needs to be done to expand our knowledge and ability to recommend an appropriate therapy to our patients.

**Practice Pearl:** Based on this study I would consider knee plica in the differential for anterior knee pain and would still treat athletes with knee pain secondary to a plica with conservative measures first. If the athlete was not responsive to less invasive treatments, surgery could be considered as a method to provide pain relief.

**References:**

Level of Evidence: Meta-Analysis and Systematic Review

Introduction: Vitamin D is a group of fat-soluble compounds that play an important role in bone metabolism. Low vitamin D levels are associated with many systemic diseases including cancer, metabolic disorders, impaired immune function, and cardiovascular diseases (2). The mechanism by which vitamin D effects bone health is well understood. The interaction of 1,25(OH)D with vitamin D receptors increases intestinal absorption of calcium and phosphorus, which promote bone mineralization. Low vitamin D levels lead to increased osteoclast activation which dissolves the mineralized collagen matrix in bone putting the individual at risk for fractures. Athletes have been shown to be at risk for vitamin D deficiency. Thus, there is considerable interest in investigating vitamin D deficiency and bone health in athletes. In this population, stress fractures are common and a significant source of lost playing time. This paper is one of the few published meta-analysis of vitamin D levels in an active athletic population known to be at risk for stress fractures (military recruits).

Methods: Under the guidance of an experienced medical librarian, a comprehensive search of multiple electronic databases was performed. Two reviewers then independently applied the eligibility criteria. The same 2 reviewers also independently assessed the methodological quality of the included studies using the Methodological Index for Non-Randomized Studies.

Results: A total of 400 studies were identified. Nine met the eligibility criteria. Six were prospective cohorts and 2 were nested case controls. The study duration ranged from 3 months to 6.5 years. Both men and women were included in the study groups. Serum vitamin D levels (25-(OH)D) were measured by radioimmunoassay in 7 studies and enzyme immunoassays in. Only 2 studies out of 9 controlled for confounding through matching. There were 830 stress fractures and 2695 controls without stress fractures. Means of diagnosis included radiography, bone scintigraphy and MRI. Vitamin D levels were measured at the time of diagnosis in 3 of the case control studies and in 6 were measured at the time of entry into basic training. One study did not report specific vitamin D levels (only reported quartiles) and was excluded from the vitamin D level analysis. Thus, 2634 military personnel with 761 stress fractures


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were analyzed. There were 1873 controls. Overall the vitamin D levels were significantly lower in the stress fracture group with a mean difference of -2.44 ng/ml (95% CI, -4.05 to -0.84; p=.003). In the 3 studies measuring vitamin D levels at or near the time of diagnosis, similar low levels were found in the stress fracture groups with a mean difference of -2.26 ng/dl (95% CI, -3.89 to -0.63; p=.007). It should be pointed out that one of these studies used controls that were symptomatic but had negative or grade 1 - 2 uptake on bone scan. The remaining 5 studies looked at vitamin D levels at the start of basic training. Again a similar significant difference in the mean difference was found (-2.63 ng/dl (95% CI, -5.8 to -.54)). Finally, 2 studies looked at vitamin D levels 4 months into basic training and in both the cases those that developed stress fractures and those that did not had a decrease in vitamin D levels. The authors concluded that this study demonstrates that low vitamin D levels may play a role in the development of stress fractures in military personnel, and that ensuring adequate vitamin D levels may be beneficial in reducing that risk.

**Strengths:** The strength of this study was that strict metholology was used to minimize selection and measurement bias. There was no evidence of publication bias in the Funnel plot analysis.

**Weaknesses:** Only 2 studies controlled for confounding variables. There was a significant amount of heterogeneity in the studies. This included variability in methods of measuring vitamin D levels and when vitamin D levels were measured relative to the diagnosis of stress fractures. Furthermore stress fractures were not uniformly defined or diagnosed.

For example one study compared high-grade stress fractures to those with stress fracture symptoms but no radiologic findings. There were also problems with diagnosing vitamin D deficiency in general that are not discussed in this paper. Firstly, there is no consensus as to what cut points we are to use to define deficiency (2). Furthermore, like in this meta analysis, the US Preventive Task Force stresses that measuring total serum 25-(OH)D is done in a variety of ways and there is a general lack of use of an internationally recognized reference standards leading to significant differences in values sometimes even within a single lab (2). In addition, serum 25-(OH)D levels are known to be a negative acute phase reactant and can be low in the setting of inflammation. Finally, vitamin D is also not the only factor in healthy bone metabolism. In fact, African Americans have a paradoxically lower reported fracture rate despite having consistently been shown to have lower vitamin D levels when compared to whites (2).

**Conclusions:** This is the first meta-analysis comparing the relationship between stress fracture and vitamin D levels in an active young adult population. It has a high relevancy in all those taking care of athletes. The study design was sound and the statistical analysis was appropriate. The conclusion that there is a statistically significant association between lower vitamin D levels and stress fractures in military personal is supported by the data. However, the magnitude of the differences, although statistically significant, are numerically very small making it difficult to know precisely how to use measured levels in a clinical setting. Ideally we would like to be able to screen and have reliable cut-off points to be able to predict who is at risk and who might need to be
supplemented to reduce risk. This meta-analysis does not answer that question.

**Practice Pearl:** If a causal relationship between vitamin D deficiency and increased rates of stress fractures screening in athletes can be demonstrated, it would be very appealing to Team Physicians and Sports Medicine professionals. Although this article demonstrates an association between low vitamin D levels and stress fractures, the limitations and problematic nature of measuring vitamin D levels in general (2) make the case for screening far from compelling. However, given the growing evidence of the role of vitamin D in a large number of disease processes including bone health and the benign nature of supplementation, it could be argued that supplementing with or without monitoring of vitamin D levels in athletes that are high risk may make sense.

**References:**

