

# REHAB IN REVIEW

TM

WWW.REHABINREVIEW.COM

Volume 18 Number 3

Published by Physicians  
In Physical Medicine and Rehabilitation

March 5, 2010

## PLATELET RICH PLASMA INJECTIONS FOR CHRONIC ACHILLES TENDINOPATHY

It has been estimated that approximately 30% to 50% of sports related injuries are tendon disorders. Achilles tendon injuries frequently lead to sport cessation and may interfere with activities of daily living. Conservative treatment is disappointing, with 25% to 45% of patients eventually requiring surgery. The recent introduction of platelet rich plasma (PRP) injections for tendinopathy has been met with high expectations. This study investigated the effects of a PRP injection for chronic Achilles tendinopathy on pain and functional outcome.

This double-blind, randomized, placebo controlled trial was conducted between August of 2008 and January of 2009. Fifty-four patients, ages 18 to 70 years, were recruited and randomly assigned to one of two groups; eccentric exercise with PRP injection or eccentric exercise with saline injection (a placebo group). For each patient, four mL of PRP was collected for infiltration and four mL of isotonic saline was also prepared in an identical syringe. The primary outcome measure was the validated Victorian Institute of Sport's Assessment-Achilles (VISA-A) questionnaire, administered at baseline and at six, 12 and 24 weeks. This questionnaire measures pain and activity level. Secondary outcome measures included subjective patient satisfaction, return to sports, and adherence to the eccentric exercises.

The mean VISA-A score in the PRP group after 24 weeks improved by 21 points, while that in the placebo group improved by 20.5 points. Variables that were considered to be important predictors of the primary outcome were the baseline VISA-A score ( $p=0.03$ ) and the duration of symptoms ( $p=0.06$ ). After adjustment for these variables, no significant

differences were found in improvement between the two study groups. In addition, no significant differences were found on the secondary outcome measures.

**Conclusion:** This double-blind, randomized study of patients with chronic Achilles tendinopathy found no significant difference in outcome between those treated with exercise only and those treated with exercise plus platelet rich plasma injections.

De Vos, R., et al. Platelet Rich Plasma Injection for Chronic Achilles Tendinopathy: A Randomized, Controlled Trial. **JAMA.** 2010, January 13; 303(2): 144-149.

## PLATELET CONCENTRATE AND LATERAL EPICONDYLITIS

Lateral epicondylitis is the most commonly diagnosed condition of the elbow. This disorder is believed to result from a combination of mechanical overload and abnormal microvascular responses. Platelet rich plasma (PRP) has been recommended as the ideal, autologous, biological, blood-derived product for application to various tissues. PRP releases high concentrations of platelet derived growth factors that have been shown to enhance wound, bone and tendon healing. This study investigated whether injection of concentrated autologous platelets improves the outcome of lateral epicondylitis.

This double-blind, randomized trial included 100, consecutive patients with chronic, lateral epicondylitis. The patients were randomized to receive either PRP or corticosteroid, with one mL of either PRP or corticosteroid mixed with bupivacaine/epinephrine and injected directly into the area of maximum tenderness. Then, using a 22 gauge needle and a peppering technique, investigators injected the remaining PRP or corticosteroid mixture into the

common extensor tendon, using a single skin portal and five penetrations of the tendon. At four weeks after the procedure, the patients were allowed to proceed with normal sporting or recreational activities. All were assessed with a visual analogue scale for pain and the Disabilities of the Arm, Shoulder and Hand (DASH) outcome measure. Successful treatment was defined as more than a 25% reduction in VAS or DASH scores, without reintervention, after one year.

Six months after the procedure, PRP treated patients attained a mean improvement of 53.5% in their VAS scores, as compared to 14% among those treated with steroids ( $p<0.001$ ). After six months, DASH scores had improved 50.7% in the PRP group, as compared to 10.7% in the steroid treated patients ( $p=0.003$ ). One year after the procedure, PRP treated patients demonstrated a mean improvement of 63.9% in VAS scores, as compared to 24% in the steroid treated group ( $p<0.001$ ). After one year, DASH scores improved to 66% in the PRP patients, as compared with 17.4% in the steroid treated patients ( $p=0.001$ ). At one year, 49% of the steroid group and 73% of the PRP group were successful according to VAS scores ( $p<0.001$ ), while 51% of the steroid group and 73% in the PRP group were successful according to DASH scores ( $p<0.005$ ).

**Conclusion:** This study of patients with chronic, lateral epicondylitis found that autologous platelet concentrate injections are superior to steroid injections in reducing pain and improving function.

Peerbooms, J., et al. Positive Effect of an Autologous Platelet Concentrate in Lateral Epicondylitis in a Double-Blind Randomized Controlled Trial. **Amer J Sp Med.** 2010, February; 38(2): 255-262.

### **Editor-in-Chief**

David T. Burke, M.D., M.A.  
Emory University, Atlanta, GA

### **Executive Editor**

Randolph L. Roig, M.D.  
Emory University, Atlanta, GA

### **Copy Editor**

Roberta Alysoun Bell, Ph.D.  
Emory University, Atlanta, GA

### **Contributing Editors**

\*Mike Green, M.D.  
Richard Huang, M.D.  
Waheed Baksh, M.D.  
Matthew Co, M.D.  
Baylor/UT Alliance, Houston, TX

\*Mark A. Hirsch, Ph.D.  
Chloe Bomberger, M.D.  
Carolinas Rehab., Charlotte, NC

\*Meredith Konya, M.D.  
Case Western Univ., Cleveland, OH

\*Jay Grainer, M.D., Ph.D.  
Paola Maria L. Mendoza, M.D.  
East Carolina University, Greenville, NC

\*Jerome Nichols, M.D.  
Ricardo Colberg, M.D.  
Andrew Geller, M.D.  
Tanya Cabrita, M.D.  
Kirsten Hogan, M.D.  
Melissa Sinkiewicz, D.O.  
Raj Valvani, D.O.  
Emory University, Atlanta, GA

\*Jennifer Sayanlar, D.O.  
\*Silvia Geraci, D.O.  
Long Is. Jewish M.C., New Hyde Park, NY

\*Chris Faubel, M.D.  
LSUHSC, New Orleans, LA

\*Ukessia Lee, D.O., M.P.H.  
Sinai Hosp. of Balt., U. of Md., Balt., MD

\*Joe Vongvorachoti, M.D.  
Mount Sinai Medical Center, New York, NY

\*Phalgun Nori  
A. Einstein-Montefiore M. Cen., Bronx, NY

David Cheng, M.D.  
NY Presb. H., Columbia-Cornell, NY, NY

\*Christina Marciniak, M.D.  
Kim Do, M.D.  
Robert Lee, M.D.  
Fred Bagares, D.O.  
Daniell Zelnik, M.D.  
Brian Liem, M.D.  
N.W.U./R.I.C., Chicago, IL

\*Jacqueline Weisbein, DO  
\*David W. Lee, M.D.  
Casey J. Fisher, M.D.  
SUNY Downstate Med. C., Brooklyn, NY

\*Rohini Kumar, M.D.  
Temple University, Philadelphia, PA

\*Gina Benaquista, D.O.  
Richard Hoppe, M.D.  
Benjamin Levy, M.D.  
Monika Krzyzek D.O.  
Christine Pfisterer, D.O.  
Kelly Scollen M.D.  
Margie Donlon, MPH, M.D.  
Miguel Coba, M.D.  
UMDNJ/Kessler Rehab, Newark, NJ

\*Mike Harris, M.D.  
Jenny Kendall, D.O.  
University of Michigan, Ann Arbor, MI

(Continued on page 8)

## **ASPIRIN PLUS DIPYRIDAMOLE EARLY AFTER STROKE**

International treatment guidelines recommend antiplatelet therapy for patients with non-cardioembolic stroke or transient ischemic attack (TIA). For secondary prevention of stroke, the combination of aspirin plus extended-release dipyridamole is more effective than aspirin monotherapy. In patients at risk for ischemic events, clopidogrel is more effective than aspirin in reducing the combined risk of ischemic stroke, myocardial infarction, or vascular death. However, the best antiplatelet treatment for stroke within 24 hours of symptom onset is unclear. This study compared the safety and efficacy of aspirin plus extended release dipyridamole, initiated within 24 hours of stroke or TIA, with that of aspirin plus standard release dipyridamole, initiated after seven days of aspirin monotherapy.

This prospective, randomized, blinded endpoint trial involved patients from 46 German stroke units between July of 2007 and February of 2009. Five hundred forty-three patients were randomized, including 283 who received early initiation of aspirin (25mg bid) and extended release dipyridamole (200mg bid) within 24 hours of symptom onset, and 260 who received seven days of aspirin therapy, followed by the addition of extended release dipyridamole. The primary outcome measure was functional neurological status, as assessed by telephone with the modified Rankin scale (tele-mRS) at day 90. Rescue or adverse events and mortality were assessed in the first seven days and from day eight to day 90 for a composite safety and efficacy endpoint.

One hundred fifty-four patients (56.4%) had a favorable outcome (tele-mRS 0 or 1 at day 90) in the early initiation group as compared with 133 (52.4%) in the late initiation group (p=0.45). Both groups also had similar tele-mRS scores at day 8 (p=0.89). Disability did not differ between treatment groups at either day 8 (p=0.89) or day 90 (p=0.68). More patients in the late initiation group (26 of 260) had a non-fatal stroke than did patients in the early initiation group (p=0.150). The number of patients with serious adverse events, which were mostly recurrent cerebrovascular events, was higher in the late initiation group

(18%) than in the early initiation group, though this was not statistically significant (16% [45/283], p=0.43). Drug-related adverse events that were not classed as serious were more frequent in the early initiation group (38%) than in the late initiation group (21% p<0.0001) and included headaches (p=0.0001), nausea (p=0.087), and vomiting (p=0.028). Twenty-eight patients in the early initiation group and 38 patients in the late initiation group reached the composite endpoint (p=0.20).

**Conclusion:** This randomized, controlled trial of patients with stroke or transient ischemic attack found that the early initiation of aspirin plus extended release dipyridamole may be more beneficial in preventing disability than early initiation of aspirin with a seven-day delay in the introduction of dipyridamole.

Dengler, R., et al. Early Treatment with Aspirin plus Extended Release Dipyridamole for Transient Ischemic Attack or Ischemic Stroke within 24 Hours of Symptom Onset (Early Trial): A Randomized, Open Label, Blinded, Endpoint Trial. *Lancet Neur.* 2010, February; 9(2): 159-166.

## **LONG-TERM DURABILITY OF CHONDROCYTE IMPLANTATION**

Patients with full thickness chondral injuries of the knee experience reduced ability to work, participate in sports or carry out ordinary activities of daily living. Common treatments include debridement, marrow stimulation techniques, osteochondral allografts or autografts and autologous chondrocyte implantation (ACI). This study assessed the long-term durability of those results in patients with ACI.

Study participants were a predefined cohort of patients implanted with ACI and enrolled in the Cartilage Repair Registry. All subjects had full thickness lesions of the distal femur, with data collected at baseline, at an intermediate follow-up time period (one to five years), and then again at six to ten years. Baseline data collected at the index knee arthroscopy and implantation included assessments of knee alignment, patella tracking and ligament stability. At baseline and follow-up, the patients prospectively rated their overall condition, pain and

swelling using modified scales of the Cincinnati Knee Rating System. Data concerning adverse events, treatment failures and surgeries after ACI were reported on follow-up questionnaires.

Seventy-two patients met the predefined inclusion and exclusion criteria. The mean size of the cartilage lesion was 5.2 cm square. For all groups, overall condition, pain and swelling significantly improved at both one to five years' follow-up and six- to ten-years' follow-up. At one to five-years' follow-up, 75% of patients had improved, with a mean change in overall condition score of 4.3 points, while 25% had not, including nine patients who met the study definition of treatment failure. At six- to ten-years' follow-up, improvement from baseline was noted in 69% of the patients. The mean change in overall condition, pain and swelling scores from baseline for patients who improved were 4.3, 4.6 and 4.5 points, respectively, at one to five-years' follow-up and 3.7, 4.7 and 5.2 points, respectively, at six- to ten-years' follow-up.

**Conclusion:** This study of patients treated with autologous chondrocyte implantation for large, symptomatic, full-thickness lesions of the distal femur demonstrated early improvement, which was sustained at longer follow-up (up to 10 years) in the majority of patients.

Moseley, J., et al. Long-Term Durability of Autologous Chondrocyte Implantation: A Multi-Center, Observational Study in U.S. Patients. *Am J Sp Med.* 2010, February; 38(2): 238-246.

### PROPHYLAXIS FOR VENOUS THROMBOEMBOLISM DURING REHABILITATION FOR TRAUMATIC BRAIN INJURY

Pulmonary embolism (PE) is thought to be the most common preventable cause of hospital deaths. Prolonged immobilization and other factors associated with higher risk for deep vein thrombosis (DVT) are prevalent after traumatic brain injury (TBI). Some studies have estimated that 11 to 13% of patients with TBI have a DVT upon rehabilitation admission. Others have estimated this rate to be as high as 20%. This study examined the safety and effectiveness of prophylactic anticoagulant use in a large sample

of patients from 12 brain injury centers.

This observational study was conducted in 12 of the 16 National Institute on Disability and Rehabilitation Research (NIDRR) TBI model system acute rehabilitation centers. All patients with TBI who were at least 16 years of age and who were admitted between January of 2004 and June of 2007 were considered for the study. Of these, 49% received prophylactic anticoagulation. The primary outcome measure was the development of a symptomatic DVT or PE after admission to a rehabilitation facility. This report covered 152 data points related to patient risk factors for DVT, methods of screening used, prophylaxis used and treatment.

Among the 2,214 qualified patients with TBI, 207 were identified with a DVT before rehabilitation. Of the remaining patients, 59 were identified at admission as having a DVT and were excluded from further analysis. Among the remaining patients, 932 received prophylactic anticoagulation and 965 did not. Symptomatic DVT/PE was detected in 1.6% with prophylaxis and 1.8% without. This difference was not statistically significant. Fewer intracranial hemorrhages occurred among those who received prophylactic anticoagulation.

**Conclusion:** This study of patients hospitalized for traumatic brain injury did not find that anticoagulation reduces venous thromboembolism after admission to a rehabilitation hospital. The results revealed little risk associated with prophylactic anticoagulation in this population.

Carlile, M., et al. Prophylaxis for Venous Thromboembolism during Rehabilitation for Traumatic Brain Injury: A Multicenter, Observational Study. *J Traum, Inj, Inf Crit Care.* DOI: 10.1097/TA.0b013e3181b16d2d.

### ANTICOAGULATION AFTER A NEGATIVE LOWER EXTREMITY ULTRASOUND

Compression ultrasound (US) has largely replaced venography for the diagnosis of proximal deep vein thrombosis (DVT). Compression US reliably confirms and excludes DVT of the veins above the knee, although its

accuracy for detecting distal DVT has been questioned. Up to 25% of distal DVTs may propagate into proximal veins, increasing the risk of pulmonary embolism. This study sought to determine the risk of venous thromboembolism in patients with suspected lower extremity DVT following a single, negative compression US.

This meta-analysis included randomized, controlled, prospective studies evaluating whole leg compression US as a diagnostic tool for suspected DVT. The included studies followed a total of 4,731 patients for at least 90 days, during which anticoagulation therapy was withheld after a negative DVT. All studies objectively confirmed venous thromboembolism during the follow-up period. Seven studies were chosen, including six, prospective, cohort studies and one, randomized, controlled trial.

During follow-up, objectively confirmed venous thromboembolism and venous thromboembolism-attributable deaths occurred in 34 of the 4,731 patients (0.7%). Of those 34 events, 11 patients had a distal DVT (32.4%), seven had a proximal DVT (20.6%), seven had a nonfatal pulmonary embolism (20.6%) and nine patients (26.5%) died. A random effects model with inverse variance revealed that the combined venous thromboembolism rate at 90 days to be 0.57%.

**Conclusion:** This meta-analysis suggests that a single, whole leg compression ultrasound is sufficiently reliable to exclude proximal and distal DVT in symptomatic patients. Withholding anticoagulation after a single, negative, whole leg compression ultrasound was associated with a low risk of venous thromboembolism, suggesting that serial ultrasound to detect DVT is not warranted.

Johnson, S., et al. Risk of Deep Vein Thrombosis Following a Single, Negative, Whole Leg Compression Ultrasound: A Systematic Review and Meta-Analysis. *JAMA.* 2010, February 3; 303(5): 438-445.

### ROCK CLIMBING IN AMPUTEES

Rock climbing has become a popular form of therapeutic exercise, often used by rehabilitation facilities. Numerous studies have

demonstrated the physiologic effects of rock climbing in non-amputee persons. To date, no studies have analyzed physiological variables during rock climbing in persons with lower extremity amputations. This study compared the energy expenditure required to climb an indoor rock wall in persons with transfemoral amputation, using five different prosthetic configurations

This study involved three experienced rock climbers with unilateral transfemoral amputations. Each subject was measured over three climbs while ascending an indoor rock wall using five different prosthetic configurations. These include no prosthesis, stubby prosthesis backward/forward and an articulating prosthesis locked and unlocked. VO<sub>2</sub> and heart rate were determined during each of the 15 climbs, with the subjects resting between. The participants were also timed and asked to rate their perceived exertion.

Climbing time was fastest, and VO<sub>2</sub> consumption lowest, with the stubby forward prosthesis. The no-prosthesis condition maintained the lowest heart rate. Overall, the subjects expended 11% to 20% more energy when using an articulated prosthesis. When asked to subjectively rate each prosthesis, the climbers all preferred either the stubby prosthesis or the no prosthesis condition.

**Conclusion:** This study, involving three experienced rock climbers with transfemoral amputations, found that climbers expended significantly more energy and less preferred using an articulated prostheses compared to a stubby or no prosthesis

Highsmith, M., et al. Metabolic Demands of Rock Climbing in Transfemoral Amputations. *Int J Sp Med.* 2010; 31: 38-43.

### SPINAL DEGENERATION AND BODY MASS INDEX

The identification of factors associated with spinal degeneration may assist in our understanding of the pathogenesis of back pain, ultimately leading to the development of better prevention and treatment strategies. This study sought to determine the relationship between CT verified lumbar spine

degeneration and demographic and anthropometric measures.

In 2002, 191 men and women between the ages of 40 and 80 years were consecutively enrolled. All were participating in an ancillary portion of the Framingham Heart Study: Third-Generation Cohort. All underwent abdominal CT to assess for aortic calcification. Scans were assessed for discs narrowing, facet joint osteoarthritis, spondylolysis or spondylolisthesis. Data concerning age, gender and body mass index were compared with spinal CT findings.

The CT results revealed intervertebral discs narrowing in 64%, facet joint osteoarthritis in 65% and spondylitis in 12% of the study sample. Spondylitis was significantly more common in males ( $p=0.015$ ), and spondylolisthesis more prevalent in females ( $p=0.008$ ). Discs narrowing, facet joint osteoarthritis and degenerative spondylolisthesis were all linearly associated with increasing age ( $p<0.0001$ ). L4-5 facet joint osteoarthritis was more prevalent among those with obesity.

**Conclusion:** This study of patients 40 to 80 years of age found that spinal degeneration, as seen on CT, is common, with specific features more prevalent with increasing age and obesity.

Kalichman, L., et al. Association between Age, Sex, BMI, and CT Evaluated Spinal Degeneration Features. *J Back Musculoskel Rehab.* 2009 22(4): 189-195.

### BASELINE PLASMA CHANGES IN SPINAL CORD INJURY

Previous studies of patients with spinal cord injury (SCI) have often focused on the long-term consequences of their immobilization in the development of chronic pain. This study analyzed the relationship between pain intensity and plasma lipid levels in acute SCI.

Subjects included 11 with paraplegia, 16 with tetraplegia and 15 with polytrauma. At hospital arrival, 13 patients were unconscious due to head injuries. Pain intensity was assessed at hospital arrival, at 14 days post-injury and once again before discharge from the hospital. Levels of total cholesterol, LDL, HDL, triglycerides, total proteins, albumin, glycemia and CRP were analyzed at

hospital arrival, after two weeks and before discharge. Post-traumatic and post-surgical pain was addressed with varying combinations of weak opioids and non-opioid analgesics, antidepressants, antipsychotics, myorelaxants and anxiolytics.

Of the biochemical measures, pain intensity at admission was significantly correlated with the level of HDL cholesterol ( $p=0.04$ ). In addition, pain was significantly correlated with body weight ( $p=0.024$ ). Pain intensity did not differ between patients with different lesion levels or in patients who suffered a craniocerebral injury as a consequence of their accident.

**Conclusion:** This study of spinal cord injury failed to find a direct connection between pain intensity and total cholesterol levels. Immediately after injury, pain intensity was positively correlated to HDL cholesterol levels and at hospital discharge with glycemia. Persons responsible for their injuries experienced less pain intensity on the day of injury.

Yamamoto, A., et al. Intensity of Pain and Biochemical Changes in Blood Plasma in Spinal Cord Trauma. *Spinal Cord.* 2010, January; 48 (1): 21-26.

### PROTEIN INTAKE DURING WEIGHT LOSS IN ATHLETES

Many athletes restrict energy intake to achieve a certain body mass category. This restriction sometimes occurs at the expense of lean body mass and subsequent performance. Previous studies have demonstrated evidence of decreased lean body mass loss with high-protein diets during weight loss in the obese and overweight. This study compared the influence of a high-protein diet on lean body mass and physical performance in healthy athletes.

Twenty subjects were recruited and matched from local sports facilities. In a parallel design, the subjects were divided into a control group and a high-protein group. The first subjects were randomly allocated to the groups, whereas the latter subjects were allocated to match the first groups for anthropometric values and training volume. Each subject participated in a four-week study. The first week was used to assess energy intake and output. In the second

week, the subjects were fed 100% of their habitual energy intake. In weeks three and four, energy intake was reduced to 60% of the subject's habitual intake. The control group's diet consisted of 50% carbohydrate, 15% protein and 35% fat, with the protein intake equaling one gram per kilogram per day. In the high-protein group, subjects were allowed 50% carbohydrate, 35% protein and 15% fat intake, equaling 2.3 grams per kilogram per day. At the end of each week, body mass, body composition and performance were measured. The subjects were asked to continue their habitual training throughout the study.

Both the control group and the high-protein group lost the same amount of fat mass, although the control group lost significantly more lean ( $p=0.006$ ) and total body mass ( $p=0.036$ ) than did the high-protein group. No significant differences were noted between the two groups on any of the performance tests. A significant decrease was seen in peak jump force ( $p=0.011$ ), along with a significant increase in muscle endurance ( $p=0.044$ ), between weeks one and four, with no significant differences between the groups. However, a significantly greater decrease in feelings of well-being occurred in the high-protein group than in the control group.

**Conclusion:** This study found that a high protein diet is superior for the maintenance of lean body mass during a weight loss program. Performance did not seem to be affected by either diet during this four-week study.

Mettler, S., et al. Increased Protein Intake Reduces Body Mass Loss during Weight Loss in Athletes. **Med Sci in Sp Exer.** 2010, February; 42: 326-337.

### DOXYCYCLINE INHIBITION OF MATRIX METALLOPROTEINASES IMPROVES HEALING AFTER ROTATOR CUFF REPAIR

Rotator cuff tears are among the most common causes of shoulder pain and disability in the adult population. Despite significant advances in surgical techniques for operative repair, a significant incidence of incomplete healing at the tendon bone interface, and structural failure rates of as high as 50 to 70%

for large tears have been observed postoperatively. The matrix metalloproteinases (MMPs) are family of zinc dependant proteases that collectively maintain and remodel the extracellular matrix of connective tissues. Recent studies have identified a critical role of these enzymes in tissue recovery after surgery, including rotator cuff repair. As the tetracycline family of antibiotics has been shown to inhibit MMPs by a mechanism independent of their antimicrobial activity, they have the theoretical capacity to reduce excessive degradation or remodeling at the healing entheses after rotator cuff repair. This animal study sought to explore the effect of doxycycline mediated inhibition of MMPs after acute rotator cuff tear.

One hundred ninety-three rats underwent detachment and immediate repair of the right supraspinatus tendon. The animals were then divided into four groups. In the control group ( $n=66$ ), the tendon was repaired to its anatomical footprint. In the experimental groups, an identical surgery was performed with doxycycline (130mg/kg) administered orally and continued until the time of sacrifice. The animals were given doxycycline beginning at days one ( $n=66$ ) five ( $n=28$ ), or 14 ( $n=23$ ) The animals were sacrificed at 5 days, 8 days, 2 weeks, and 4 weeks postoperatively. The tendon/bone interface was evaluated by histomorphometry, with additional measures including chemical testing, MMP-13 (interstitial collagenase) activity by immunosorbant assay, serum level measurement and histologic analysis.

Doxycycline treated animals demonstrated greater metachromasia at the healing entheses and improved collagen organization at post-operative days five ( $p<0.06$ ), eight ( $p<0.03$ ) and 14( $p<0.04$ ). MMP-13 activity was significantly less in the doxycycline treated animals than in controls at post-operative day eight. Mean load to failure was significantly greater at 2 weeks for animals started on doxycycline preoperatively or at day 5, as compared with control animals ( $p < .01$ ) At four weeks, the mean load to failure was not significantly different between the controls and those treated with doxycycline beginning postoperatively and up to 14 days postoperatively ( $p=0.17$ ).

**Conclusion:** This animal study demonstrates that doxycycline mediated inhibition of MMP-13 activity after acute rotator cuff repair is associated with significant improvements in early, biochemical and histological parameters of healing at the tendon-bone interface.

Bedi, A., et al. Doxycycline-Mediated Inhibition of Matrix Metalloproteinases Improves Healing after Rotator Cuff Repair. **Am J Sp Med.** 2010, February; 38(2): 308-317.

### ARE ROTATOR CUFF TEARS MORE PREVALENT IN PARAPLEGIC PATIENTS?

An estimated 11,000 new cases of spinal cord injury (SCI) occur each year in the United States. While most of these individuals are able to live independent, wheelchair-bound lives, shoulder pain is a common problem. This study evaluated the prevalence and risk of rotator cuff tears (RCT) and pain in patients who have been paraplegic wheelchair-users for more than 30 years.

Between October of 2005 and May of 2007, 100 paraplegic patients were matched for age and gender with a group of 100, able-bodied volunteers. Subjects were screened with a clinical examination of the shoulder, the Constant score (a 100-point scoring system based on a number of individual subjective and objective parameters), a visual analogue pain scale, the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire, and a shoulder MRI. Results were compared between the patients with paraplegia and the controls.

The able-bodied group scored significantly better than the paraplegic group on all measures administered. This difference reached significance on the Constant score ( $p<0.001$ ), the DASH questionnaire ( $p<0.001$ ) and the visual analogue scale ( $p<0.001$ ). In addition, MRI revealed RTC tears four times more often in the paraplegic group than in the control group ( $p<0.001$ ). The rates of glenohumeral osteoarthritis were 19% in the paraplegic group and one percent in the control group ( $p<0.0001$ ).

**Conclusion:** This study demonstrates that structural and functional changes in the shoulder joint are more severe, and the risk of

shoulder girdle pathology significantly higher, in individuals with long-term paraplegia than in age matched controls.

Akbar, M., et al. Prevalence of Rotator Cuff Tear in Paraplegic Patients Compared with Controls. **J Bone Joint Surg.** 2010, January; 92: 23-30.

### LASER TREATMENT FOR CHRONIC NECK PAIN

Chronic back pain is a highly prevalent condition, affecting 10 to 24% of the population. Low-level laser therapy (LLLT) uses laser to aid tissue repair, relieve pain, and stimulate acupuncture points. Previous reviews of the efficacy of LLLT for low back pain and rheumatoid arthritis have been unable to draw firm conclusions about treatment efficacy due to insufficient data or conflicting findings. This systematic review and meta-analysis sought to better establish whether LLLT is effective in the treatment of acute and chronic back pain.

The authors completed a search of published work, including randomized or quasi-randomized, controlled trials of LLLT for acute or chronic neck pain. All studies used a laser device that delivered irradiation to points in the neck identified by tenderness, local acupuncture points, or on a grid at predetermined points overlying the neck. Control groups were given either placebo laser or an active treatment control such as exercise. This systematic literature review identified 16, randomized, placebo or active treatment controlled trials involving 820 patients with neck pain, but excluding those with rheumatoid arthritis, fibromyalgia, radiculopathy or neurological disease. Effect size for the primary outcome variable, pain intensity, was defined as a pooled estimate of the mean difference in change on a 100 mm visual analogue scale.

Analysis of categorical data both immediately before and after LLLT revealed that, in the two trials of acute neck pain, the LLLT groups had a significant RR of 1.69 for improvement immediately after treatment as compared with placebo. The five trials for chronic neck pain reported categorical data, with the relative risk of pain improvement with LLLT 4.05 as compared with placebo

at the end of treatment. Analysis of data from the visual analogue scale showed that, for patients in 13 groups in 11 trials, pain intensity was reduced by a mean value of 19.86 mm as compared with placebo. The pain relief effects in the short term persisted for up to six months. Five studies provided evidence for improvement in disability at the end of treatment.

**Conclusion:** This meta-analysis supports the efficacy of low-level laser for treatment of acute and chronic neck pain over the short and medium term (22 weeks).

Chow, R., et al. Efficacy of Low-Level Laser Treatment in the Management of Neck Pain: A Systematic Review and Meta-Analysis of Randomized, Placebo or Active Treatment, Controlled Trials. **Lancet.** 2009 December; 374: 1897-1908.

### LONG-TERM USE OF CREATINE AND MUSCLE MORPHOLOGY

Dietary supplementation with creatine has been found to increase muscle levels of both creatine and phosphocreatine by up to 50%. Creatine supplementation is thought to exert an ergogenic effect on activities involving short-duration, high-intensity muscular activity and those that feature repeated bouts of high-intensity activity. This study investigated the effect of creatine supplementation on muscle morphology and swimming performance using an animal model.

Sixty rats were subjected to exercise 15 minutes daily over a period of three months. The subjects were randomly divided into four groups, to receive no supplementation (CON), no creatine supplementation and incomplete food intake lacking lysine and methionine (INCON), creatine supplementation at one gram per kilogram per day (creat-1) or creatine supplementation at two grams per kilogram per day (creat-2). Three months later, all rats exercised to exhaustion in swimming pool chambers. The animals were then sacrificed for histologic analysis.

All rats were increased in body weight over the 12 weeks of the study, with no significant differences among the groups. Swimming times were superior in the creat-1 and creat-2 groups when compared to the CON group ( $p < 0.05$  for each). In both

creatine supplementation groups, basic histological changes in the diaphragm included both large-scale muscle fibers and hypertrophic muscle cells. Quantitative analysis indicated that the number of muscle fibers per defined area increased more in the supplementation groups than in the CON group ( $p < 0.05$ ).

**Conclusion:** This animal study found that creatine supplementation enlarged the magnitude of the cross sectional area of skeletal muscle fibers and increased the number of fibers per defined area. In addition, this supplementation improved swimming performance.

Yildiz, A., et al. Effects of Creatine Long-Term Supplementation on Muscle Morphology and Swimming Performance in Rats. **J Sp Sci Med.** 2009, December; 8: 516-522.

### LONG-TERM TEST-RETEST RELIABILITY OF THE IMPACT TEST BATTERY

Repeated psychological assessment is frequently used to identify the effects of concussion on cognitive function. As the results of these assessments are widely employed to determine return to play in concussed athletes, it is important to understand how often baseline assessment should be performed. This study sought to establish the long-term, test-retest reliability of baseline cognitive performance using the Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) Test Battery.

Participants included varsity collegiate athletes participating in baseball, basketball, field hockey, lacrosse, soccer or softball. All had completed mandatory preseason cognitive assessments as required by their athletic programs. Of those, 95 athletes were eligible to complete a follow-up cognitive assessment two years later. All participants were tested with the ImPACT, version 3.0, consisting of six tests evaluating attention, working memory and processing speed. Results of the two tests were compared.

The mean ImPACT composite and symptom scores showed little variation between the two assessments. Processing speed showed the most stability, followed by reaction time, visual memory, verbal memory and total symptom scores. At

follow-up assessments, 95% to 97% of all composite scores and 89% of symptom scale scores fell within the 80% confidence interval, while 97% to 98% of all composite scores and 95% of symptom scale scores were within the 95% confidence interval.

**Conclusion:** This study demonstrates that cognitive performance on the ImpACT remains considerably stable over a two-year period, suggesting that repeat baseline measurements may not be necessary on a yearly basis.

Schatz, P. Long-Term Test-Retest Reliability of Baseline Cognitive Assessments Using ImpACT. *Am J Sp Med.* 2010, January; 38(1): 47-53.

### FOCAL CARTILAGE DEFECTS VERSUS OSTEOARTHRITIS OF THE KNEE

Focal cartilage defects of the knee are common in the working population. However, it is unclear to what degree these injuries affect quality of life. This study evaluated complaints of patients with localized cartilage defects of the knee, comparing the extent to which those problems impaired quality of life with other groups of patients with knee disabilities.

Data were obtained for previously registered patients enrolled in different knee treatment studies at three cooperating hospitals. The patients ranged from 18 to 67 years of age, defined as the working population, at data registration. The three categories of patients included those with knee osteoarthritis enrolled for arthroplasty, patients with knee osteoarthritis enrolled for osteotomies, patients with focal cartilage lesions enrolled for cartilage surgery, and patients with anterior cruciate ligament (ACL) deficient knees enrolled for reconstruction. All subjects were assessed pre-surgery with Knee Injury and Osteoarthritis Outcome Scores (KOOSs). The data were normalized for the population, correcting the subscale scores for age and gender.

A one-way analysis of variance revealed significant differences among the patient categories for all subscales, including the quality of life. The cartilage patients scored significantly worse ( $p < 0.001$ ) on all subscales of the KOOS compared with the ACL deficient patients.

Patients with focal cartilage deficits earned quality-of-life scores similar to those of patients with severe osteoarthritis who were awaiting arthroplasty.

**Conclusion:** This study suggests that patients with focal cartilage defects have difficulty with pain and function, such that their quality-of-life is similar to that of those with severe osteoarthritis awaiting knee replacement.

Heir, S., et al. O. Cartilage Defects in the Knee Impair Quality of Life as Much as Severe Osteoarthritis. *Am J Sp Med.* 2010, February; 38(2): 231-236.

### RESISTANCE TRAINING AND COGNITIVE DECLINE IN SENIORS

Previous research has established the beneficial effects of aerobic exercise on cognitive function in the elderly. Noting that the greatest gains have been found for protocols involving aerobic exercise with resistance training, others have hypothesized that resistance training would be more beneficial to executive function than balance and tone training for the elderly.

This randomized, controlled, prospective study included women ages 65 to 75 years, independent in their own homes, who scored 24 or higher on the Mini Mental State Exam, and had a visual acuity of at least 20/40. The subjects were randomly assigned to 12 months of one of the following exercise protocols: once weekly resistance training, twice-weekly resistance training or twice-weekly balance and tone training. Resistance training included bicep curls, triceps extension, seated rowing, latissimus dorsi pull downs, leg presses, hamstring curls, calf raises, mini squats, mini lunges and lunge walks. Balance and tone exercises included stretching, range of motion, core strengthening and tai chi. Dependent variables included the Stroop Test (an executive cognitive test of selective attention and conflict resolution), the Trail Making Test, digit span, gate speed, quadriceps strength and whole brain volume.

At the completion of the study, both resistance training groups had significantly greater improvement in Stroop performance than did the balance training group ( $p < 0.03$ ). The

twice weekly resistance training group had greater quadriceps strength than the balance training group ( $p < 0.001$ ). Across groups, improvement in Stroop test performance was significantly related to improvement in gate speed.

**Conclusion:** This study, comparing resistance and balance training, suggests that resistance training can improve cognitive function, including the executive functions involving selective attention and conflict resolution, among senior women.

Liu-Ambrose, T., et al. Resistance Training and Executive Functions. *Arch Int Med.* 2010, January 25; 170(2): 170-178.

### PHYSICAL FRAILITY AND MILD COGNITIVE IMPAIRMENT

Mild cognitive impairment (MCI) is increasingly recognized as a precursor to dementia, particularly to Alzheimer's disease (AD). With MCI identified as one of the earliest manifestations of AD, there is increasing interest in identifying the risk factors associated with its development. Emerging data suggest that physical frailty may be one such risk factor. This study examined the relationship between physical frailty and the development of MCI.

This prospective, observational study included data collected from 761, community dwelling, elderly individuals without cognitive impairment. Each participant underwent baseline clinical evaluation, including neurological and physical examination as well as an assessment of cognitive function. Examinations were repeated annually for up to 12 years. Cognitive function was assessed using a battery of 21 tests, with raw scores for each individual test converted to z scores, which were then averaged. Subjects were diagnosed with MCI if they had cognitive impairment but did not meet the criteria for AD.

Over the course of the study, 305 of the 761 subjects developed MCI. Those who developed MCI were older ( $p < 0.001$ ), had lower global cognitive function scores ( $p < 0.001$ ) and had higher levels of physical frailty at baseline ( $p < 0.001$ ) than did those who did not develop MCI. The relationship between the baseline level of physical frailty and the risk of

(Continued from page 2)

\*Jaspal Ricky Singh, M.D.  
Univ. of Pennsylvania, Philadelphia, PA

\*Thiru Annaswamy, M.D.  
Erin Derbigny, M.D.  
Temeka L Tate, M.D.  
Poonam Ochani, M.D.  
U. of Tex. SW Med. Cen., Dallas TX

\*Carly Kreps, M.D.  
Emily Darr, M.D.  
Geoffrey Keenan, M.D.  
Sara Myers, M.D.  
Univ. of Virginia, Charlottesville, VA

\*James Babington, M.D.  
University of Washington, Seattle, WA

\*Bonnie Weigert, M.D.  
University of Wisconsin, Madison, WI

\*Jeremy Hoff, M.D.  
\*Amit Sinha, M.D.  
Jeff Tubbs, M.D.  
Cara Jennings, M.D.  
Va. Commonwealth Univ., Richmond, VA

\*Jon Kronberg, M.D.  
Peter Taylor, M.D.  
Vijay Katukuri, M.D.  
Washington University, St. Louis, MO

**Executive Editor Emeritus**  
Donald F. Langenbeck, Jr., M.D.

**Subscription Manager**  
Michael P. Burke, M.S.

**\*Regional Managing Editors**

developing MCI was examined in a proportional hazards model, which demonstrated that physical frailty was associated with a substantially greater risk of MCI. Each one-unit increase in frailty at baseline was associated with more than a 60% increase in the risk of MCI [hazard ratio (HR) =1.63]. Of the four points of physical frailty measured, grip strength and time walked were associated with the risk of first occurrence of MCI, while BMI and fatigue were not. A higher level of physical frailty was associated with a more rapid decline in cognitive global function ( $p < 0.01$ ).

**Conclusion:** This study of 761 older persons free of cognitive impairment at baseline found that physical frailty was associated with a greater risk of developing MCI. The greater the frailty, the more rapid was the decline in cognitive function.

Boyle, P., et al. Physical Frailty Is Associated with Incident Mild Cognitive Impairment in Community-Based Older Persons. *J Am Ger Soc.* 2010, February; 58: 248-255.

**Rehab in Review** is a monthly publication produced by physicians in the field of Physical Medicine and Rehabilitation (PM&R). The summaries appearing in this publication are intended as an aid in reviewing the broad base of literature relevant to this field. These summaries are not intended for use as the sole basis for clinical treatment, or as a substitute for the reading of the original research.

**Rehab in Review** is produced with the cooperation and assistance of Emory University School of Medicine, Department of Rehabilitation Medicine. **Rehab in Review** is affiliated with the Association of Academic Physiatrists, the World Health Organization, and the Chinese and Indian Societies of PM&R. Funding for academic training subscriptions is provided by corporate sponsorship.

Private subscriptions are available by mail at P.O. Box 183, Lampe, MO 65681, or by fax or phone at (800) 850-REMU (7388).

ISSN # 1081-1303



**EMORY**  
UNIVERSITY  
SCHOOL OF  
MEDICINE



## REHAB IN REVIEW

is produced by the  
Emory University Department of  
Rehabilitation Medicine.



**EMORY**  
UNIVERSITY  
SCHOOL OF  
MEDICINE