

## 1. LUMBAR SPINE

### Opioid use and PT in elderly

J Am Board Fam Med. 2017 Nov-Dec;30(6):784-794. doi: 10.3122/jabfm.2017.06.170064.

#### **Relationship of Opioid Prescriptions to Physical Therapy Referral and Participation for Medicaid Patients with New-Onset Low Back Pain.**

Thackeray A<sup>1</sup>, Hess R<sup>2</sup>, Dorius J<sup>2</sup>, Brodke D<sup>2</sup>, Fritz J<sup>2</sup>.

#### *INTRODUCTION:*

Physical therapy (PT) early in the management of low back pain (LBP) is associated with reductions in subsequent health care utilization and LBP-related costs. The objectives of this study were to 1) Examine differences among newly consulting patients with LBP who received a PT referral and those who did not, 2) examine differences between patients who participated in PT to those who did not, and 3) compare the impact of a PT referral and PT participation on LBP-related health care utilization and costs over 1 year.

#### *METHODS:*

This was a retrospective cohort study using electronic medical records and claims data. Participants were 454 Medicaid enrollees with new LBP consultations (mean age, 40.4 years; SD = 12.0; 70% women). Outcomes included advanced imaging, injections, emergency department visits, opioid prescriptions, surgery and LBP-related costs. Variables associated with a PT consult, PT participation, and subsequent outcomes were evaluated with multivariate models.

#### *RESULTS:*

A total of 251 (55%) participants received a PT consult within 7 days of the index LBP visit and 81 (19%) participated in PT. The odds of a PT consult were increased if patients were prescribed non-steroidal anti-inflammatories (aOR = 1.81; 95% confidence interval [CI], 1.0 to 3.27;  $P = .05$ ) or muscle relaxers (adjusted odds ratio [aOR] = 2.24; 95% CI, 1.03 to 4.87;  $P = .04$ ). Whereas tobacco users and individual with multiple comorbidities were less likely to receive a PT consult (aOR = 0.52; 95% CI, 0.20 to 0.91) and 0.42 (95% CI, 0.23 to 0.78), respectively). Odds of participating in PT were higher for patients receiving an radiograph at baseline (odds ratio [OR] = 2.63; 95% CI, 1.25 to 5.53) or having multiple comorbidities (OR = 2.96; 95% CI, 1.20 to 7.20). The odds of receiving an opioid prescription over the year following the index visit reduced with a PT consult (aOR = 0.65; 95% CI, 0.43 to 1.00) and with PT participation (aOR = 0.47; 95% CI, 0.24 to 0.92). No differences in LBP related costs over 1 year were noted between any of the groups.

#### *CONCLUSIONS:*

Among Medicaid recipients with new-onset LBP, the index provider's prescription and imaging decisions and patient demographics were associated with PT referrals and participation. A referral to PT and subsequent PT participation was associated with reduced opioid prescriptions during follow-up. There was no difference in overall LBP-related health care costs.

### Modic Changes

Spine (Phila Pa 1976). 2017 May 25. doi: 10.1097/BRS.0000000000002254.

#### Does Modic Change Progress with Age?

Tarukado K<sup>1</sup>, Ono T, Tono O, Tanaka H, Ikuta K, Harimaya K, Doi T.

#### STUDY DESIGN:

Cross-sectional imaging study.

#### OBJECTIVE:

The aim of this study was to clarify the trend in the generation distinctions about the prevalence of Modic change (MC) including elderly patients.

#### SUMMARY OF BACKGROUND DATA:

MC has been discussed regarding its clinical significance, relationship with low back pain, suitable treatments, prevalence, and natural history. However, previous reports have focused on younger subjects, with few studies conducted in elderly patients. If MC is actually a progressive condition of a patient, then it should become more common as the patient ages. We herein report the distribution of MC across several age groups.

#### METHODS:

Patients who underwent lumbar magnetic resonance imaging (MRI) in our institution from April 2013 to March 2015 were recruited. MC was assessed using T1- and T2-weighted MRI and divided into Modic types (MT) 1, 2, and 3, and mixed type. Trends in the prevalence of MC were analyzed based on age.

#### RESULTS:

We ultimately included 585 patients of an initial 937 who underwent lumbar MRI. The mean age was 65 years. MC was identified in 36.0% of the patients. The prevalence of MC by age was 0% for those in their 10s, 10% for those in their 20s, 33% for those in their 30s, 27% for those in their 40s, 32% for those in their 50s, 44% for those in their 60s, 42% for those in their 70s, and 26% for those in their 80s. By type, 3.3% were MT1, 81.3% were MT2, 0.5% were MT3, and 14.8% were mixed type.

#### CONCLUSIONS:

The prevalence of MC increased with age to some degree, with the highest frequency observed in individuals in their 60s before declining in those in their 70s and 80s. These findings suggest that MC might not simply progress with age, particularly after the seventh decade of life.

## 2. LBP

### Gait changes

Spine (Phila Pa 1976). 2017 Dec 1;42(23):E1350-E1356. doi: 10.1097/BRS.0000000000002161.

#### **A Kinematic Symmetry Index of Gait Patterns Between Older Adults With and Without Low Back Pain.**

Sung PS<sup>1</sup>, Danial P.

##### *STUDY DESIGN:*

Cross-sectional study.

##### *OBJECTIVE:*

To investigate the symmetry index for limb support patterns in right limb-dominant older adults with and without low back pain (LBP).

##### *SUMMARY OF BACKGROUND DATA:*

The effects of bilateral asymmetry on gait performance were reported; however, there is a lack of understanding on kinematic symmetry to assess subjects with LBP. This asymmetry might be related to increased compensatory patterns to the dominant side in subjects with LBP.

##### *METHODS:*

Eighty-two right limb-dominant older adults (45 control subjects and 37 subjects with LBP) participated in the study. A three-dimensional motion capture system was used to measure temporal-spatial gait parameters (cadence, speed, stride length, step length, and limb support times). The symmetry index was the ratio of the gait cycle between the limbs to compare the dominance pattern between groups.

##### *RESULTS:*

Although the symmetry index was not different between groups, the initial limb support ( $t=2.07$ ,  $P=0.04$ ) and terminal limb support ( $t=-2.26$ ,  $P=0.02$ ) times were significantly different. The LBP group demonstrated significantly greater nondominant initial support times and dominant terminal support times. The single-limb support was not different between groups ( $t=1.72$ ,  $P=0.09$ ). The limb support pattern demonstrated a significant interaction between groups ( $F=4.72$ ,  $P=0.03$ ) regardless of gait speed ( $F=0.91$ ,  $P=0.34$ ).

##### *CONCLUSION:*

An asymmetrical gait pattern was evident in the LBP group as they demonstrated a longer double-limb support pattern due to a possible pain avoidance strategy. The control group demonstrated a symmetrical pattern for limb support in the stance phase. Clinicians need to consider asymmetric limb support patterns of gait modification similar to the control group when developing rehabilitation strategies for patients with LBP.

## 5. SURGERY

### Stenosis and fusion

N Engl J Med. 2016 Apr 14;374(15):1413-23. doi: 10.1056/NEJMoa1513721.

#### **A Randomized, Controlled Trial of Fusion Surgery for Lumbar Spinal Stenosis.**

Försth P<sup>1</sup>, Ólafsson G<sup>1</sup>, Carlsson T<sup>1</sup>, Frost A<sup>1</sup>, Borgström F<sup>1</sup>, Fritzell P<sup>1</sup>, Öhagen P<sup>1</sup>, Michaëlsson K<sup>1</sup>, Sandén B<sup>1</sup>.

#### **BACKGROUND:**

The efficacy of fusion surgery in addition to decompression surgery in patients who have lumbar spinal stenosis, with or without degenerative spondylolisthesis, has not been substantiated in controlled trials.

#### **METHODS:**

We randomly assigned 247 patients between 50 and 80 years of age who had lumbar spinal stenosis at one or two adjacent vertebral levels to undergo either decompression surgery plus fusion surgery (fusion group) or decompression surgery alone (decompression-alone group). Randomization was stratified according to the presence of preoperative degenerative spondylolisthesis (in 135 patients) or its absence. Outcomes were assessed with the use of patient-reported outcome measures, a 6-minute walk test, and a health economic evaluation. The primary outcome was the score on the Oswestry Disability Index (ODI; which ranges from 0 to 100, with higher scores indicating more severe disability) 2 years after surgery. The primary analysis, which was a per-protocol analysis, did not include the 14 patients who did not receive the assigned treatment and the 5 who were lost to follow-up.

#### **RESULTS:**

There was no significant difference between the groups in the mean score on the ODI at 2 years (27 in the fusion group and 24 in the decompression-alone group,  $P=0.24$ ) or in the results of the 6-minute walk test (397 m in the fusion group and 405 m in the decompression-alone group,  $P=0.72$ ). Results were similar between patients with and those without spondylolisthesis. Among the patients who had 5 years of follow-up and were eligible for inclusion in the 5-year analysis, there were no significant differences between the groups in clinical outcomes at 5 years. The mean length of hospitalization was 7.4 days in the fusion group and 4.1 days in the decompression-alone group ( $P<0.001$ ). Operating time was longer, the amount of bleeding was greater, and surgical costs were higher in the fusion group than in the decompression-alone group. During a mean follow-up of 6.5 years, additional lumbar spine surgery was performed in 22% of the patients in the fusion group and in 21% of those in the decompression-alone group.

#### **CONCLUSIONS:**

Among patients with lumbar spinal stenosis, with or without degenerative spondylolisthesis, decompression surgery plus fusion surgery did not result in better clinical outcomes at 2 years and 5 years than did decompression surgery alone. (Funded by an Uppsala institutional Avtal om Läkarutbildning och Forskning [Agreement concerning Cooperation on Medical Education and Research] and others; Swedish Spinal Stenosis Study ClinicalTrials.gov number, NCT01994512.).

## 6. PELVIC GIRDLE

### Osteitis pubis

Eur J Radiol. 2017 Sep;94:46-52. doi: 10.1016/j.ejrad.2017.07.009. Epub 2017 Jul 19.

#### **Osteitis pubis in professional football players: MRI findings and correlation with clinical outcome.**

Gaudino F<sup>1</sup>, Spira D<sup>2</sup>, Bangert Y<sup>3</sup>, Ott H<sup>4</sup>, Beomonte Zobel B<sup>5</sup>, Kauczor HU<sup>2</sup>, Weber MA<sup>6</sup>.

#### **BACKGROUND AND PURPOSE:**

Osteitis pubis (OP), a common pathology in elite athletes, is an aseptic inflammatory process of the pubic symphysis bone, and may involve surrounding soft tissues, tendons and muscles. OP is typically characterized by (often recurring) groin pain and is an important cause of time-off from sports activity in athletes. Aim of this retrospective study was to analyze magnetic resonance imaging (MRI) findings in professional football players with clinical diagnosis of OP and to correlate MRI findings with clinical outcome.

#### **MATERIAL AND METHODS:**

All professional football players (23 males, 1 female; mean age:  $21 \pm 3.7$  years; range: 16-30 years) with groin pain and clinical diagnosis of OP, who underwent pelvic MRI in our institution were retrospectively analyzed. The MR images were analyzed regarding the presence of bone marrow edema and its extension, whether fluid in the symphysis pubis or periarticular soft tissue edema with a rim-like periosteal distribution or edema in the muscles located around the symphyseal joint were present, whether degenerative changes of the symphysis pubis and of signs of symphyseal instability were encountered. A quantitative measurement of the signal intensity in bone marrow edema on 3T STIR sequences was performed, normalizing these values to the mean signal intensity values in the ipsilateral iliopsoas muscle. All patients were classified according to a 3-point grading scale. For each patient, both the symptoms 18 months after the initial MRI examination, the duration of time off from playing football and the kind of treatment applied were evaluated.

#### **RESULTS:**

Among all professional athletes, in 20/24 (83.3%) MRI showed signs of OP with bone marrow edema at the pubic bone. 12 of these patients showed complete clinical recovery without any symptoms after 18 months, while in 8 patients partial recovery with persistence of groin pain during higher sports activity was observed. Patients with edema in periarticular soft tissues or in the muscles around the symphyseal joint on MRI at the beginning of symptoms presented significantly more often with a partial recovery after returning to high sports activity ( $p=0.042$  and  $p=0.036$ , respectively). A partial recovery was also significantly associated with higher normalized mean signal intensity values in bone marrow edema on STIR sequences at the beginning of symptoms (mean= $4.77 \pm 1.63$  in the group with partial recovery vs. mean= $2.86 \pm 0.45$  in the group with complete recovery;  $p=0.0019$ ). No significant association was noticed between MRI findings and time of abstinence from high sports activity, as well as between the 3-point grading scale and the time off from high sport activity and recovery at 18 months.

#### **CONCLUSIONS:**

Edema in periarticular soft tissues, edema with extension to the muscles located around the symphyseal joint, as well as higher normalized signal intensity values in bone marrow edema on STIR sequences in the pubic bones at the beginning of groin pain are the most reliable MRI findings of a poor clinical long-term outcome of OP in professional football players and should be regarded as negative prognostic factors.

## 8. VISCERA

### Prostate CA

N Engl J Med. 2017 Jul 13;377(2):132-142. doi: 10.1056/NEJMoa1615869.

#### **Follow-up of Prostatectomy versus Observation for Early Prostate Cancer.**

Wilt TJ<sup>1</sup>, Jones KM<sup>1</sup>, Barry MJ<sup>1</sup>, Andriole GL<sup>1</sup>, Culkin D<sup>1</sup>, Wheeler T<sup>1</sup>, Aronson WJ<sup>1</sup>, Brawer MK<sup>1</sup>.

#### *BACKGROUND:*

We previously found no significant differences in mortality between men who underwent surgery for localized prostate cancer and those who were treated with observation only. Uncertainty persists regarding nonfatal health outcomes and long-term mortality.

#### *METHODS:*

From November 1994 through January 2002, we randomly assigned 731 men with localized prostate cancer to radical prostatectomy or observation. We extended follow-up through August 2014 for our primary outcome, all-cause mortality, and the main secondary outcome, prostate-cancer mortality. We describe disease progression, treatments received, and patient-reported outcomes through January 2010 (original follow-up).

#### *RESULTS:*

During 19.5 years of follow-up (median, 12.7 years), death occurred in 223 of 364 men (61.3%) assigned to surgery and in 245 of 367 (66.8%) assigned to observation (absolute difference in risk, 5.5 percentage points; 95% confidence interval [CI], -1.5 to 12.4; hazard ratio, 0.84; 95% CI, 0.70 to 1.01; P=0.06). Death attributed to prostate cancer or treatment occurred in 27 men (7.4%) assigned to surgery and in 42 men (11.4%) assigned to observation (absolute difference in risk, 4.0 percentage points; 95% CI, -0.2 to 8.3; hazard ratio, 0.63; 95% CI, 0.39 to 1.02; P=0.06). Surgery may have been associated with lower all-cause mortality than observation among men with intermediate-risk disease (absolute difference, 14.5 percentage points; 95% CI, 2.8 to 25.6) but not among those with low-risk disease (absolute difference, 0.7 percentage points; 95% CI, -10.5 to 11.8) or high-risk disease (absolute difference, 2.3 percentage points; 95% CI, -11.5 to 16.1) (P=0.08 for interaction). Treatment for disease progression was less frequent with surgery than with observation (absolute difference, 26.2 percentage points; 95% CI, 19.0 to 32.9); treatment was primarily for asymptomatic, local, or biochemical (prostate-specific antigen) progression. Urinary incontinence and erectile and sexual dysfunction were each greater with surgery than with observation through 10 years. Disease-related or treatment-related limitations in activities of daily living were greater with surgery than with observation through 2 years.

#### *CONCLUSIONS:*

After nearly 20 years of follow-up among men with localized prostate cancer, surgery was not associated with significantly lower all-cause or prostate-cancer mortality than observation. Surgery was associated with a higher frequency of adverse events than observation but a lower frequency of treatment for disease progression, mostly for asymptomatic, local, or biochemical progression. (Funded by the Department of Veterans Affairs and others; PIVOT ClinicalTrials.gov number, [NCT00007644](#) .).

## Intestinal parameters

### Intestinal parameters of oxidative imbalance in celiac adults with extraintestinal manifestations

World Journal of Gastroenterology | December 01, 2017 Piatek-Guziewicz A, et al.

Physicians designed this study to assess selected intestinal parameters of oxidative stress, and antioxidant capacity in adult celiac disease (CD) patients with extraintestinal manifestations. Despite gluten-free diet (GFD), increased intestinal expression of heat-shock protein 70 (HSP-70) showed that GFD only partially reduced oxidative stress. An oxidative imbalance and inflammatory response was observed despite GFD, in CD patients. In CD, uric acid could act as an important antioxidant.

**Methods** The physicians recruited 85 adult patients in this study. Patients were divided into the following subgroups: Patients with newly diagnosed celiac disease (CD) ( $n = 7$ ); Celiac patients not adhering to a gluten-free diet (GFD) ( $n = 22$ ); Patients with CD on the GFD ( $n = 31$ ); Patients with functional disorders of the gastrointestinal tract, serving as controls ( $n = 25$ ). Non-classic symptoms or extraintestinal manifestations were noted in celiac patients. Standard blood tests were determined, including serum antioxidant levels (uric acid, bilirubin, and vitamin D), celiac antibody levels, and histopathological status of duodenal biopsy specimens. They analyzed the expression of mRNA for tumor necrosis factor  $\alpha$  (TNF- $\alpha$ ), interleukin 1 $\beta$  (IL-1 $\beta$ ), interleukin 10 (IL-10), superoxide dismutase (SOD), heat-shock protein 70 (HSP-70), hypoxia-inducible factor 1 (HIF-1 $\alpha$ ), and BAX in the duodenal mucosa of patients by reverse transcriptase-polymerase chain reaction.

### Results

In patients with active CD (newly diagnosed and nonadherent patients) and treated celiac patients, the mean plasma uric acid level was significantly higher than in controls ( $260.17 \pm 53.65$  vs  $190.8 \pm 22.98$ ,  $P < 0.001$ , and  $261.7 \pm 51.79$  vs  $190.8 \pm 22.98$ ,  $P < 0.001$ , respectively).

In active and treated celiac patients, the mean bilirubin concentration was significantly lower than in controls ( $8.23 \pm 5.04$  vs  $10.48 \pm 4.08$ ,  $P < 0.05$  and  $8.06 \pm 3.31$  vs  $10.48 \pm 4.08$ ,  $P < 0.05$ , respectively).

Among active celiac patients, the mean plasma vitamin D level was significantly lower than in treated celiac patients and controls ( $19.37 \pm 9.03$  vs  $25.15 \pm 11.2$ ,  $P < 0.05$  and  $19.37 \pm 9.03$  vs  $29.67 \pm 5.12$ ,  $P < 0.001$ , respectively). Regardless of the diet, the expression of TNF- $\alpha$ , IL-10, and HSP-70 mRNAs was significantly elevated in the celiac groups when compared with controls.

A significantly lower mRNA expression of TNF- $\alpha$  and IL-10 was observed in patients on the GFD than in newly diagnosed and nonadherent patients ( $P < 0.05$ ). In celiac patients, the expression of SOD mRNA was significantly elevated compared with controls ( $P < 0.05$ ), with a significant difference between treated and untreated patients ( $P < 0.05$ ).

In patients with active CD, the expression of HIF-1 $\alpha$  mRNA and BAX mRNA was significantly higher compared with controls and patients on GFD. No difference was observed between the latter 2 groups.

## Inflammation in CD

**Circulating *miR-125a* but not *miR-125b* is decreased in active disease status and negatively correlates with disease severity as well as inflammatory cytokines in patients with Crohn's disease**

World Journal of Gastroenterology | December 01, 2017

Sun CM, et al.

Researchers carried out this study to ascertain the association of circulating *miR-125a/b* expression with the risk and disease severity of Crohn's disease (CD), and with inflammatory cytokines. In patients with active disease status, circulating *miR-125a* was decreased. However, this was not observed with *miR-125b*. In patients with CD, circulating *miR-125a* was negatively correlated with disease severity and inflammatory cytokines.

Methods

- The researchers collected plasma samples from patients with active CD (A-CD), or CD in remission (R-CD) and from healthy controls (HCs).
- They measured the levels of the inflammatory cytokines interleukin-17 (IL-17), tumour necrosis factor- $\alpha$  (TNF- $\alpha$ ), and interferon- $\gamma$  (IFN- $\gamma$ ) by enzyme-linked immunosorbent assay.
- They evaluated the expression of *miR-125a/b* by quantitative polymerase chain reaction (qPCR).

Results

- The researchers included 29 A-CD patients, 37 R-CD patients, and 37 HCs in the study.
- In A-CD patients, plasma *miR-125a* expression was decreased compared with that in R-CD patients ( $P < 0.001$ ) and HCs ( $P < 0.001$ ).
- The differentiation of A-CD from R-CD patients [area under curve (AUC) = 0.854] and from HCs (AUC = 0.780) was enabled by *miR-125a* expression, while this was not noted with *miR-125b* expression.
- In A-CD patients, *miR-125a* was negatively associated with C-reaction protein (CRP) ( $P=0.017$ ), erythrocyte sedimentation rate (ESR) ( $P=0.026$ ), Crohn's disease activity index (CDAI) ( $P=0.003$ ), IL-17 ( $P=0.015$ ), and TNF- $\alpha$  ( $P=0.004$ ).
- Furthermore, in R-CD patients, *miR-125a* was negatively correlated with CRP ( $P=0.038$ ) and CDAI ( $P=0.021$ ).
- No association with CRP, CDAI, IL-17, TNF- $\alpha$ , or IFN- $\gamma$  was found in A-CD or in R-CD patients regarding *miR-125b*.
- In A-CD patients who achieved clinical remission ( $P=0.009$ ) after 3-mo treatment, *miR-125a* levels gradually increased, while they remained unchanged among patients who failed to achieve remission.
- In remission or non-remission patients, no changes in *miR-125b* expression were detected after treatment.

GERD and hiatal hernia and asthma



**Original Article**

**Contribution of hiatal hernia to asthma in patients with gastroesophageal reflux disease**

**Authors**

- **Zhi-tong Li, eng Ji, Xin-wei Han, in-xia Gu, Li Wang, Yong-qiang Yue, Zhong-gao Wang**

**ABSTRACT**

**Background:** To determine the correlation between asthma and hiatal hernia (HH) in patients with gastroesophageal reflux disease (GERD)-related asthma requiring laparoscopic anti-reflux surgery.

**Methods:** One hundred thirty-six GERD patients with medically refractory asthma with (80 patients) or without HH (56 patients) were enrolled. GERD was assessed by endoscopy, esophageal manometry, reflux monitoring, and symptom questionnaires, and treated with laparoscopic Nissen fundoplication (LNF) or LNF with concomitant hiatal hernia repair (LNF-HHR). The outcome measures included patient satisfaction and drug independence.

**Results:** HH patients had lower esophageal sphincters ( $P = 0.005$ ) and higher DeMeester scores ( $P = 0.014$ ) than those without HH. After an average follow-up of 24 months, symptom scores were significantly decreased from the preoperative values ( $P < 0.05$ ). Compared to LNF, LNF-HHR showed a better improvement in both esophageal and asthmatic symptoms ( $P = 0.00$  and  $P = 0.016$ , respectively).

**Conclusions:** GERD patients with asthma have a high prevalence of HH. The presence of HH maybe correlated with asthma and severe GERD. Actively treating HH not only improved reflux, but also controlled asthma symptoms.

Spine J. 2017 Nov 15. pii: S1529-9430(17)31156-7. doi: 10.1016/j.spinee.2017.11.007.

**The association of inflammatory bowel disease and immediate postoperative outcomes following lumbar fusion.**

Tanenbaum JE<sup>1</sup>, Kha ST<sup>2</sup>, Benzel EC<sup>3</sup>, Steinmetz MP<sup>3</sup>, Mroz TE<sup>4</sup>.

**BACKGROUND CONTEXT:** The United States Centers for Disease Control estimates the prevalence of inflammatory bowel disease (IBD) at over 3.1 million people. As diagnostic techniques and treatment options for IBD improve, the prevalence of IBD is expected to increase. For spine surgeons, patients with IBD have a unique complication profile because IBD patients may present with poor nutritional status and because the medications used to manage IBD have been associated with poor vertebral bone mineralization and immunosuppression. Presently, there are very limited data regarding perioperative outcomes among patients with IBD who undergo spinal surgery. The present study begins to address this knowledge gap by describing trends in lumbar fusion patients with IBD and by quantifying the association between IBD and immediate postoperative outcomes using a large, national database.

**PURPOSE:** To advance our understanding of the potential pitfalls and risks associated with lumbar fusion surgery in patients with inflammatory bowel disease.

**STUDY DESIGN/SETTING:** Retrospective cross-sectional analysis **PATIENT SAMPLE:** The Nationwide Inpatient Sample database was queried from 1998 to 2011 to identify adult patients (18+) who underwent primary lumbar fusion operations using International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) coding.

**OUTCOME MEASURES:** Incidence of lumbar fusion procedures, prevalence of IBD, complication rates, length of stay, and total hospital charges.

**METHODS:** The annual number of primary lumbar fusion operations performed between 1998 and 2011 was obtained from the Nationwide Inpatient Sample (NIS) database. Patients younger than 18 years of age were excluded. The prevalence of IBD in this population (both Crohn's disease and ulcerative colitis) was determined using ICD-9-CM codes. Logistic regression models were estimated to determine the association between IBD and the odds of postoperative medical and surgical complications, while controlling for patient demographics, comorbidity burden, and hospital characteristics. The complex survey design of the NIS was taken into account by clustering on hospitals and assuming an exchangeable working correlation using the discharge weights supplied by the NIS. We accounted for multiple comparisons using the Bonferroni correction and an alpha level for statistical significance of 0.0028.

**RESULTS:** The prevalence of IBD is increasing among lumbar fusion patients, from 0.21% of all lumbar fusion patients in 1998 to 0.48% of all lumbar fusion patients in 2011 ( $p < 0.001$ ). The odds of experiencing a post-operative medical or surgical complication were not significantly different when comparing IBD patients to control patients without IBD after controlling for patient demographics, comorbidity burden, and hospital characteristics (adjusted odds ratio=1.1, 95% confidence interval [CI] 0.99-1.3,  $p=0.08$ ). On multivariable analysis, the presence of IBD in patients undergoing lumbar fusion surgery was associated with longer length of stay and greater hospitalization charges.

**CONCLUSIONS:** Among lumbar fusion patients, IBD is a rare comorbidity that is becoming increasingly more common. Importantly, IBD patients were not at increased risk of postoperative complications. Spine surgeons should be prepared to treat more IBD patients and should incorporate the present findings into preoperative risk counseling and patient selection.

IBS = higher risk of malignancy

### **Risk of malignancy in a nationwide cohort of elderly inflammatory bowel disease patients**

Drugs & Aging | November 28, 2017

Khan N, et al.

The purpose of this retrospective cohort study was to determine the risk of cancer among elderly inflammatory bowel disease (IBD) patients compared with younger IBD patients. The absolute risk of malignancy and factors contributing to the risk were assessed with respect to the therapeutic patterns among the elderly. When compared with younger IBD patients and the general age-matched population, the elderly with IBD had a higher risk of malignancy, with some cancers being more common among these patients.

#### Methods

- The researchers extracted data from the Truven Health Analytics MarketScan database.
- A Cox model for time to cancer was fitted that adjusted for several covariates, including time-dependent treatment among adult IBD patients who were free of cancer before starting on corticosteroids, immunomodulators, or biologics.
- The baseline results were evaluated by age group along with the incidence of cancer and the distribution of cancer subtypes.

#### Results

- Relative to the younger IBD cohort aged 18-64 years (n = 54,971), the elderly IBD cohort (n = 8,788) had a higher prevalence of cancer and several other medical disorders before starting treatment.
- The elderly IBD cohort experienced a higher incidence of malignancy during follow-up, confirmed by a hazard ratio (HR) of 3.04 (95% confidence interval [CI] 2.71-3.41) from the Cox model fit.
- Factors significantly associated with the risk of cancer were male gender (HR 0.82 female), duration of disease (HR 1.08), several co-morbidities and corticosteroid use (HR 1.35); however, the risk was not associated with the use of immunomodulators or biologics.
- When compared with the same age group in the Surveillance, Epidemiology, and End Results (SEER) database, non-Hodgkin's lymphoma, urinary tract malignancy, and prostate, lung, and female breast cancers were observed more commonly in this elderly IBD cohort.

### Carries and QOL

#### **Impact of untreated dental caries on the daily activities of children**

Journal of Public Health Dentistry

| December 01, 2017

Souza JGS, et al.

Using a representative sample of Brazilian children, the authors identified which specific daily activities were affected by the presence of untreated dental caries. Among Brazilian children, the presence of untreated dental caries was correlated with an impact on specific daily activities (difficulty eating and sleeping) and the psychological domain of oral health-related quality of life (OHRQoL).

### Carries

**Blood Lead Levels and Dental Caries in U.S. Children Who Do Not Drink Tap Water**

Anne E. Sanders, PhD Gary D. Slade, BDS, PhD

DOI: <http://dx.doi.org/10.1016/j.amepre.2017.09.004>

**Introduction**

This study's purpose is to determine whether nonconsumption of tap water is associated with lower prevalence of elevated blood lead levels and higher prevalence of dental caries in children and adolescents.

**Methods**

Cross-sectional data from the National Health and Nutrition Examination Survey 2005–2014 recorded drinking water source ( $n=15,604$ ) and blood lead levels ( $n=12,373$ ) for participants aged 2–19 years, and dental caries experience for the 2011–2014 subset ( $n=5,677$ ). The threshold for elevated blood lead level was  $\geq 3 \mu\text{g/dL}$ . A binary outcome indicated presence or absence of dental caries experience. Multivariable generalized linear models estimated adjusted prevalence ratios with 95% confidence limits.

**Results**

In analysis conducted in 2017, 15% of children and adolescents did not drink tap water, 3% had elevated blood lead levels  $\geq 3 \mu\text{g/dL}$ , and 50% had dental caries experience. Children and adolescents who did not drink water were less likely than tap water drinkers to have an elevated blood lead level (adjusted prevalence ratios=0.62, 95% confidence limits=0.42, 0.90). Nonconsumers of tap water were more likely to have dental caries (adjusted prevalence ratios=1.13, 95% confidence limits=1.03, 1.23). Results persisted after adjustment for other covariates and using a higher threshold for elevated blood lead level.

**Conclusions**

In this nationally representative U.S. survey, children and adolescents who did not drink tap water had lower prevalence of elevated blood lead levels and higher prevalence of dental caries than those who drank tap water.

**15. VESTIBULAR**

BPPV and osteoporosis

Arch Osteoporos. 2017 Nov 25;12(1):106. doi: 10.1007/s11657-017-0403-7.

**Osteoporosis is associated with increased risk for benign paroxysmal positional vertigo: a nationwide population-based study.**

Chan KC<sup>1,2,3</sup>, Tsai YT<sup>2,3,4</sup>, Yang YH<sup>5,6,7</sup>, Chen PC<sup>8,9</sup>, Chang PH<sup>10,11,12</sup>.

Recent evidence has indicated that osteoporosis is a risk factor for benign paroxysmal positional vertigo (BPPV). This large population-based study demonstrated that patients with osteoporosis had a 1.82-fold higher risk of developing BPPV than those without osteoporosis through the use of the Taiwan National Health Insurance Research Database.

*PURPOSE:*

Benign paroxysmal positional vertigo (BPPV) is one of the most frequent causes of vertigo. Osteoporosis reflects a homeostatic imbalance in the rate of bone turnover, with the rate of bone resorption exceeding that of bone formation. Recent evidence has indicated that osteoporosis is a risk factor for BPPV. We aimed to validate the risk of BPPV in osteoporotic patients through a nationwide, population-based, cohort study.

*METHODS:*

Patients treated for osteoporosis were identified from entries made in the Taiwan National Health Insurance Research Database (NHIRD) between 2000 and 2013. Each osteoporosis patient was age- and sex-matched with four randomly selected subjects without osteoporosis. We compared the incidence rates of BPPV in the two cohorts (with and without osteoporosis) and identified risk factors.

*RESULTS:*

We identified 6649 osteoporosis patients and 26,596 match controls. According to the incidence of BPPV among the two groups, patients with osteoporosis were found to have a 1.82-fold higher risk of developing BPPV than those without osteoporosis. The incidence rate ratio (IRR) between osteoporotic patients and the control cohort was 2.0 ( $p < 0.001$ ).

*CONCLUSIONS:*

This large population-based study demonstrated that patients with osteoporosis were associated with an increased risk for BPPV. The results of this study provide some insight into the management of BPPV.

## 19. GLENOHUMERAL/SHOULDER

Sleeper stretch modified

**The modified sleeper stretch and modified cross-body stretch to increase shoulder internal rotation range of motion in the overhead throwing athlete.**

Wilk KE; Hooks TR; Macrina LC.

Ovid MEDLINE(R)Journal of Orthopaedic & Sports Physical Therapy. 43(12):891-4, 2013 Dec.

Wilk, Kevin E; Hooks, Todd R; Macrina, Leonard C.

techniques that focus on increasing posterior shoulder soft tissue flexibility are commonly incorporated into prevention and treatment programs for the overhead athlete.

The cross-body and sleeper stretch exercises have been described as stretching techniques to improve posterior shoulder soft tissue flexibility and to increase glenohumeral joint internal rotation and horizontal adduction range of motion in the overhead athlete. But, based on the inability to stabilize the scapula and control glenohumeral joint rotation with the cross-body stretch and the potential for subacromial impingement with the sleeper stretch, the authors recommend modifications to both of these commonly performed stretches.

This clinical commentary reviews the literature on posterior shoulder stretches, describes modifications to both of these commonly performed stretches, and outlines a strategy to maintain or improve posterior shoulder soft tissue flexibility and glenohumeral joint internal rotation range of motion in the overhead athlete.

### **30 A. IMPINGEMENT**

**Adolescent athletes and development of CAM**

Br J Sports Med. 2017 Aug 10. pii: bjsports-2017-097626. doi: 10.1136/bjsports-2017-097626.

**Physical activity during adolescence and the development of cam morphology: a cross-sectional cohort study of 210 individuals.**

Palmer A<sup>1</sup>, Fernquest S<sup>1</sup>, Gimpel M<sup>2</sup>, Birchall R<sup>2</sup>, Judge A<sup>1,3</sup>, Broomfield J<sup>1</sup>, Newton J<sup>1</sup>, Wotherspoon M<sup>2</sup>, Carr A<sup>1</sup>, Glyn-Jones S<sup>1</sup>.

**INTRODUCTION:**

Cam morphology is a strong risk factor for the development of hip pain and osteoarthritis. It is increasingly thought to develop in association with intense physical activity during youth; however, the aetiology remains uncertain. The study aim was to characterise the effect of physical activity on morphological hip development during adolescence.

**METHODS:**

Cross-sectional study of individuals aged 9-18 years recruited from Southampton Football Club Academy (103 male) with an age-matched control population (52 males and 55 females). Assessments included questionnaires and 3 Tesla MRI of both hips. Alpha angle, epiphyseal extension and epiphyseal tilt were measured on radial images.

**RESULTS:**

Alpha angle and epiphyseal extension increased most rapidly between ages 12 and 14 years. Soft-tissue hypertrophy at the femoral head-neck junction preceded osseous cam morphology and was first evident at age 10 years. The greatest increase and highest absolute values of alpha angle and epiphyseal extension were colocalised at 1 o'clock. Maximum alpha angles were 6.7 degrees greater in males than females ( $p=0.005$ ). Compared with individuals who play no regular sport, alpha angles were 4.0 degrees higher in individuals who play sport for a school or club ( $p=0.041$ ) and 7.7 degrees higher in individuals competing at a national or international level ( $p=0.035$ ). There was no association with leg dominance.

**CONCLUSIONS:**

Sporting activity during adolescence is strongly associated with the development of cam morphology secondary to epiphyseal hypertrophy and extension with a dose-response relationship. Males participating in competitive sport are at particularly elevated risk of developing cam morphology and secondary hip pathology.

© Article author(s) (or their employer(s) unless otherwise stated in the text of the article) 2017. All rights reserved. No commercial use is permitted unless otherwise expressly granted.

**KEYWORDS:** MRI; football; hip; physical activity; sport

[Continues activity after diagnosis](#)

Clin J Sport Med. 2017 Jun 22. doi: 10.1097/JSM.0000000000000460.



### **Differences in Athletic Performance Between Sportsmen With Symptomatic Femoroacetabular Impingement and Healthy Controls.**

Mullins K<sup>1</sup>, Hanlon M, Carton P.

#### **OBJECTIVE:**

Femoroacetabular impingement (FAI) is a commonly recognized condition in athletes characterized by activity-related hip pain and stiffness, which if left untreated can progress to hip osteoarthritis. The aim of the study was to determine the effect of symptomatic FAI on performance in young athletes based on the hypothesis that athletes with FAI would show deficits in performance compared with healthy controls.

#### **DESIGN:**

The functional performance of a cohort of preoperative, competitive sportsmen with symptomatic FAI (FAI group, n = 54), was compared with that of a group of age, sex and activity-level matched controls (n = 66).

#### **OUTCOME MEASURES:**

Participants performed functional tests including a 10-m sprint, a modified agility T-test, a maximal deep squat test and a single-leg drop jump (reactive strength index). Hip range of motion was assessed by measuring maximal hip flexion, abduction, and internal rotation (at 90 degree hip flexion).

#### **RESULTS:**

The FAI group was significantly slower during the 10-m sprint (3%,  $P = 0.002$ ) and agility T-test (8%,  $P < 0.001$ ); flexion, abduction, and internal rotation values for the FAI group were reduced compared with controls ( $P < 0.001$ ). No significant differences between groups were identified for squat depth or reactive strength index. The FAI group also reported higher levels of anterior groin pain during the 10-m sprint, modified agility T-test, and while squatting.

#### **CONCLUSIONS:**

Many sportsmen with confirmed FAI continue sports participation up to and after diagnosis, despite issues with activity-related pain and stiffness. This study highlights the functional limitations in speed, agility, and flexibility that are likely to be present in this group of FAI patients.

**34. PATELLA****Proximal muscle strengthening important**

Br J Sports Med. 2015 Nov;49(21):1365-76. doi: 10.1136/bjsports-2015-094723. Epub 2015 Jul 14.

**Proximal muscle rehabilitation is effective for patellofemoral pain: systematic review with meta-analysis.**

Lack S<sup>1</sup>, Barton C<sup>2</sup>, Sohan O<sup>1</sup>, Crossley K<sup>3</sup>, Morrissey D<sup>4</sup>.

**BACKGROUND:**

Proximal muscle rehabilitation is commonly prescribed to address muscle strength and function deficits in individuals with patellofemoral pain (PFP). This review (1) evaluates the efficacy of proximal musculature rehabilitation for patients with PFP; (2) compares the efficacy of various rehabilitation protocols; and (3) identifies potential biomechanical mechanisms of effect in order to optimise outcomes from proximal rehabilitation in this problematic patient group.

**METHODS:**

Web of Knowledge, CINAHL, EMBASE and Medline databases were searched in December 2014 for randomised clinical trials and cohort studies evaluating proximal rehabilitation for PFP. Quality assessment was performed by two independent reviewers. Effect size calculations using standard mean differences and 95% CIs were calculated for each comparison.

**RESULTS:**

14 studies were identified, seven of high quality. Strong evidence indicated proximal combined with quadriceps rehabilitation decreased pain and improved function in the short term, with moderate evidence for medium-term outcomes. Moderate evidence indicated that proximal when compared with quadriceps rehabilitation decreased pain in the short-term and medium-term, and improved function in the medium term. Limited evidence indicated proximal combined with quadriceps rehabilitation decreased pain more than quadriceps rehabilitation in the long term. Very limited short-term mechanistic evidence indicated proximal rehabilitation compared with no intervention decreased pain, improved function, increased isometric hip strength and decreased knee valgum variability while running.

**CONCLUSIONS:**

A robust body of work shows proximal rehabilitation for PFP should be included in conservative management. Importantly, greater pain reduction and improved function at 1 year highlight the long-term value of proximal combined with quadriceps rehabilitation for PFP.

Published by the BMJ Publishing Group Limited. For permission to use (where not already granted under a licence) please go to <http://group.bmj.com/group/rights-licensing/permissions>.

**KEYWORDS:** Exercises; Knee; Rehabilitation

**37. OSTEOARTHRITIS/KNEE****Inflammation****Differential Involvement of Synovial Adipokines in Pain and Physical Function in Female Patients with Knee Osteoarthritis. A Cross-Sectional Study**

Joan Calvet Cristóbal Orellana Néstor Albiñana Giménez Antoni Berenguer-Llargo  
Jordi Gratacós

DOI: <http://dx.doi.org/10.1016/j.joca.2017.11.010>

**Objective**

Adipokines have been reported to play a role in the development, progression and severity of knee osteoarthritis but the influence of the different adipokines are not well known. The aim of this study was to evaluate the association between different synovial fluid adipokines with pain and disability knee osteoarthritis patients.

**Methods**

Cross-sectional study with systematic inclusion of 115 symptomatic primary knee osteoarthritis female patients with ultrasound-confirmed joint effusion. Age, physical exercise, symptoms duration and different anthropometric measurements were collected. Radiographic severity was evaluated according to Kellgren-Lawrence scale. Pain and disability were assessed by WOMAC-total, -pain, -function subscales and KOOS pain and function scales. Seven adipokines and three inflammatory markers were measured by ELISA in synovial fluid. Partial Correlation Coefficient (PCC) and corresponding 95% confidence interval were used as a measure of association.

**Results**

Leptin, osteopontin and inflammatory factors, especially TNF-alpha, were associated to pain and function. After adjustment for potential confounders including inflammatory factors and all adipokines, an association was found for adiponectin with pain (PCC 0.240 [0.012,0.444]) and for resistin and visfatin with function (PCC 0.336 [0.117,0.524] and -0.262 [-0.463,-0.036]). No other adipokines or inflammatory markers were statistically and independently associated. An association between physical exercise and pain and disability remained after adjustment, whereas an attenuation of the influence of anthropometric measurements was observed.

**Conclusions**

Different patterns of association between synovial fluid adipokines were observed regarding pain and disability in knee osteoarthritis patients. Specifically, adiponectin was associated to pain while resistin and visfatin were mainly related to function.

**41 A. ACHILLES TENDON AND CALF****Running biomechanics**

Am J Sports Med. 2017 Sep;45(11):2614-2621. doi: 10.1177/0363546517708193. Epub 2017 Jun 5.

**Biomechanical Factors Associated With Achilles Tendinopathy and Medial Tibial Stress Syndrome in Runners.**

Becker J<sup>1</sup>, James S<sup>2</sup>, Wayner R<sup>3</sup>, Osternig L<sup>4</sup>, Chou LS<sup>4</sup>.

**BACKGROUND:**

There is disagreement in the literature regarding whether the excessive excursion or velocity of rearfoot eversion is related to the development of 2 common running injuries: Achilles tendinopathy (AT) and medial tibial stress syndrome (MTSS). An alternative hypothesis suggests that the duration of rearfoot eversion may be an important factor. However, the duration of eversion has received relatively little attention in the biomechanics literature.

**HYPOTHESIS:**

Runners with AT or MTSS will demonstrate a longer duration of eversion but not greater excursion or velocity of eversion compared with healthy controls.

**STUDY DESIGN:**

Controlled laboratory study.

**METHODS:**

Forty-two runners participated in this study (13 with AT, 8 with MTSS, and 21 matched controls). Participants were evaluated for lower extremity alignment and flexibility, after which a 3-dimensional kinematic and kinetic running gait analysis was performed. Differences between the 2 injuries and between injured and control participants were evaluated for flexibility and alignment, rearfoot kinematics, and 3 ground-reaction force metrics. Binary logistic regression was used to evaluate which variables best predicted membership in the injured group.

**RESULTS:**

Injured participants, compared with controls, demonstrated higher standing tibia varus angles ( $8.67^\circ \pm 1.79^\circ$  vs  $6.76^\circ \pm 1.75^\circ$ , respectively;  $P = .002$ ), reduced static dorsiflexion range of motion ( $6.14^\circ \pm 5.04^\circ$  vs  $11.19^\circ \pm 5.10^\circ$ , respectively;  $P = .002$ ), more rearfoot eversion at heel-off ( $-6.47^\circ \pm 5.58^\circ$  vs  $1.07^\circ \pm 2.26^\circ$ , respectively;  $P < .001$ ), and a longer duration of eversion ( $86.02\% \pm 15.65\%$  stance vs  $59.12\% \pm 16.50\%$  stance, respectively;  $P < .001$ ). There were no differences in the excursion or velocity of eversion. The logistic regression ( $\chi^2 = 20.84$ ,  $P < .001$ ) revealed that every 1% increase in the duration of eversion during the stance phase increased the odds of being in the injured group by 1.08 (95% CI, 1.023-1.141;  $P = .006$ ).

**CONCLUSION:**

Compared with healthy controls, runners currently symptomatic with AT or MTSS have a longer duration of eversion but not greater excursion or velocity of eversion.

**CLINICAL RELEVANCE:**

Static measures of the tibia varus angle and dorsiflexion range of motion, along with dynamic measures of the duration of eversion, may be useful for identifying runners at risk of sustaining AT or MTSS.

**KEYWORDS:** Achilles tendinopathy; medial tibial stress syndrome; period of pronation; running injuries

**Running changes**

J Foot Ankle Res. 2011 May 30;4:15. doi: 10.1186/1757-1146-4-15.

**Lower limb biomechanics during running in individuals with achilles tendinopathy: a systematic review.**

Munteanu SE<sup>1</sup>, Barton CJ.

**BACKGROUND:**

Abnormal lower limb biomechanics is speculated to be a risk factor for Achilles tendinopathy. This study systematically reviewed the existing literature to identify, critique and summarise lower limb biomechanical factors associated with Achillestendinopathy.

**METHODS:**

We searched electronic bibliographic databases (Medline, EMBASE, Current contents, CINAHL and SPORTDiscus) in November 2010. All prospective cohort and case-control studies that evaluated biomechanical factors (temporospatial parameters, lowerlimb kinematics, dynamic plantar pressures, kinetics [ground reaction forces and joint moments] and muscle activity) associated with mid-portion Achilles tendinopathy were included. Quality of included studies was evaluated using the Quality Index. The magnitude of differences (effect sizes) between cases and controls was calculated using Cohen's d (with 95% CIs).

**RESULTS:**

Nine studies were identified; two were prospective and the remaining seven case-control study designs. The quality of 9 identified studies was varied, with Quality Index scores ranging from 4 to 15 out of 17. All studies analysed running biomechanics. Cases displayed increased eversion range of motion of the rearfoot ( $d = 0.92$  and  $0.67$  in two studies), reduced maximum lower leg abduction ( $d = -1.16$ ), reduced ankle joint dorsiflexion velocity ( $d = -0.62$ ) and reduced knee flexion during gait ( $d = -0.90$ ). Cases also demonstrated a number of differences in dynamic plantar pressures (primarily the distribution of the centre of force), ground reaction forces (large effects for timing variables) and also showed reduced peak tibial external rotation moment ( $d = -1.29$ ). Cases also displayed differences in the timing and amplitude of a number of lower limb muscles but many differences were equivocal.

**CONCLUSIONS:**

There are differences in lower limb biomechanics between those with and without Achilles tendinopathy that may have implications for the prevention and management of the condition. However, the findings need to be interpreted with caution due to the limited quality of a number of the included studies. Future well-designed prospective studies are required to confirm these findings.

**Inflammation**

Br J Sports Med. 2017 Nov 8. pii: bjsports-2017-098161. doi: 10.1136/bjsports-2017-098161.

**Chronic inflammation is a feature of Achilles tendinopathy and rupture.**

Dakin SG<sup>1</sup>, Newton J<sup>1</sup>, Martinez FO<sup>2</sup>, Hedley R<sup>1</sup>, Gwilym S<sup>1</sup>, Jones N<sup>1</sup>, Reid HAB<sup>1</sup>, Wood S<sup>1</sup>, Wells G<sup>1</sup>, Appleton L<sup>1</sup>, Whewey K<sup>1</sup>, Watkins B<sup>1</sup>, Carr AJ<sup>1</sup>.

**BACKGROUND:**

Recent investigation of human tissue and cells from positional tendons such as the rotator cuff has clarified the importance of inflammation in the development and progression of tendon disease. These mechanisms remain poorly understood in disease of energy-storing tendons such as the Achilles. Using tissue biopsies from patients, we investigated if inflammation is a feature of Achilles tendinopathy and rupture.

**METHODS:**

We studied Achilles tendon biopsies from symptomatic patients with either mid-portion tendinopathy or rupture for evidence of abnormal inflammatory signatures. Tendon-derived stromal cells from healthy hamstring and diseased Achilles were cultured to determine the effects of cytokine treatment on expression of inflammatory markers.

**RESULTS:**

Tendinopathic and ruptured Achilles highly expressed CD14<sup>+</sup> and CD68<sup>+</sup> cells and showed a complex inflammation signature, involving NF- $\kappa$ B, interferon and STAT-6 activation pathways. Interferon markers IRF1 and IRF5 were highly expressed in tendinopathic samples. Achilles ruptures showed increased *PTGS2* and *interleukin-8* expression. Tendinopathic and ruptured Achilles tissues expressed stromal fibroblast activation markers podoplanin and CD106. Tendon cells isolated from diseased Achilles showed increased expression of pro-inflammatory and stromal fibroblast activation markers after cytokine stimulation compared with healthy hamstring tendon cells.

**CONCLUSIONS:**

Tissue and cells derived from tendinopathic and ruptured Achilles tendons show evidence of chronic (non-resolving) inflammation. The energy-storing Achilles shares common cellular and molecular inflammatory mechanisms with functionally distinct rotator cuff positional tendons. Differences seen in the profile of ruptured Achilles are likely to be attributable to a superimposed phase of acute inflammation and neo-vascularisation. Strategies that target chronic inflammation are of potential therapeutic benefit for patients with Achilles tendon disease.

© Article author(s) (or their employer(s) unless otherwise stated in the text of the article) 2017. All rights reserved. No commercial use is permitted unless otherwise expressly granted.

**KEYWORDS:** Achilles tendon; immunology; orthopaedics; tendinopathy; tendon

**Genetic factors in rupture**

Orthop J Sports Med. 2017 Aug 23;5(8):2325967117724416. doi: 10.1177/2325967117724416. eCollection 2017 Aug.

**Genetic Factors in Tendon Injury: A Systematic Review of the Literature.**

Vaughn NH<sup>1</sup>, Stepanyan H<sup>1</sup>, Gallo RA<sup>1</sup>, Dhawan A<sup>1</sup>.

**BACKGROUND:**

Tendon injury such as tendinopathy or rupture is common and has multiple etiologies, including both intrinsic and extrinsic factors. The genetic influence on susceptibility to tendon injury is not well understood.

**PURPOSE:**

To analyze the published literature regarding genetic factors associated with tendon injury.

**STUDY DESIGN:**

Systematic review; Level of evidence, 3.

**METHODS:**

A systematic review of published literature was performed in concordance with the Preferred Reporting Items of Systematic Reviews and Meta-analysis (PRISMA) guidelines to identify current evidence for genetic predisposition to tendon injury. PubMed, Ovid, and ScienceDirect databases were searched. Studies were included for review if they specifically addressed genetic factors and tendon injuries in humans. Reviews, animal studies, or studies evaluating the influence of posttranscription factors and modifications (eg, proteins) were excluded.

**RESULTS:**

Overall, 460 studies were available for initial review. After application of inclusion and exclusion criteria, 11 articles were ultimately included for qualitative synthesis. Upon screening of references of these 11 articles, an additional 15 studies were included in the final review, for a total of 26 studies. The genetic factors with the strongest evidence of association with tendon injury were those involving type V collagen A1, tenascin-C, matrix metalloproteinase-3, and estrogen-related receptor beta.

**CONCLUSION:**

The published literature is limited to relatively homogenous populations, with only level 3 and level 4 data. Additional research is needed to make further conclusions about the genetic factors involved in tendon injury.

**KEYWORDS:** Achilles tendon; biology of tendon; cell/molecular biology; genetic association; single nucleotide polymorphism; tendinosis

**41 B. COMPARTMENT SYNDROME**

**Biomechanical differences**

Gait Posture. 2017 Oct;58:66-71. doi: 10.1016/j.gaitpost.2017.07.044. Epub 2017 Jul 18.

**Biomechanical differences between cases with chronic exertional compartment syndrome and asymptomatic controls during walking and marching gait.**

Roberts A<sup>1</sup>, Roscoe D<sup>2</sup>, Hulse D<sup>2</sup>, Bennett AN<sup>3</sup>, Dixon S<sup>4</sup>.

Chronic exertional compartment syndrome is a significant problem in military populations that may be caused by specific military activities.

This study aimed to investigate the kinematic and kinetic differences in military cases with chronic exertional compartment syndrome and asymptomatic controls. 20 males with symptoms of chronic exertional compartment syndrome of the anterior compartment and 20 asymptomatic controls were studied. Three-dimensional lower limb kinematics and kinetics were compared during walking and marching.

Cases were significantly shorter in stature and took a relatively longer stride in relation to leg length than controls. All kinematic differences identified were at the ankle. Cases demonstrated increased ankle plantarflexion from mid-stance to toe-off. Cases also demonstrated less ankle inversion at the end of stance and early swing phases. Lower ankle inversion moments were observed during mid-stance. The anthropometric and biomechanical differences demonstrated provide a plausible mechanism for the development of chronic exertional compartment syndrome in this population. The shorter stature in combination with the relatively longer stride length observed in cases may result in an increased demand on the anterior compartment musculature during ambulation.

The results of this study, together with clinical insights and the literature suggest that the suppression of the walk-to-run stimulus during group marches may play a significant role in the development of chronic exertional compartment syndrome within a military population. The differences in joint angles and moments also suggest an impairment of the muscular control of ankle joint function, such as a reduced effectiveness of tibialis anterior. It is unclear whether this is a cause or consequence of chronic exertional compartment syndrome.

Crown Copyright © 2017. Published by Elsevier B.V. All rights reserved.

**KEYWORDS:** Anthropometry; Biomechanics; Chronic exertional compartment syndrome; Exercise-induced leg pain; Military training



### Fasciotomy of ant compartment helps

Am J Sports Med. 1988 May-Jun;16(3):224-7.

#### **The results of fasciotomy in the management of chronic exertional compartment syndrome.**

Rorabeck CH<sup>1</sup>, Fowler PJ, Nott L.

Twenty-five patients with well-documented clinical history and elevated tissue pressures were subjected to surgical fasciotomy of the respective compartment (anterior, 13; anterior and posterior, 4; deep posterior, 8). The indications for surgery were resting pressures in excess of 15 mmHg and elevated postexercise pressure measurements with delayed normalization.

Twenty-two patients were satisfied with the procedure and were able to return to athletics. There were three failures, all of whom had decompression of the deep posterior compartment.

This study has demonstrated that fasciotomy of the anterior compartment, when done with the correct indications, gives excellent relief of chronic anterior leg pain. It is recommended that fasciotomy of the deep posterior compartment include a formal release of the tibialis posterior at the time of decompression.

#### 44. RHUMATOID ARTHRITIS

##### AE of Glucocorticoids

J Clin Rheumatol. 2017 Sep 19. doi: 10.1097/RHU.0000000000000585.

##### **A Survey of Glucocorticoid Adverse Effects and Benefits in Rheumatic Diseases: The Patient Perspective.**

Black RJ<sup>1</sup>, Goodman SM, Ruediger C, Lester S, Mackie SL, Hill CL.

##### *OBJECTIVE:*

The aim of this study was to explore, from the patient's perspective, the beneficial and adverse effects (AEs) of glucocorticoids (GCs) in patients with rheumatic diseases, to be used in the development of a patient-reported outcome measure.

##### *METHODS:*

A cross-sectional survey, capturing benefits and AEs of GC use, was administered to 2 groups of patients: (1) those attending a tertiary rheumatology clinic with various rheumatic diseases who had used GCs within the past year and (2) patients from the Hospital for Special Surgery rheumatoid arthritis database.

##### *RESULTS:*

Cohort 1 had 55 GC users, and cohort 2 had 95 GC users and 29 nonusers. The majority of GC users in both cohorts reported at least 1 AE (100%, 86%). The AE prevalence per person was 50% higher in cohort 1 compared with GC users in cohort 2 (7.7 vs. 5.3; AE ratio, 1.5; 95% confidence interval, 1.3-1.7) and 2-fold greater in cohort 2 GC users compared with GC nonusers (5.3 vs. 2.6; AE ratio, 2.0; 95% confidence interval, 1.6-2.6). In both cohorts, AEs identified as "worst" by GC users included skin thinning/easy bruising, sleep disturbance, mood disturbance, and change in facial shape. Most felt GCs helped their disease "a lot" (78%/62%) and that the benefits were greater than the AEs (55%/64%). Many AEs were more frequent in GC users than in nonusers.

##### *CONCLUSIONS:*

Patients receiving GC therapy for rheumatic conditions report a large number of AEs and those that have the greatest life impact are often difficult for physicians to measure. These results will inform the development of a patient-reported outcome measure to capture the effects of GCs from the patient's perspective

### 50 A. MOTOR CONTROL

#### Attentional focus

Int J Sports Phys Ther. 2017 Nov;12(6):901-907.

#### **THE IMPACT OF ATTENTIONAL FOCUS ON THE TREATMENT OF MUSCULOSKELETAL AND MOVEMENT DISORDERS.**

Hunt C<sup>1</sup>, Paez A<sup>1</sup>, Folmar E<sup>1</sup>.

Treatment plans employed by physical therapists involved in musculoskeletal rehabilitation may follow a conventional medical-model approach, isolating care at the tissue level but neglecting consideration for neurocognitive contributions to recovery. Understanding and integration of motor learning concepts into physical therapy practice is integral for influencing the human movement system in the most effective manner. One such motor learning concept is the use of verbal instruction to influence the attentional focus of the learner.

Evidence suggests that encouraging an external focus of attention through verbal instruction promotes superior motor performance, and more lasting effects of a learning experience than an internal focus of attention. Utilizing an external focus of attention when instructing a patient on a motor task may facilitate improved motor performance and improved functional outcomes in treatment plans devised to address musculoskeletal injury and movement disorders.

The purpose of this review is to summarize the basic principles of motor learning and available evidence on the influence an external focus of attention has on motor learning and performance, including the benefits of an external focus of attention over an internal focus of attention and how therapists may inadvertently encourage the latter. Furthermore, the benefits of possessing greater awareness of neurocognitive mechanisms are discussed to exhibit how implementing such concepts into musculoskeletal rehabilitation can maximize treatment outcomes.

**LEVEL OF EVIDENCE:** 5.

**KEYWORDS:** Focus of attention; motor learning; movement system; musculoskeletal rehabilitation

## 52. EXERCISE

### Blood flow restrictions

Exp Gerontol. 2017 Dec 1;99:127-132. doi: 10.1016/j.exger.2017.09.016. Epub 2017 Oct 3.

#### **Effects of blood flow restricted exercise training on muscular strength and blood flow in older adults.**

Kim J<sup>1</sup>, Lang JA<sup>1</sup>, Pילania N<sup>1</sup>, Franke WD<sup>2</sup>.

#### **BACKGROUND:**

In young adults, blood flow restricted exercise (BFRE) at relatively low intensities can increase muscle strength as effectively as conventional high intensity training. Ischemic exercise can also increase collateral blood flow in skeletal muscle. However, the effects of chronic BFRE on muscle strength and blood flow in older adults remain unknown. The purpose of this study was to compare the effects of 4weeks of BFRE training on skeletal muscle strength and blood flow between young and older subjects and between older adults performing BFRE and conventional high intensity resistance exercise.

#### **METHODS:**

Maximum voluntary contraction (MVC), forearm girth, peak forearm blood flow (FBF) and forearm vascular conductance (FVC) were assessed before and after 4weeks of forearm resistance training with BFRE in older adults (O-BFRE, 63±1 y, n=9) and younger adults (Y-BFRE, 22±1 y, n=8) and with high intensity training at 75% maximum voluntary contraction in older adults (O-HI, 63±1 y, n=10).

#### **RESULTS:**

MVC increased in all groups (O-BFRE, 33.4±4.7 to 36.3±4.7kg; Y-BFRE, 37.2±4.9 to 43.0±5.0kg; O-HI, 34.0±4.4 to 39.8±4.4kg; all p<0.05). Forearm girth increased in O-BFRE (26.3±1.1 to 26.7±1.1cm; p<0.05) and Y-BFRE (23.9±0.9 to 25.1±1.5cm; p<0.05) but not in O-HI (25.9±1.0 to 26.1±1.0cm; p=0.26). Peak forearm vascular conductance increased in Y-BFRE (0.190±0.016 to 0.311±0.031units; p=0.01) but not in O-BFRE (0.157±0.024 to 0.193±0.029units; p=0.48) and O-HI (0.188±0.035 to 0.227±0.035units; p=0.18).

#### **CONCLUSION:**

These data suggest that chronic BFRE training is effective in increasing muscular strength, muscle size and vascularity in young adults but, in older adults, increases only muscular strength and size. Longer training durations or higher volumes may be required to evoke similar vascular adaptations in older adults.

Hamstrings and Gluts

J Strength Cond Res. 2017 Oct 20. doi: 10.1519/JSC.0000000000001893.

### **Gluteus Maximus and Hamstring Activation During Selected Weight-Bearing Resistance Exercises.**

McCurdy K<sup>1</sup>, Walker J, Yuen D.

#### **Author information**

D. Gluteus maximus and hamstring activation during selected weight-bearing resistance exercises. J Strength Cond Res XX(X): 000-000, 2017-

The purpose of this study was to compare the gluteus maximus (GM) and hamstring group (HG) electromyographic (EMG) activation levels among selected weight-bearing resistance exercises.

Eighteen young adult females with previous resistance training experience completed the study. Strength was assessed on the bilateral squat (BS) (3 repetition maximum [RM]), modified single-leg squat (MSLS) (3RM), and stiff-leg deadlift (SLDL) (8RM) to determine an 8RM load for all lifts. Surface EMG was collected after 48 hours of rest using wireless Trigno IM Sensors using EMMA software (Delsys), which also collected and synchronized 3D hip and knee motion. A maximum voluntary isometric contraction was determined for the GM and HG to normalize the EMG data. During EMG data collection, 3 repetitions were completed using an 8RM load on all 3 exercises. Gluteus maximus EMG was significantly greater than HG EMG on the BS (40.3 vs. 24.4%,  $p < 0.001$ ), MSLS (65.6 vs. 40.1 %,  $p < 0.012$ ), and SLDL (40.5 vs. 29.9 %,  $p < 0.047$ ). The MSLS produced significantly greater HG EMG ( $p = 0.001$ ) compared with the SLDL, whereas the SLDL was significantly greater ( $p = 0.004$ ) than the BS.

The MSLS GM EMG was also significantly greater ( $p < 0.001$ ) than the SLDL and BS, whereas no difference was found between the SLDL and BS. Comparing the activation of the 2 muscle groups in all exercises, the GM seems to be the primary muscle recruited whereas the MSLS seems to produce greater GM and HG activation. The data indicate that it would be most beneficial to include the MSLS during GM and HG training.

**ES and calf cramps**

Neuromodulation. 2017 Nov 22. doi: 10.1111/ner.12728

**Effects of Neuromuscular Electrical Stimulation on the Frequency of Skeletal Muscle Cramps: A Prospective Controlled Clinical Trial.**

Behringer M<sup>1</sup>, Harmsen JF<sup>2</sup>, Fasse A<sup>3</sup>, Mester J<sup>2</sup>.

**OBJECTIVES:**

We investigated if neuromuscular electrical stimulation (NMES) of calf muscles prevents spontaneous calf cramps.

**MATERIALS AND METHODS:**

In 19 individuals affected by more than or equal to one calf cramp per week the gastrocnemius of the predominantly affected leg was stimulated twice a week (intervention leg, IL) over six weeks (3 × 6 stimulation trains at 30 Hz above the individual cramp threshold frequency). The other leg served as control (CL). The participants were advised to record all spontaneous muscle cramps from two weeks before the intervention until two weeks after the last NMES session.

**RESULTS:**

The number of spontaneous calf cramps in the two weeks after the intervention was 78% lower ( $2.1 \pm 6.8$  cramps) in the stimulated ( $p < 0.001$ ) and 63% lower ( $2.0 \pm 6.9$  cramps) in the unstimulated calves ( $p < 0.001$ ), when compared to the two weeks prior to the intervention (IL:  $9.6 \pm 12.4$  cramps; CL:  $5.5 \pm 12.7$  cramps). Only in the IL, this improvement was accompanied by an increase in the cramp threshold frequency from  $15.5 \pm 8.5$  Hz before the NMES intervention to  $21.7 \pm 12.4$  Hz after the intervention. The severity of the remaining calf cramps tended to be lower in both legs after the intervention.

**CONCLUSIONS:**

The applied stimulation protocol seems to provide an effective prevention strategy in individuals affected by regular calf cramps.

**Testing gluten sensitivity**

Gastroenterology. 2017 Nov 13. pii: S0016-5085(17)36352-7. doi: 10.1053/j.gastro.2017.11.006.

**HLA-DQ-Gluten Tetramer Blood Test Accurately Identifies Patients With and Without Celiac Disease in Absence of Gluten Consumption.**

Sarna VK<sup>1</sup>, Lundin KEA<sup>2</sup>, Mørkrid L<sup>3</sup>, Qiao SW<sup>4</sup>, Sollid LM<sup>4</sup>, Christophersen A<sup>5</sup>.

**BACKGROUND & AIMS:**

Celiac disease is characterized by HLA-DQ2/8-restricted responses of CD4+ T cells to cereal gluten proteins. A diagnosis of celiac disease based on serologic and histologic evidence and duodenal histology requires patients to be on gluten-containing diets. The growing number of individuals adhering to a gluten-free diet (GFD) without exclusion of celiac disease complicates its detection. HLA-DQ-gluten tetramers can be used to detect gluten-specific T cells in blood of patients with celiac disease, even if they are on a GFD. We investigated whether an HLA-DQ-gluten tetramer-based assay accurately identifies patients with celiac disease.

**METHODS:**

We produced HLA-DQ-gluten tetramers and added them to peripheral blood mononuclear cells isolated from 143 HLA-DQ2.5+ subjects (62 subjects with celiac disease on a GFD, 19 subjects without celiac disease on a GFD [due to self-reported gluten-sensitivity], 10 subjects with celiac disease on a gluten-containing diet, and 52 presumed healthy individuals [controls]). T cells that bound HLA-DQ-gluten tetramers were quantified by flow cytometry. Laboratory tests and flow cytometry gating analyses were performed by researchers blinded to sample type, except for samples from subjects with celiac disease on a gluten-containing diet. Test precision analyses were performed using samples from 10 subjects.

**RESULTS:**

For the HLA-DQ-gluten tetramer-based assay, we combined flow-cytometry variables in a multiple regression model that identified individuals with celiac disease on a GFD with an area under the receiver operating characteristic curve (AUROC) value of 0.96 (95% CI, 0.89-1.00) vs subjects without celiac disease on a GFD. The assay detected individuals with celiac disease on a gluten-containing diet vs controls with an AUROC value of 0.95 (95% CI, 0.90-1.00). Optimized cut-off values identified subjects with celiac disease on a GFD with 97% sensitivity (95% CI, 0.92-1.00) and 95% specificity (95% CI, 0.84-1.00), vs subjects without celiac disease on a GFD. The values identified subjects with celiac disease on a gluten-containing diet with 100% sensitivity (95% CI, 1.00-1.00) and 90% specificity (95% CI, 0.83-0.98) vs controls. In an analysis of 4 controls with positive results from the HLA-DQ-gluten tetramer test, 2 had unrecognized celiac disease and the remaining 2 had T cells that proliferated in response to gluten antigen in vitro.

**CONCLUSIONS:**

An HLA-DQ-gluten tetramer-based assays that detects gluten-reactive T cells identifies patients with and without celiac disease with a high level of accuracy, regardless of whether the individuals are on a GFD. This test would allow individuals with suspected celiac disease to avoid gluten challenge and duodenal biopsy, but requires validation in a larger study. Clinicaltrials.gov no: [NCT02442219](https://clinicaltrials.gov/ct2/show/study/NCT02442219).

Gluten sensitivity

Gastroenterology. 2017 Nov 1. pii: S0016-5085(17)36302-3. doi: 10.1053/j.gastro.2017.10.040.

**Fructan, Rather Than Gluten, Induces Symptoms in Patients With Self-reported Non-celiac Gluten Sensitivity.**

Skodje GI<sup>1</sup>, Sarna VK<sup>2</sup>, Minelle IH<sup>3</sup>, Rolfsen KL<sup>3</sup>, Muir JG<sup>4</sup>, Gibson PR<sup>4</sup>, Veierød MB<sup>5</sup>, Henriksen C<sup>6</sup>, Lundin KEA<sup>7</sup>.

**BACKGROUND & AIMS:**

Non-celiac gluten sensitivity is characterized by symptom improvement after gluten withdrawal in absence of celiac disease. The mechanisms of non-celiac gluten sensitivity are unclear, and there are no biomarkers for this disorder. Foods with gluten often contain fructans, a type of fermentable oligo-, di-, monosaccharides and polyols. We aimed to investigate the effect of gluten and fructans separately in individuals with self-reported gluten sensitivity.

**METHODS:**

We performed a double-blind crossover challenge of 59 individuals on a self-instituted gluten-free diet, for whom celiac disease had been excluded. The study was performed at Oslo University Hospital in Norway from October 2014 through May 2016. Participants were randomly assigned to groups placed on diets containing gluten (5.7 g), fructans (2.1 g), or placebo, concealed in muesli bars, for 7 days. Following a minimum 7-day washout period (until the symptoms induced by the previous challenge were resolved), participants crossed over into a different group, until they completed all 3 challenges (gluten, fructan, and placebo). Symptoms were measured by gastrointestinal symptom rating scale irritable bowel syndrome (GSRS-IBS) version. A linear mixed model for analysis was used.

**RESULTS:**

Overall GSRS-IBS scores differed significantly during gluten, fructan, and placebo challenges; mean values were  $33.1 \pm 13.3$ ,  $38.6 \pm 12.3$ , and  $34.3 \pm 13.9$ , respectively ( $P = .04$ ). Mean scores for GSRS bloating were  $9.3 \pm 3.5$ ,  $11.6 \pm 3.5$ , and  $10.1 \pm 3.7$ , respectively, during the gluten, fructan, and placebo challenges ( $P = .004$ ). The overall GSRS-IBS score for participants consuming fructans was significantly higher than for participants consuming gluten ( $P = .049$ ), as was the GSRS bloating score ( $P = .003$ ). Thirteen participants had the highest overall GSRS-IBS score after consuming gluten, 24 had the highest score after consuming fructan, and 22 had the highest score after consuming placebo. There was no difference in GSRS-IBS scores between gluten and placebo groups.

**CONCLUSIONS:**

In a randomized, double-blind, placebo-controlled crossover study of individuals with self-reported non-celiac gluten sensitivity, we found fructans to induce symptoms, measured by the gastrointestinal symptom rating scale irritable bowel syndrome version. [Clinicaltrials.gov](https://www.clinicaltrials.gov) no: [NCT02464150](https://www.clinicaltrials.gov/ct2/show/study/NCT02464150).

Heart problems and athletics

Published in Cardiology and



Journal Scan / Research · November 22, 2017

### **Sudden Cardiac Arrest Uncommon During Participation in Competitive Sports**

The New England Journal of Medicine

#### **TAKE-HOME MESSAGE**

- Data from the Canadian Rescu Epistry cardiac arrest database were used to evaluate the incidence of cardiac arrest during sports among individuals aged 12 to 45 years. There were 74 sudden cardiac arrests during participation in sports identified over 18.5 million person-years of observation. There were 16 cardiac arrests during competitive sports and 58 arrests seen during noncompetitive sports. During competitive sports, the incidence of sudden cardiac arrest was 0.76 per 100,000 athlete-years and survival to discharge from the hospital was seen in 43.8% of cases.
- The incidence of sudden cardiac arrest during participation in competitive sports is low, and arrest is usually not secondary to a structural heart abnormality.

**Attentional focus**

Int J Sports Phys Ther. 2017 Nov;12(6):901-907.

### **THE IMPACT OF ATTENTIONAL FOCUS ON THE TREATMENT OF MUSCULOSKELETAL AND MOVEMENT DISORDERS.**

Hunt C<sup>1</sup>, Paez A<sup>1</sup>, Folmar E<sup>1</sup>.

Treatment plans employed by physical therapists involved in musculoskeletal rehabilitation may follow a conventional medical-model approach, isolating care at the tissue level but neglecting consideration for neurocognitive contributions to recovery. Understanding and integration of motor learning concepts into physical therapy practice is integral for influencing the human movement system in the most effective manner. One such motor learning concept is the use of verbal instruction to influence the attentional focus of the learner.

Evidence suggests that encouraging an external focus of attention through verbal instruction promotes superior motor performance, and more lasting effects of a learning experience than an internal focus of attention. Utilizing an external focus of attention when instructing a patient on a motor task may facilitate improved motor performance and improved functional outcomes in treatment plans devised to address musculoskeletal injury and movement disorders.

The purpose of this review is to summarize the basic principles of motor learning and available evidence on the influence an external focus of attention has on motor learning and performance, including the benefits of an external focus of attention over an internal focus of attention and how therapists may inadvertently encourage the latter. Furthermore, the benefits of possessing greater awareness of neurocognitive mechanisms are discussed to exhibit how implementing such concepts into musculoskeletal rehabilitation can maximize treatment outcomes.

**LEVEL OF EVIDENCE:** 5.

**KEYWORDS:** Focus of attention; motor learning; movement system; musculoskeletal rehabilitation

## **57. GAIT**

**Gait changes in LBP**

Spine (Phila Pa 1976). 2017 Dec 1;42(23):E1350-E1356. doi: 10.1097/BRS.0000000000002161.

### **A Kinematic Symmetry Index of Gait Patterns Between Older Adults With and Without Low Back Pain.**

Sung PS<sup>1</sup>, Danial P.

*STUDY DESIGN:*

Cross-sectional study.

*OBJECTIVE:*

To investigate the symmetry index for limb support patterns in right limb-dominant older adults with and without low back pain (LBP).

*SUMMARY OF BACKGROUND DATA:*

The effects of bilateral asymmetry on gait performance were reported; however, there is a lack of understanding on kinematic symmetry to assess subjects with LBP. This asymmetry might be related to increased compensatory patterns to the dominant side in subjects with LBP.

*METHODS:*

Eighty-two right limb-dominant older adults (45 control subjects and 37 subjects with LBP) participated in the study. A three-dimensional motion capture system was used to measure temporal-spatial gait parameters (cadence, speed, stride length, step length, and limb support times). The symmetry index was the ratio of the gait cycle between the limbs to compare the dominance pattern between groups.

*RESULTS:*

Although the symmetry index was not different between groups, the initial limb support ( $t=2.07$ ,  $P=0.04$ ) and terminal limb support ( $t=-2.26$ ,  $P=0.02$ ) times were significantly different. The LBP group demonstrated significantly greater nondominant initial support times and dominant terminal support times. The single-limb support was not different between groups ( $t=1.72$ ,  $P=0.09$ ). The limb support pattern demonstrated a significant interaction between groups ( $F=4.72$ ,  $P=0.03$ ) regardless of gait speed ( $F=0.91$ ,  $P=0.34$ ).

*CONCLUSION:*

An asymmetrical gait pattern was evident in the LBP group as they demonstrated a longer double-limb support pattern due to a possible pain avoidance strategy. The control group demonstrated a symmetrical pattern for limb support in the stance phase. Clinicians need to consider asymmetric limb support patterns of gait modification similar to the control group when developing rehabilitation strategies for patients with LBP.

## **58. RUNNING**

### **Speed running**

J Sports Sci. 2017 Oct 7:1-10. doi: 10.1080/02640414.2017.1389101.

**Step-to-step spatiotemporal variables and ground reaction forces of intra-individual fastest sprinting in a single session.**

Nagahara R<sup>1</sup>, Mizutani M<sup>1</sup>, Matsuo A<sup>1</sup>, Kanehisa H<sup>1</sup>, Fukunaga T<sup>1</sup>.

We aimed to investigate the step-to-step spatiotemporal variables and ground reaction forces during the acceleration phase for characterising intra-individual fastest sprinting within a single session. Step-to-step spatiotemporal variables and ground reaction forces produced by 15 male athletes were measured over a 50-m distance during repeated (three to five) 60-m sprints using a long force platform system. Differences in measured variables between the fastest and slowest trials were examined at each step until the 22nd step using a magnitude-based inferences approach. There were possibly-most likely higher running speed and step frequency (2nd to 22nd steps) and shorter support time (all steps) in the fastest trial than in the slowest trial. Moreover, for the fastest trial there were likely-very likely greater mean propulsive force during the initial four steps and possibly-very likely larger mean net anterior-posterior force until the 17th step.

The current results demonstrate that better sprinting performance within a single session is probably achieved by 1) a high step frequency (except the initial step) with short support time at all steps, 2) exerting a greater mean propulsive force during initial acceleration, and 3) producing a greater mean net anterior-posterior force during initial and middle acceleration.

**KEYWORDS:** Locomotion; intra-individual; running speed; short term; step frequency

**Heel length**

J Appl Biomech. 2017 Oct 1;33(5):317-322. doi: 10.1123/jab.2016-0173. Epub 2017 Sep 18.

**Does Foot Anthropometry Predict Metabolic Cost During Running?**

van Werkhoven H<sup>1,2</sup>, Piazza SJ<sup>2</sup>.

**Abstract**

Several recent investigations have linked running economy to heel length, with shorter heels being associated with less metabolic energy consumption. It has been hypothesized that shorter heels require larger plantar flexor muscle forces, thus increasing tendon energy storage and reducing metabolic cost.

The goal of this study was to investigate this possible mechanism for metabolic cost reduction. Fifteen male subjects ran at  $16 \text{ km} \cdot \text{h}^{-1}$  on a treadmill and subsequently on a force-plate instrumented runway. Measurements of oxygen consumption, kinematics, and ground reaction forces were collected. Correlational analyses were performed between oxygen consumption and anthropometric and kinetic variables associated with the ankle and foot. Correlations were also computed between kinetic variables (peak joint moment and peak tendon force) and heel length. Estimated peak Achilles tendon force normalized to body weight was found to be strongly correlated with heel length normalized to body height ( $r = -.751$ ,  $p = .003$ ).

Neither heel length nor any other measured or calculated variable were correlated with oxygen consumption, however. Subjects with shorter heels experienced larger Achilles tendon forces, but these forces were not associated with reduced metabolic cost. No other anthropometric and kinetic variables considered explained the variance in metabolic cost across individuals.

**KEYWORDS:** ankle; biomechanics; heel; oxygen consumption; running economy

**Biomechanics in LL syndromes**

Am J Sports Med. 2017 Sep;45(11):2614-2621. doi: 10.1177/0363546517708193. Epub 2017 Jun 5.

### **Biomechanical Factors Associated With Achilles Tendinopathy and Medial Tibial Stress Syndrome in Runners.**

Becker J<sup>1</sup>, James S<sup>2</sup>, Wayner R<sup>3</sup>, Osternig L<sup>4</sup>, Chou LS<sup>4</sup>.

#### **BACKGROUND:**

There is disagreement in the literature regarding whether the excessive excursion or velocity of rearfoot eversion is related to the development of 2 common running injuries: Achilles tendinopathy (AT) and medial tibial stress syndrome (MTSS). An alternative hypothesis suggests that the duration of rearfoot eversion may be an important factor. However, the duration of eversion has received relatively little attention in the biomechanics literature.

#### **HYPOTHESIS:**

Runners with AT or MTSS will demonstrate a longer duration of eversion but not greater excursion or velocity of eversion compared with healthy controls.

#### **STUDY DESIGN:**

Controlled laboratory study.

#### **METHODS:**

Forty-two runners participated in this study (13 with AT, 8 with MTSS, and 21 matched controls). Participants were evaluated for lower extremity alignment and flexibility, after which a 3-dimensional kinematic and kinetic running gait analysis was performed. Differences between the 2 injuries and between injured and control participants were evaluated for flexibility and alignment, rearfoot kinematics, and 3 ground-reaction force metrics. Binary logistic regression was used to evaluate which variables best predicted membership in the injured group.

#### **RESULTS:**

Injured participants, compared with controls, demonstrated higher standing tibia varus angles ( $8.67^\circ \pm 1.79^\circ$  vs  $6.76^\circ \pm 1.75^\circ$ , respectively;  $P = .002$ ), reduced static dorsiflexion range of motion ( $6.14^\circ \pm 5.04^\circ$  vs  $11.19^\circ \pm 5.10^\circ$ , respectively;  $P = .002$ ), more rearfoot eversion at heel-off ( $-6.47^\circ \pm 5.58^\circ$  vs  $1.07^\circ \pm 2.26^\circ$ , respectively;  $P < .001$ ), and a longer duration of eversion ( $86.02\% \pm 15.65\%$  stance vs  $59.12\% \pm 16.50\%$  stance, respectively;  $P < .001$ ). There were no differences in the excursion or velocity of eversion. The logistic regression ( $\chi^2 = 20.84$ ,  $P < .001$ ) revealed that every 1% increase in the duration of eversion during the stance phase increased the odds of being in the injured group by 1.08 (95% CI, 1.023-1.141;  $P = .006$ ).

#### **CONCLUSION:**

Compared with healthy controls, runners currently symptomatic with AT or MTSS have a longer duration of eversion but not greater excursion or velocity of eversion.

#### **CLINICAL RELEVANCE:**

Static measures of the tibia varus angle and dorsiflexion range of motion, along with dynamic measures of the duration of eversion, may be useful for identifying runners at risk of sustaining AT or MTSS.

#### **KEYWORDS:**

Achilles tendinopathy; medial tibial stress syndrome; period of pronation; running injuries

### **Fatigue in running**

Sports Biomech. 2017 Jul 21:1-11. doi: 10.1080/14763141.2017.1347193

**Novice runners show greater changes in kinematics with fatigue compared with competitive runners.**

Maas E<sup>1</sup>, De Bie J<sup>1</sup>, Vanfleteren R<sup>1</sup>, Hoogkamer W<sup>2</sup>, Vanwanseele B<sup>1</sup>.

Fatigue, developed over the course of a run, may cause changes in running kinematics. Training status may influence the effect of fatigue on running kinematics, since well trained, competitive runners are used to running until exhaustion, whereas novice runners are not.

This study aimed to determine changes in running kinematics during an exhaustive run in both novice (NOVICE) and competitive (COMP) long-distance runners. About 15 NOVICE and 15 COMP runners performed a treadmill run, until voluntary exhaustion at 3,200 m time trial pace. Joint angles and global trunk and pelvis angles were recorded at the beginning and at the end of the run.

In both groups, peak pelvic anterior tilt, pelvic rotation range of motion (both during stance phase) and ankle plantar flexion during swing phase increased after the exhaustive run. There was a significant interaction effect between group and exhaustion for peak forward trunk lean, which increased only in the NOVICE group, and for hip abduction during mid-swing, which increased in NOVICE and decreased in COMP runners.

In conclusion, NOVICE runners showed larger kinematic adjustments when exhausted than COMP runners. This may affect their running performance and should be taken into account when assessing a runner's injury risk.

**KEYWORDS:** Running; biomechanics; performance; training

### Changes in running with Achilles pathology

J Foot Ankle Res. 2011 May 30;4:15. doi: 10.1186/1757-1146-4-15.

**Lower limb biomechanics during running in individuals with achilles tendinopathy: a systematic review.**

Munteanu SE<sup>1</sup>, Barton CJ.

**BACKGROUND:**

Abnormal lower limb biomechanics is speculated to be a risk factor for Achilles tendinopathy. This study systematically reviewed the existing literature to identify, critique and summarise lower limb biomechanical factors associated with Achillestendinopathy.

**METHODS:**

We searched electronic bibliographic databases (Medline, EMBASE, Current contents, CINAHL and SPORTDiscus) in November 2010. All prospective cohort and case-control studies that evaluated biomechanical factors (temporospatial parameters, lowerlimb kinematics, dynamic plantar pressures, kinetics [ground reaction forces and joint moments] and muscle activity) associated with mid-portion Achilles tendinopathy were included. Quality of included studies was evaluated using the Quality Index. The magnitude of differences (effect sizes) between cases and controls was calculated using Cohen's d (with 95% CIs).

**RESULTS:**

Nine studies were identified; two were prospective and the remaining seven case-control study designs. The quality of 9 identified studies was varied, with Quality Index scores ranging from 4 to 15 out of 17. All studies analysed running biomechanics. Cases displayed increased eversion range of motion of the rearfoot ( $d = 0.92$  and  $0.67$  in two studies), reduced maximum lower leg abduction ( $d = -1.16$ ), reduced ankle joint dorsiflexion velocity ( $d = -0.62$ ) and reduced knee flexion during gait ( $d = -0.90$ ). Cases also demonstrated a number of differences in dynamic plantar pressures (primarily the distribution of the centre of force), ground reaction forces (large effects for timing variables) and also showed reduced peak tibial external rotation moment ( $d = -1.29$ ). Cases also displayed differences in the timing and amplitude of a number of lower limb muscles but many differences were equivocal.

**CONCLUSIONS:**

There are differences in lower limb biomechanics between those with and without Achilles tendinopathy that may have implications for the prevention and management of the condition. However, the findings need to be interpreted with caution due to the limited quality of a number of the included studies. Future well-designed prospective studies are required to confirm these findings.



**59. PAIN****Neuropathic pain testing**

Pain. 2017 Dec;158(12):2340-2353. doi: 10.1097/j.pain.0000000000001034.

**Sensory phenotype and risk factors for painful diabetic neuropathy: a cross-sectional observational study.**

Raputova J<sup>1</sup>, Srotova I, Vlckova E, Sommer C, Üçeyler N, Birklein F, Rittner HL, Reborn C, Adamova B, Kovalova I, Kralickova Nekvapilova E, Forer L, Belobradkova J, Olsovsky J, Weber P, Dusek L, Jarkovsky J, Bednarik J.

Different sensory profiles in diabetic distal symmetrical sensory-motor polyneuropathy (DSPN) may be associated with pain and the responsiveness to analgesia.

We aimed to characterize sensory phenotypes of patients with painful and painless diabetic neuropathy and to assess demographic, clinical, metabolic, and electrophysiological parameters related to the presence of neuropathic pain in a large cohort of well-defined DSPN subjects. This observational cross-sectional multi-center cohort study (performed as part of the ncRNAPain EU consortium) of 232 subjects with nonpainful (n = 74) and painful (n = 158) DSPN associated with diabetes mellitus of type 1 and 2 (median age 63 years, range 21-87 years; 92 women) comprised detailed history taking, laboratory tests, neurological examination, quantitative sensory testing, nerve conduction studies, and neuropathy severity scores. All parameters were analyzed with regard to the presence and severity of neuropathic pain. Neuropathic pain was positively correlated with the severity of neuropathy and thermal hyposensitivity ( $P < 0.001$ ). A minority of patients with painful DSPN (14.6%) had a sensory profile, indicating thermal hypersensitivity that was associated with less severe neuropathy. Neuropathic pain was further linked to female sex and higher cognitive appraisal of pain as assessed by the pain catastrophizing scale ( $P < 0.001$ ), while parameters related to diabetes showed no influence on neuropathic pain with the exception of laboratory signs of nephropathy.

This study confirms the value of comprehensive DSPN phenotyping and underlines the importance of the severity of neuropathy for the presence of pain. Different sensory phenotypes might be useful for stratification of patients with painful DSPN for analgesic treatment and drug trials.

**62 A. NUTRITION/VITAMINS****Caffeine and work load**

Med Sci Sports Exerc. 2017 Aug 21. doi: 10.1249/MSS.0000000000001408.

**Caffeine Increases Work Done above Critical Power, but not Anaerobic Work.**

Silveira R<sup>1</sup>, Andrade-Souza VA, Arcoverde L, Tomazini F, Sansonio A, Bishop DJ, Bertuzzi R, Lima-Silva AE.

**PURPOSE:**

The assumption that the curvature constant ( $W'$ ) of the power-duration relationship represents anaerobic work capacity is a controversial, unresolved question. We investigated if caffeine ingestion could increase total work done above critical power (CP), and if this would be accompanied by greater anaerobic energy expenditure and by an enhanced maintenance of maximal oxidative metabolic rate.

**METHODS:**

Nine men ( $26.6 \pm 5.3$  years,  $\dot{V}O_{2\max}$   $40.6 \pm 5.8$  mL·kg<sup>-1</sup>·min<sup>-1</sup>) cycled until exhaustion at different exercise intensities on different days to determine the CP and  $W'$ . On separated days, participants cycled until exhaustion in the severe-intensity domain ( $136 \pm 7\%$  of CP) after ingesting either caffeine (5 mg·kg body mass) or a placebo. Results Time to exhaustion was 34% longer with caffeine compared to placebo, and this was accompanied by a greater work done above CP ( $23.7 \pm 5.7$  vs  $17.5 \pm 3.6$  kJ;  $130 \pm 30\%$  vs  $95 \pm 14\%$  of  $W'$ ,  $P < 0.01$ ). Caffeine increased the aerobic energy expenditure ( $296.4 \pm 91.0$  vs  $210.2 \pm 71.9$  kJ,  $P < 0.01$ ), but not anaerobic lactic, anaerobic alactic, and total anaerobic (lactic + alactic) energy expenditure. The end values of heart rate and ventilation were higher with caffeine, but the  $\dot{V}O_2$  end was similar between conditions and was not different from  $\dot{V}O_{2\max}$ . Caffeine did not change time to reach  $\dot{V}O_{2\max}$ , but increased time maintained at  $\dot{V}O_{2\max}$  ( $199.3 \pm 105.9$  vs  $111.9 \pm 87.1$  s,  $P < 0.05$ ).

Conclusions Caffeine increased total work done above CP, but this was not associated with greater anaerobic work. Rather, this was associated with a higher tolerance to maintain exercise at maximal oxidative metabolic rate.

**63. PHARMACOLOGY**

**White matter changes in war veterans with chronic pain**

Pain. 2017 Dec;158(12):2364-2375. doi: 10.1097/j.pain.0000000000001038.

**Cerebral white matter structure is disrupted in Gulf War Veterans with chronic musculoskeletal pain.**

Van Riper SM<sup>1</sup>, Alexander AL, Koltyn KF, Stegner AJ, Ellingson LD, Destiche DJ, Dougherty RJ, Lindheimer JB, Cook DB.

Chronic musculoskeletal pain (CMP) affects ~25% of the 700,000 Veterans deployed during the Persian Gulf War (1990-1991). The cause of their pain is unknown, and there are no efficacious treatments. A small body of literature suggests that brain abnormalities exist in Gulf War Veterans (GVs), yet relationships between brain abnormalities and disease symptoms remain largely unexplored.

Our purpose was to compare white matter (WM) integrity between GVCMP and matched, healthy Veteran controls (GVCO) and investigate relationships between cerebral WM integrity and symptoms. Thirty GVCMP and 31 controls completed magnetic resonance imaging with diffusion tensor imaging. Tract-based spatial statistics estimated WM fractional anisotropy, mean diffusivity, radial diffusivity, and axial diffusivity over the whole brain ( $P < 0.05$ ) and were corrected using threshold-free cluster enhancement. GVCMP had greater pain symptoms and mood disturbance and lower quality of life and physical function compared with GVCO ( $P < 0.05$ ). GVCMP had lower WM integrity across several brain regions implicated in chronic pain ( $P < 0.05$ ) including the middle and inferior frontal gyrus, corpus callosum, corona radiata, precentral gyrus, external capsule, and posterior thalamic radiation. For GVCMP, WM integrity was associated with pain and mood symptoms in widespread brain areas that were found to be different between groups ( $P < 0.05$ ).

Results indicate widespread WM microstructure disruption across brain regions implicated in pain processing and modulation in chronic pain. The observed relationships between WM microstructure and symptoms encourage the testing of treatments designed to improve the brain health of affected Veterans.

**Socioeconomic status and opioid perscriptions**

J Am Board Fam Med. 2017 Nov-Dec;30(6):775-783. doi: 10.3122/jabfm.2017.06.170061.

### **Neighborhood Socioeconomic Status and Receipt of Opioid Medication for New Back Pain Diagnosis.**

Gebauer S<sup>1</sup>, Salas J<sup>2</sup>, Scherrer JF<sup>2</sup>.

#### **BACKGROUND:**

Although treatment for new back pain is heavily guideline driven, deviations occur frequently. Neighborhood socioeconomic status (nSES) may contribute to these deviations.

#### **OBJECTIVE:**

Determine whether nSES is associated with type of treatment provided for patients seeking treatment for new back pain in primary care clinics.

#### **METHODS:**

This retrospective cohort was conducted in academic internal and family medicine practices. Data were examined from the Primary Care Patient Data Registry. Eligibility criteria included age  $\geq 18$  years, free of HIV and cancer, and presenting to primary care with a new diagnosis of back pain, resulting in 1646 patients included. Patients' nSES was determined using ZIP code and calculating a validated index of 7 census-tract variables. Multinomial logistic regression was used to measure the association between nSES and 3 treatment outcomes compared with no pharmacologic management. Outcomes included opioid prescription, nonsteroidal anti-inflammatory (NSAID)/muscle relaxant prescription, or combined opioid/nonopioid treatment within 90 days of initial presentation. Covariates included age, sex, race, high clinic utilization (HCU), depression, anxiety, substance use, obesity, comorbidities, smoking, number of pain conditions, and physical therapy (PT) referral.

#### **RESULTS:**

The cohort was 67.9% female with an average age of 55.72 years (Standard Error [SE] = 0.387). Compared with no pharmacologic treatment, individuals in the low nSES group had 63% higher odds of receiving an opioid only compared with the high nSES group (odds ratio [OR], 1.63; 95% confidence interval [CI], 1.01 to 2.62). There was no significant association between nSES and odds of nonopioid or combined treatment compared with no pharmacotherapy (OR, 1.17; 95% CI, 0.97 to 1.50), (OR, 1.09; 95% CI, 0.67 to 1.78), respectively. Covariates associated with increased odds of opioid only included HCU, ever smoker, and increasing comorbidity index. PT referral was associated with NSAID/muscle relaxant only, and increasing age and comorbidity index were inversely associated with odds of NSAID/muscle relaxant only. Finally, covariates associated with increased odds of receiving both therapies included high clinic utilization, ever smoking, and PT referral.

#### **CONCLUSIONS:**

These data characterize a possible association between low nSES and increased risk of receiving an opioid only when being treated for new back pain. This may be evidence that patients of low nSES are at increased risk of receiving guideline-noncompliant treatment for new back pain.

Opioid use and AE post-surgery

Pain. 2017 Dec;158(12):2422-2430. doi: 10.1097/j.pain.0000000000001047.

### **Opioid prescription levels and postoperative outcomes in orthopedic surgery.**

Cozowicz C<sup>1</sup>, Olson A, Poeran J, Mörwald EE, Zubizarreta N, Girardi FP, Hughes AP, Mazumdar M, Mementsoudis SG.

Given the basic need for opioids in the perioperative setting, we investigated associations between opioid prescription levels and postoperative outcomes using population-based data of orthopedic surgery patients.

We hypothesized that increased opioid amounts would be associated with higher risk for postoperative complications. Data were extracted from the national Premier Perspective database (2006-2013); N = 1,035,578 lower joint arthroplasties and N = 220,953 spine fusions. Multilevel multivariable logistic regression models measured associations between opioid dose prescription and postoperative outcomes, studied by quartile of dispensed opioid dose.

Compared to the lowest quartile of opioid dosing, high opioid prescription was associated with significantly increased odds for deep venous thrombosis and postoperative infections by approx. 50%, while odds were increased by 23% for urinary and more than 15% for gastrointestinal and respiratory complications ( $P < 0.001$  respectively). Furthermore, higher opioid prescription was associated with a significant increase in length of stay (LOS) and cost by 12% and 6%,  $P < 0.001$  respectively. Cerebrovascular complications risk was decreased by 25% with higher opioid dose ( $P = 0.004$ ), while odds for myocardial infarction remained unaltered. In spine cases, opioid prescription was generally higher, with stronger effects observed for increase in LOS and cost as well as gastrointestinal and urinary complications. Other outcomes were less pronounced, possibly because of smaller sample size.

Overall, higher opioid prescription was associated with an increase in most postoperative complications with the strongest effect observed in thromboembolic, infectious and gastrointestinal complications, cost, and LOS. Increase in complication risk occurred stepwise, suggesting a dose-response gradient.

## **65. NEUROLOGICAL CONDITIONS**

**ES for stroke**

**Effect of EMG-triggered neuromuscular electrical stimulation with bilateral arm training on hemiplegic shoulder pain and arm function after stroke: a randomized controlled trial**

- Li-Ling Chuang, You-Lin Chen, Chih-Chung Chen, Yen-Chen Li, Alice May-Kuen Wong, An-Lun Hsu<sup>†</sup> Ya-Ju Chang<sup>†</sup>

*Journal of NeuroEngineering and Rehabilitation* 2017;14:122

<https://doi.org/10.1186/s12984-017-0332-0>

**Background** Hemiplegic shoulder pain is a frequent complication after stroke, leading to limited use of the affected arm. Neuromuscular electrical stimulation (NMES) and transcutaneous electrical nerve stimulation (TENS) are two widely used interventions to reduce pain, but the comparative efficacy of these two modalities remains uncertain. The purpose of this research was to compare the immediate and retained effects of EMG-triggered NMES and TENS, both in combination with bilateral arm training, on hemiplegic shoulder pain and arm function of stroke patients.

**Methods** A single-blind, randomized controlled trial was conducted at two medical centers. Thirty-eight patients (25 males and 13 females,  $60.75 \pm 10.84$  years old, post stroke duration  $32.68 \pm 53.07$  months) who had experienced a stroke more than 3 months ago at the time of recruitment and hemiplegic shoulder pain were randomized to EMG-triggered NMES or TENS. Both groups received electrical stimulation followed by bilateral arm training 3 times a week for 4 weeks. The primary outcome measures included a vertical Numerical Rating Scale supplemented with a Faces Rating Scale, and the short form of the Brief Pain Inventory. The secondary outcome measures were the upper-limb subscale of the Fugl-Meyer Assessment, and pain-free passive shoulder range of motion. All outcomes were measured pretreatment, post-treatment, and at 1-month after post-treatment. Two-way mixed repeated measures ANOVAs were used to examine treatment effects.

**Results** Compared to TENS with bilateral arm training, the EMG-triggered NMES with bilateral arm training was associated with lower pain intensity during active and passive shoulder movement ( $P=0.007$ ,  $P=0.008$ ), lower worst pain intensity ( $P=0.003$ ), and greater pain-free passive shoulder abduction ( $P=0.001$ ) and internal rotation ( $P=0.004$ ) at follow-up. Both groups improved in pain at rest ( $P=0.02$ ), pain interference with daily activities, the Fugl-Meyer Assessment, and pain-free passive shoulder flexion and external rotation post-treatment ( $P < 0.001$ ) and maintained the improvement at follow-up ( $P < 0.001$ ), except for resting pain ( $P=0.08$ ).

#### Conclusions

EMG-triggered NMES with bilateral arm training exhibited greater immediate and retained effects than TENS with bilateral arm training with respect to pain and shoulder impairment for chronic and subacute stroke patients with hemiplegic shoulder pain.