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Volume 27 Number 10

Published by Physicians  
In Physical Medicine and Rehabilitation

October 5, 2019

## HIGH-DOSE VITAMIN D VERSUS BONE DENSITY AND STRENGTH

Recent meta-analyses have not supported a major treatment benefit of vitamin D for osteoporosis or for preventing falls or fractures. As three percent of the United States population consumes daily doses of at least 4,000 international units (IU) of vitamin D, this study assessed the effect of high-dose vitamin D on bone density and strength.

This double-blind, randomized, clinical trial included healthy men and women, 55 to 70 years of age. The subjects were allocated to one of three groups, including vitamin D supplementation with 400IU, 4,000IU or 10,000 IU daily. Excluded were those who had used bone active medication within the past two years or had previous clinical assessments compatible with osteoporosis. Primary outcome variables were high-resolution peripheral quantitative computed tomography (HRpQCT) measurements at baseline, six, 12, 24, and 36 months, as well as total volumetric bone mineral density (BMD) at the distal radius and tibia and bone strength (failure load) by finite element analysis at the distal radius and tibia, for a total of four primary variables.

A final analysis was completed for 287 subjects. At both the tibia and the radius, total volumetric BMD displayed a negative dose-response relationship, with greater loss associated with higher dose supplementation. There were no differences between groups in changes in failure load.

**Conclusion:** This randomized, controlled trial found that vitamin D supplementation of 4,000 or 10,000 international units in healthy adults was associated with a greater loss in bone mineral density as compared to supplementation with 400 international units.

Burt, L., et al. Effect of High-Dose Vitamin D Supplementation on Volumetric Bone Density and Bone Strength. A Randomized, Clinical

Trial. *JAMA*. 2019, August 27; 322 (8): 736-745.

## POSTOPERATIVE WEIGHTBEARING RESTRICTIONS IN ELDERLY HIP FRACTURE

Previous studies have found that, contrary to evidence-based guidelines, less than half of patients are allowed weight-bearing as tolerated after hip fracture surgery. This study assessed the effects of post-operative weight bearing restrictions on subsequent mobility.

This prospective study included patients over 75 years of age with a trochanteric fracture and surgical repair, with intramedullary nailing of the proximal femur. Physiotherapy began on postoperative day one. Those treated before October of 2017 were included in a partial weight bearing (PWB) group while all successive patients were placed in a full weight-bearing (FWB) group. Mobilization with PWB (less than 20 kg) was instructed for the first 19 patients and mobilization with FWB for the following 22. Pre-fracture and postoperative mobility and activities of daily living were assessed using the Parker Mobility Score (PMS) and the Barthel Index (BI).

The differences between the pre-fracture and postoperative PMS scores were significantly higher (better) in the FWB than in the PWB group ( $p < 0.001$ ). Post-treatment gait analysis revealed significantly higher gait speed in the FWB than in the PWB group ( $p = 0.003$ ). Loading of the affected limb was, on average, 350.25 N peak force in the FWB group, and 353.08 N in the PWB group ( $p = 0.918$ ).

**Conclusion:** This study of elderly hip fracture patients found that, compared with partial weight-bearing, those allowed full weight-bearing after surgery achieved better mobility.

Pfeufer, D., et al. Weight-bearing Restrictions Reduce Postoperative Mobility in Elderly Hip Fracture

Patients. *Arch Ortho Trauma Surg*. 2019, September; 139(9): 1253-1259.

## ANKLE FRACTURE IMMOBILIZATION FOR THREE VERSUS SIX WEEKS

After stable Weber B ankle fractures, treatment has routinely included six weeks of immobilization in a cast or an orthosis. This study assessed the effect of immobilization for three and six weeks in a cast or an orthosis, with outcomes reviewed at one year.

Subjects were 247 patients seen in an emergency department for isolated stable Weber B type ankle fractures. The participants were randomized to receive a standard cast applied for three weeks, a commercially available orthotic device applied for three weeks, or a standard cast applied for six weeks. The primary outcome measure was the Olerud-Molander Ankle Score (OMAS) at 52 weeks.

At 52-week follow-up, the mean OMAS scores were 92 in the six-week cast group, 90 in the orthosis group and 88 in the six-week cast group (lower scores indicating more severe symptoms), revealing no statistical difference. At 52 weeks, ankle range of motion did not significantly differ between groups. Fracture nonunion was found in 2.8% of the three-week cast group, zero percent of the three-week orthosis group and six percent of the six-week cast group. Symptomatic deep vein thrombosis was diagnosed in eight patients. These included five in the six-week cast group, three in the three-week cast group and none in the orthosis group ( $p = 0.06$ ).

**Conclusion:** This study of patients with stable Weber B type ankle fractures found that immobilization for three weeks was not inferior to cast immobilization for six weeks for bone healing or function at one year.

Kortekangas, T., et al. Three-Week versus Six-Week Immobilisation for

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Stable Weber B Type Ankle Fractures: Randomised, Multicentre, Non-Inferiority Clinical Trial. **Br Med J.** 2019; 364: k5432.

## **INTENSIVE UPPER LIMB REHABILITATION AND CHRONIC STROKE**

After a stroke, the consensus remains that most of the spontaneous recovery of the upper limb occurs over the first three months. This study evaluated the effect of high intensity rehabilitation in patients with chronic stroke.

Subjects were patients with a history of stroke who were referred by primary care physicians. Subjects received six hours of therapy, implemented five days a week for three weeks, for total of 90 hours of therapy. Therapy was delivered in two two-hour daily sessions each of physiotherapy and occupational therapy, including repetitive practice with a rehabilitation assistant or robotic device. Assessment tools included the modified upper limb Fugl-Meyer (FM-UL), the Action Research Arm Test (ARAT) and the Chedoke Arm and Hand Activity Inventory (CAHAI). Patient-reported outcomes were recorded with the Arm Activity Measure (ArmA), parts A (ArmA-A) and B (ArmA-B).

Data were completed for 224 patients. Significant improvements from admission to discharge, as well as six week and six-month follow-up, were noted for the FM-UL ( $p<0.001$ ), the ARAT ( $p<0.001$ ), the CAHAI ( $p<0.001$ ), and the ArmA-A ( $p<0.001$ ) and the ArmA-B ( $p<0.001$ ).

**Conclusion:** This study of patients with chronic stroke found that three weeks of intensive rehabilitation could significantly improve upper extremity function.

Ward, N., et al. Intensive Upper Limb Neurorehabilitation in Chronic Stroke: Outcomes from the Queen Square Programme. **J Neurol Neurosurg Psychiatr.** 2019; 90(5): 498-506.

## **CARPOMETACARPAL SPLINTING, THUMB PAIN AND PINCH STRENGTH**

Osteoarthritis (OA) of the first carpometacarpal (CMC) joint affects up to 11% of men and 30% of women over the age of 50 years. Splinting of the CMC has been found to be effective for decreasing pain, although some question its effect on the functional use of the thumb. This

study assessed the effect of CMC splinting on hand function and pain.

Subjects were 14 healthy, right-handed individuals who completed two experimental sessions, two weeks apart. At each session, thumb pain was induced by hypertonic saline injection into the dorsal radial ligament (DRL), located at the base of the first metacarpal bone. Isotonic saline was injected into the contralateral DLR as a control. Isometric tip pinch strength was measured and EMG measures were taken before the injections, after the painful injection and then after the pain resolved.

Post-injection pain was significantly greater in those injected with hypertonic saline than in those injected with isotonic saline ( $p<0.01$ ). Tip pinch strength decreased after hypertonic saline injection but not after isotonic injection ( $p<0.001$ ). While wearing the CMC splint, the subjects reported less pain, and demonstrated less reduction in pinch strength compared to the non-splinted condition ( $p<0.05$ ). The EMG studies revealed that the muscle activity was significantly reduced in the APB and FDI in the non-splinted hand as compared to the splinted hand ( $p<0.05$ ) and as compared to the isotonic condition ( $p<0.01$ ).

**Conclusion:** This study of carpometacarpal joint pain of the thumb found that splinting significantly reduced pain and improved pinch strength.

Ooishi, D., et al. Splinting for the Carpometacarpal Joint Relieves Experimental Basal Thumb Pain and Loss of Pinch Strength. **Euro J Pain.** 2019, August; 23(7): 1351-1357.

## **SMOKING AND CARPAL TUNNEL SYNDROME**

Cross-sectional studies have suggested that smoking is a risk factor for carpal tunnel syndrome (CTS). This finding has not been evaluated in cross-sectional studies. This study assessed the effect of maternal smoking and offspring smoking on the risk of CTS.

Data were obtained from the Northern Finland birth cohort of 1966. The study originally included 12,231 children with an expected birthdate in 1966. The prenatal data were collected from mothers of 12,065 children. In 1997, 8,719 cohort participants were alive, living in Finland and gave their informed consent to participate in the 31-year

assessment. Data from 1981 forward were obtained from the Finnish Care Register for Healthcare, a national register covering both public and private hospitals in Finland. Diagnoses of CTS were obtained from these data. All subjects were asked about their use of tobacco, with prenatal assessments of the subjects' mothers including smoking in the 12 months before pregnancy or during pregnancy.

Prenatal smoking was significantly related to offspring smoking, but not to subsequent CTS. CTS was more prevalent among those with a history of smoking than among those with no such history in both men and women ( $p < 0.001$  for both comparisons). Regular smoking of 10 or less pack years by the age of 31 was associated with 1.5-fold increased risk of CTS, while over ten pack years increased the risk to nearly double. Overweight/obesity was associated with a higher risk of CTS in both genders.

**Conclusion:** This study found that smoking is associated with an increased risk of carpal tunnel syndrome, although no such association was found with prenatal smoking by the mother.

Hulkkonen, S., et al. Smoking as Risk Factor for Carpal Tunnel Syndrome: A Birth Cohort Study. *Musc Nerve*. 2019, September; 60(3): 299-304.

### MID- TO LATE LIFE BLOOD PRESSURE AND INCIDENT DEMENTIA

A number of studies have suggested that hypertension during midlife may be a risk factor for cognitive decline and dementia. This study tested the hypothesis that individuals with an extended duration of midlife hypertension, followed by low blood pressure later in life, are at higher risk for dementia at an older age.

This community-based cohort study initially enrolled 15,792 participants, 45 to 65 years of age, from four communities in United States. Subjects were evaluated every three years until visit four, and then were seen again 15 years later, between 2011 and 2013, with a final follow-up between 2016 and 2017. At the last two visits, all patients underwent a comprehensive cognitive and functional assessment. Hypertension was defined as systolic blood pressure (SBP) of above 140 mm Hg or diastolic blood pressure

(DBP) of above 90 mm Hg. Hypotension was defined as SBP of lower than 90 mm Hg or DBP of lower than 60 mm Hg. Blood pressure patterns were grouped into one of five categories based upon blood pressure measurements at visits one through five. These included midlife and late-life normotension (N-N), midlife normotension and late-life hypertension (N-H), midlife and late-life hypertension (H-H), midlife normotension and late-life hypotension (N-HO) and midlife hypertension and late-life hypotension (H-HO). Dementia was determined at visit six and compared by blood pressure patterns.

Subjects were 4,761 participants, of whom 516 progressed to dementia and 435 progressed to mild cognitive impairment by visit six. The rates of dementia per 100 person years were 1.31 for the N-N group, 1.99 for the N-H group, 2.83 for the H-H group, 2.07 for the N-HO group and 4.26 for the H-HO group.

**Conclusion:** This community-based cohort study found the pattern of sustained hypertension for midlife to late life in a pattern of midlife hypertension followed by late life hypotension was associated with an increased risk of subsequent dementia.

Walker, K., et al. Association of Midlife to Late-Life Blood Pressure Patterns with Incident Dementia. *JAMA*. 2019, August 13; 322(6): 535-545.

### BETA ALANINE AND DEMENTIA RISK

A number of studies have suggested that some modifiable risk factors, including diet, are associated with an increased risk of dementia. This Japanese study was designed to understand the association between serum beta alanine and the risk of dementia.

The Hisayama Study is a prospective, cohort study of cerebral cardiovascular disease, initiated in 1961 in the town of Hisayama, Japan. Health examinations were repeated every year beginning in 1961, with dementia screening surveys for the elderly repeated every six to seven years. In 2007, 1,560 residents, ages 60 to 79 years, underwent a blood draw to assess serum beta alanine concentration. Those subjects were followed for a median of 5.3 years to determine the association between beta alanine concentration and incident dementia.

During follow-up, 117 subjects developed dementia, of whom 77 were diagnosed with Alzheimer disease (AD) and 31 with vascular dementia. Dividing the groups into quartiles of serum beta alanine levels, the five-year adjusted risk of all-cause dementia decreased with increasing serum beta alanine levels ( $p < 0.05$ ). This association held true for all-cause dementia and AD, but not for vascular dementia.

**Conclusion:** This prospective cohort study of elderly Japanese found that the risk of developing all-cause dementia and AD decreased with increased serum beta alanine levels.

Hata, J., et al. Association between Serum Beta Alanine and Risk of Dementia. *Am J Epidem*. 2019, September; 188 (9): 1637-1645.

### INTENSIVE BLOOD PRESSURE CONTROL AND CEREBRAL WHITE MATTER LESIONS

Although intensive systolic blood pressure (SBP) control has been shown to reduce cardiovascular disease morbidity and mortality, its effect on brain health is uncertain. This study, the Systolic Blood Pressure Intervention Trial (SPREAD) tested the effect of intensive SBP control as compared to standard SBP control.

Subjects were 50 years of age or older with SBP of between 130 and 180 mm Hg at screening who also had increased cardiovascular risk factors. The participants were randomized to either a group receiving intensive treatment with an SBP goal of less than 120 mm Hg or a standard treatment group with a goal of SBP of under 140 mm Hg. MRIs were completed at baseline and at 48 months after randomization, with outcome parameters including white matter lesion (WML) volume change from baseline and change in total brain volume (TBV).

Data were completed for 670 participants with a mean age of 67.3 years. At follow-up MRI assessment, the intensive treatment group had smaller increases in WML volume as compared to the standard treatment group ( $p < 0.001$ ). In contrast, the mean loss of TBV was greater in the intensive treatment group than in the standard treatment group ( $p = 0.006$ ).

**Conclusion:** This study of adults with hypertension found that, compared to standard blood pressure control, those with a systolic blood pressure target of less than 120 mm

Hg had fewer white matter lesions, but had a slightly greater loss in total brain volume.

Nasrallah, I. and the SPRINT research group. Association of Intensive versus Standard Blood Pressure Control with Cerebral White Matter Lesions. *JAMA*. 2019, August 13; 322 (6): 524-534.

### QUALITY OF LIFE WHILE AWAITING JOINT ARTHROPLASTY

With the aging of the world's population, degenerative joint disease and the need for joint replacement is increasing. This study evaluated quality-of-life among individuals waiting for a joint replacement.

Subjects were consecutive patients seen for primary total hip arthroplasty (THA) or total knee arthroplasty (TKA) between January of 2014 and September of 2017. Preoperatively, the participants completed the EuroQol Five-Dimension (EQ-5D) general health questionnaire, wherein an EQ-5D of less than zero is defined as a state "worse than death" (WTD). In addition, the patients completed questionnaires including a detailed comorbidity questionnaire, general health questions and a joint specific hip or knee outcome measure.

Participants were seen two weeks before surgery, with demographic data collected concerning body mass index (BMI). At one year postoperatively, questionnaires included a detailed comorbidity questionnaire, general health (EQ-5D), and joint-specific (the Oxford Hip Score (OHS) or Oxford Knee Score (OKS)) measures and a measure of patient satisfaction.

Data were completed for 2,073 patients undergoing THA and 2,168 undergoing TKA. Preoperatively, EQ-5D scores were WTD in 391 (19%) of the THA and 263 (12%) of the TKA patients. Comorbidities identified preoperatively which were independently associated with WTD scores were chronic obstructive pulmonary disease among those undergoing THA and peripheral artery disease and inflammatory arthropathy among those undergoing TKA. At one-year post-surgery, 19 patients had EQ-5D scores within the range of WTD.

**Conclusion:** This cross-sectional study of patients who were waiting to undergo hip or knee replacement found that quality of life was rated as worse than death in

19% of the hip and 12% of the knee patients.

Scott, C., et al. Worse than Death and Waiting for a Joint Arthroplasty. *Bone Joint J*. 2019; 101-B: 941-950.

### BLOOD FLOW RESTRICTION AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

After anterior cruciate ligament reconstruction (ACLR), many individuals do not completely regain their quadriceps strength. While performing resistance exercise at 60-80% of the 1RM is ideal for increasing quadriceps strength, high loads are often contraindicated after ACLR. This study evaluated the efficacy of a blood flow restricted (BFR) weightlifting program to increase quadriceps strength after ACLR.

Subjects were nine patients with ACLR at least two years prior to the study, and nine healthy controls. All ACLR subjects exhibited at least a 10% difference in rectus femoris thickness, vastus lateralis weakness or knee extension strength between the involved and uninvolved legs. All participants completed a home-based exercise program, focusing on the ACLR leg. Exercise involved BFR using a thigh cuff set at 50% of the occlusion pressure. All subjects performed five training sessions per week for four weeks. Thicknesses of the rectus femoris and vastus lateralis were measured at baseline and at follow-up in the involved and uninvolved legs using B-ultrasound. A symmetry index was calculated by comparing the strength and thickness of one leg to the other.

The ACLR group had their surgeries an average of five years prior to the study onset. At follow up, the rectus femoris and vastus lateralis thickness of the involved leg increased by 10% and 11%, respectively ( $p < 0.001$ ). In addition, the knee extensor strength increased by 20%. Strength symmetry significantly improved from baseline to follow up in the ACLR group, with post-training values similar to the controls.

**Conclusion:** This study of patients with anterior cruciate ligament repair five years earlier found that home-based blood flow restriction exercise significantly increased quadriceps muscle thickness and knee extensor strength and reduced asymmetry between the surgical and nonsurgical legs.

Kilgas, M., et al. Exercise with Blood Flow Restriction to Improve Quadriceps Function Long after ACL Reconstruction. *Int J Sports Med*. 2019, September; 40(10): 650-656.

### HIGH-RESOLUTION DIFFUSION-WEIGHTED IMAGING AND TRANSIENT ISCHEMIC ATTACK

A transient ischemic attack (TIA) is defined as a focal neurologic deficit caused by ischemia and lasting for less than 24 hours. As diffusion-weighted imaging (DWI) allows for early, sensitive diagnosis of ischemic injury, this study explored the utility of that technique for the detection of ischemic lesions.

Adult patients presenting within 24 hours of suspected cerebrovascular events were studied. A magnetic resonance imaging (MRI) study with high resolution diffusion weighted imaging (hrDWI) was performed at admission, and, if the patient was admitted to the stroke unit, the MRI was repeated the next day and again within six days.

Of the 446 patients presenting with a TIA according to the World Health Organization's definition, 53.8% had an hrDWI lesion on baseline and/or follow-up MRI, of which 51.8% were visible on admission. In comparison, no DWI lesion was identified in 206 patients. While occlusion of the corresponding vessel and perfusion deficit were strongly associated with the presence of DWI lesions (odds ratio 4.37), the functional outcome at three months, (as measured by the modified Rankin Scale score) was not.

**Conclusion:** This study suggests that high-resolution diffusion weighted imaging provides evidence of ischemic brain injury in the majority of patients who present to the ER with evidence of a transient ischemic attack.

Hotter, B., et al. High-Resolution Diffusion-Weighted Imaging Identifies Ischemic Lesions in a Majority of Transient Ischemic Attack Patients. *Ann Neurol*. 2019, September; 86 (3): 452-457.

### BLOOD FLOW RESTRICTION AND MOTOR UNIT BEHAVIOR

Previous studies have found that blood flow restriction (BFR) can enhance muscle activation during low intensity exercise. This study assessed whether high threshold motor units with lower firing rates are

recruited more effectively following BFR, as compared with non-blood flow restriction exercise.

Subjects were healthy men with an average age of 26 years. All underwent baseline assessments, including strength testing to determine the one repetition maximum (1RM) for knee extension. Each subject was tested under different conditions of unilateral knee extension, with one condition involving leg extension at 20% of the 1RM and another involving leg extension at 20% of the 1RM during BFR.

Exercises included five sets of 15 repetitions, with 30 seconds of passive rest between sets. Blood flow restriction was set at 60% of arterial occlusion pressure (AOP). Blood flow restriction was sustained for a total of eight minutes per session. During exercise, EMG activity was recorded from the vastus lateralis, with signals analyzed to extract motor unit recruitment threshold, firing rates and action potential amplitudes.

EMG force decrement was seen only after BFR, reduced by 20.5% ( $p < 0.05$ ). The BFR group had increased activity of the motor units with higher motor unit action potential. Those motor units with similar motor unit action potential were activated at higher firing rates in the BFR group.

**Conclusion:** This study indicates that blood flow restriction during exercise induces a shift in the motor unit recruitment pattern during exercise.

Fatela, P., et al. Blood Flow Restriction Alters Motor Unit Behavior during Resistance Exercise. *Int J Sp Med.* 2019; 40(9): 601-608.

### PREOPERATIVE WEIGHT LOSS FOR MORBIDLY OBESE UNDERGOING KNEE ARTHROPLASTY

For patients undergoing total knee arthroplasty, morbid obesity (body mass index (BMI)  $> 40 \text{ kg/m}^2$ ) is associated with numerous concerns, including thirty-day mortality and surgical site infection. This study assessed whether different levels of preoperative weight loss are associated with improved postoperative outcome measures.

This retrospective study included 2,157 patients. For all subjects, BMI was measured 90 days before surgery and then repeated preoperatively. Weight loss in the 90

days before surgery was compared to outcome measures.

Surgery was performed in 203 patients. Of those who lost weight, 41% had lost at least five pounds, 29% had lost at least 10 pounds and 14% had lost over 20 pounds. No significant association was seen between a weight loss of five to 10 pounds and the outcome measures. Those who had lost 20 pounds had a shorter adjusted length of stay, with a mean difference of 0.87 days ( $p = 0.001$ ) and a lower rate of discharge to a facility ( $p = 0.039$ ).

**Conclusion:** This study of morbidly obese patients scheduled for total knee arthroplasty found that a weight loss of five to 10 pounds prior to surgery did not impact outcomes, while losing at least 20 pounds was associated with a shorter length of stay and reduced odds of discharge to a facility.

Keeney, B., et al. Preoperative Weight Loss for Morbidly Obese Patients Undergoing Total Knee Arthroplasty: Determining the Necessary Amount. *J Bone Joint Surg Amer.* 2019, August; 101(16): 1440-1450.

### MALPRACTICE LITIGATION IN THE DIAGNOSIS OF STROKE

Recent evidence supports the use of tissue-type plasminogen activator, or thrombectomy, for the treatment of acute ischemic strokes (AIS). This review and meta-analysis assessed the risk of litigation related to the treatment of AIS.

A systematic review was completed using legal databases queried for jury verdicts and settlements related to medical malpractice in stroke evaluation and treatment. For those cases identified, stroke type, year of stroke and case settlement were recorded.

From the search, 251 legal cases were identified. Of these, 246 were related to AIS and 26 to intracranial hemorrhage (ICH). The average time from incident to case outcome was 4.9 years. The specialty of the defending physician included emergency department (33%), primary care (27%), neurology (17%), neurosurgery/interventional radiology (9%) and radiology (4%). In 36% of the cases, the patient was discharged from the hospital or not admitted and subsequently was discovered to have suffered a stroke. Of the legal cases involving AIS, 56% resulted in outcomes in favor of the defendant. Another 27% were resolved with a

settlement out of court and 17% went to trial with a plaintiff verdict. For those settled out of court, the mean award was \$1.8 million. For those that went to trial, the mean award was \$9.7 million. For cases of ICH, 46% were resolved for the defense without payout, 27% were settled out of court for an average payout of \$2.7 million and 27% went to trial with an average payout of \$8.7 million.

**Conclusion:** This literature review of litigation involving the treatment of acute stroke found that 56% of cases resulted in a verdict favoring the defense, with the allegations most commonly resulting from a failure to timely transfer to another hospital or the performance of a surgical procedure that resulted in a stroke.

Haslett, J., et al. Systematic Review of Malpractice Litigation in the Diagnosis and Treatment of Acute Stroke. *Stroke.* 2019, October; 50(10): 2858-2864.

### INTRANASAL KETAMINE FOR ACUTE PAIN

Ketamine is an N-methyl-D-aspartate receptor antagonist which is widely used as an analgesic agent for the treatment of acute pain. This study assessed the efficacy of intranasal ketamine for reducing pain among individuals undergoing a digital block in the emergency room.

This randomized trial included 100 patients presenting to the emergency department, each of whom required a digital nerve block (DNB). A 100-point visual analog scale (VAS) was used to assess the pain of the nerve block. Before the procedure, the patients were randomized to receive either 50 mg of ketamine intranasally or one mL of normal saline.

Five minutes after the ketamine injection, a standard dorsal web space digital nerve block was performed, with the patient's VAS pain score assessed and then repeated 45 minutes later. The primary outcome variable was reduction in pain intensity, with secondary outcomes including adverse events.

The median VAS score immediately after the procedure was significantly less in the ketamine group than in the normal saline group ( $p < 0.001$ ). In addition, 45 minutes after the DNB, the VAS pain scores were significantly better in the ketamine group than the placebo group ( $p < 0.001$ ).

**Conclusion:** This study of patients undergoing digital nerve block found that intranasal ketamine

significantly reduced the acute pain of the procedure.

Nejati, A., et al. Intranasal Ketamine Reduces Pain of Digital Nerve Block; A Double-Blind, Randomized, Clinical Trial. *Amer J Emerg Med.* 2019, September; 37:1622–1626.

### SPINAL CORD INJURY SPECIALTY UNITS AND OUTCOME

Worldwide, the incidence of spinal cord injury (SCI) ranges from 10 per million in the Netherlands to 83 per million in North America. This study assessed the effect on functional progress of specialized SCI units versus nonspecialized rehabilitation units on functional progress.

This study reviewed data from the medical records of patients with SCI, each admitted to one of four tertiary rehabilitation facilities. One of these was an SCI specialized rehabilitation facility (SSRF) and the other three were non-SSRFs. Rehabilitation effectiveness was calculated using change in the Spinal Cord Independence Measure (SCIM) score. Rehabilitation efficiency was calculated as the change of rehabilitation outcome scores divided by length of stay.

Compared to the patients in the non-SSRI units, those in the SSRF demonstrated greater improvement in SCIM scores ( $p < 0.01$ ). The rehabilitation efficiency was also significantly greater in the SSRF compared with the non-SSRFs ( $p = 0.029$ ).

**Conclusion:** This study of patients hospitalized with spinal cord injury found that admission to a spinal cord specialty unit resulted in better improvement than those treated in a non-specialized unit.

Pattanakuhar, S., et al. Is Admission to an SCI Specialized Rehabilitation Facility Associated with Better Functional Outcomes? Analysis of Data from the Thai Spinal Cord Injury Registry. *Spinal Cord.* 2019, September; 57: 684-691.

### DOSING OF TRIAMCINOLONE FOR KNEE SYNOVITIS

For patients with rheumatoid arthritis (RA) and psoriatic arthritis (PsA) intra-articular glucocorticoid injections have become a cornerstone of therapy. Triamcinolone hexacetonide (TH) is one of the most commonly used preparations for this treatment, although research has varied in doses tested for patients with RA, from 20 mg to 80 mg. This study

compared the clinical treatment outcome of two doses of TH.

Subjects were patients with chronic polyarthritis who were seen at outpatient rheumatology units between 2015 and 2017. Those participants were randomized to receive injections of either 20 mg or 40 mg of TH, with the patient held blind to treatment condition. The subjects were asked to contact the clinic if joint symptoms recurred. If so, the knee was examined again, and, if clinical signs of synovitis were confirmed, a relapse was recorded and the time from injection to relapse was calculated.

Participants included 159 patients, of whom 102 were diagnosed with RA and 57 with PsA. At six-month follow-up, a relapse had been recorded in 30% of the 20 mg group and in 32% of the 40 mg group ( $p = 0.822$ ). No significant differences were found between the RA and PsA groups.

**Conclusion:** This study of patients with rheumatoid or psoriatic arthritis found that the response to knee injections with triamcinolone did not differ between those given 20 mg and 40 mg.

Weitof, T., et al. Dosing of Intra-Articular Triamcinolone Hexacetonide for Knee Synovitis in Chronic Polyarthritis: A Randomized, Controlled Study. *J Rheum.* 2019, March; 48(4); 279-283.

### DALFAMPRIDINE ON INFORMATION PROCESSING SPEED IN MULTIPLE SCLEROSIS

Cognitive impairment is a disabling symptom of multiple sclerosis (MS). Aminopyridines are broad-spectrum potassium channel blocking agents with the capacity to improve conduction across demyelinated axons of the central nervous system. This randomized, placebo-controlled trial evaluated the effects of Dalfampridine on cognitive function in patients with MS.

Subjects were screened during routine visits at MS centers. All underwent baseline screening, including a cognitive battery which included the Symbol Digit Modalities Test (SDMT). The participants were then randomized to receive Dalfampridine 10 mg daily or a placebo for 12 consecutive weeks. At 12 weeks, the patients repeated a cognitive battery and behavioral tests. The primary endpoint was performance on the SDMT.

Of the 120 subjects randomized, data were completed for 70 in the treatment group and 38 in the placebo group. At 12 weeks, improvement from baseline in the

SDTM was 9.9 in the treatment group and 5.2 in the placebo group ( $p = 0.0018$ ). At four-week follow-up, the difference between groups was no longer significant. The treatment group was also superior on tests of processing speed, working memory and attention. Evaluations of fatigue revealed improvement to be greater in the treatment than in the placebo group ( $p = 0.0085$ ).

**Conclusion:** This prospective, randomized, controlled trial found that Dalfampridine improved processing speed and cognitive fatigue in patients with multiple sclerosis.

De Giglio, L., et al. Effect of Dalfampridine on Information Processing Speed Impairment in Multiple Sclerosis. *Neurol.* 2019, August 20; 93(8): e733-e746.

### NOCICEPTION AND QUADRICEPS WEAKNESS FOLLOWING TOTAL KNEE ARTHROPLASTY

Total knee arthroplasty (TKA) is widely regarded as effective in reducing osteoarthritis (OA) related knee pain, and is among the most commonly performed surgical procedures in the United States. The surgery is associated with an immediate and profound loss of quadriceps strength within the first few days. This study examined the relationship between quadriceps strength and measures of nociception.

Data were collected as part of a longitudinal observational study examining recovery after TKA. Subjects included 53 consecutive patients recruited from three different practices. All subjects were tested for muscle strength, muscle activation, and nociceptor sensitization. For the latter, pressure pain thresholds were assessed at the medial joint line and at the ipsilateral arm, with pressure increased until subjects indicated a sensation of pain.

The percent change in activation and the percentage change of quadriceps strength were significantly correlated ( $p < 0.001$ ). The knee pressure pain threshold was significantly associated with both change in quadriceps strength ( $p = 0.001$ ) and the percentage of change in quadriceps activation ( $p = 0.001$ ). Forearm pressure-pain thresholds did not have similar associations.

**Conclusion:** This study found that local nociceptor sensitization is correlated with reduced strength and muscle activation following total knee arthroplasty.

Loyd, B., et al. Peripheral Nociception Is Associated with Voluntary Activation Deficits and Quadriceps Weakness Following Total Knee Arthroplasty. *JBJS Am* 2019, Sept; 101(17):1539–1545.

### HELMET USE AND TRAUMA INJURY

Approximately 67 million people ride bicycles in United States. This study examined the relationship between helmet use and bicycle-related trauma injury outcomes.

Data were obtained from the National Trauma Databank from 2002–2012, including data concerning trauma-admitted patients involved in a bicycle-related accident. Using multiple logistic regression, adjusting for demographic variables, the independent relationship was calculated between helmet use, total mortality, Injury Severity Score, hospital length of stay, and intensive care unit length of stay.

Data were analyzed for 76,032 trauma admitted patients involved in a bicycle related accident diagnosed with a head or neck injury. Only 22% reported wearing a helmet at the time of the accident. Patients wearing helmets had a lower hospital length of stay ( $p=0.006$ ), total mortality ( $p<0.001$ ), and in-hospital mortality ( $p<0.001$ ) compared to those not wearing a helmet.

**Conclusion:** This study of trauma-admitted patients involved in bicycle-related accidents found that only 22% were wearing a helmet and that those not wearing a helmet had a higher mortality rate and longer length of hospital stay.

Scott, L., et al. Helmet Use and Bicycle Related Trauma Outcomes. *Brain Inj.* 2019.

### EARLY AEROBIC EXERCISE FOR SPORT-RELATED CONCUSSION

After a concussion, rest has been a mainstay of treatment. As regular exercise has been found to have a positive effect on cognition in other populations, this study assessed the effect of subthreshold aerobic exercise on the recovery of adolescents after a concussion.

This study compared two convenience samples that were otherwise similar in age, sex, athletic background, and time since injury but who had received different recommendations from their treating physicians. The rest group (RG), seen between March 2013 and February 2015 was instructed to rest according to the previous standard of

care (no structured exercise). The exercise group (EG) data were obtained from an ongoing randomized controlled trial beginning in September 2016. All EG participants performed the Buffalo Concussion Treadmill Test (BCTT). The EG subjects were asked to exercise at home for 20 minutes a day on a treadmill or stationary bike at 80% of the heart rate (HR) achieved at symptom exacerbation on the BCTT. Both groups were assessed at baseline and at seven and 14 days. Symptom recovery was defined as a return to baseline level symptoms.

Recovery time from the initial visit was significantly faster for the exercise group (8.29 days) than for the rest group (23.93 days), significant at  $p=0.048$ . The total symptom score, physical symptom score, and sleep symptom score became significantly lower in the exercise group compared to the rest group from day four forward ( $p=0.02$ ,  $p=0.024$  and  $p<0.001$  respectively).

**Conclusion:** This non-randomized cohort study provides evidence for the efficacy of controlled and individualized subthreshold exercise as an active early treatment for sports-related concussions.

Leddy, J., et al. A Preliminary Study of the Effect of Early Aerobic Exercise Treatment for Sport-Related Concussion in Males. *Clin J Sports Med.* 2019, September; 29(5):353–360.

### BODY MASS INDEX AND PROGNOSIS OF TRAUMATIC BRAIN INJURY

Obesity is correlated with an increased risk of diabetes, cardiovascular disease and cerebrovascular disease. However, a number of researchers have found that patients hospitalized for cardiac disease often have better recovery when their body mass index (BMI) is in excess of the normal range. This “BMI paradox” has been apparent in our studies of stroke, pulmonary, and amputee rehabilitation. This study assessed the effect of BMI on the functional prognosis of patients hospitalized with a traumatic brain injury (TBI).

Subjects were consecutive patients admitted to the TBI unit of a freestanding acute rehabilitation hospital over a period of six years. All patients underwent measures of height and weight on admission and functional independence measures (FIM) on admission and discharge. The total FIM score as well as the FIM subscales of mobility and

cognition were reviewed. The FIM gains per day (FIM efficiency) were calculated by determining the FIM change from admission to discharge and dividing this by the length of stay. Using the BMI formula of weight/height<sup>2</sup> the patients were grouped as underweight ( $<18.50$  kg/m<sup>2</sup>), normal weight (18.50–24.99 kg/m<sup>2</sup>), overweight ( $\geq 25.00$  kg/m<sup>2</sup>), and obese ( $\geq 30.00$  kg/m<sup>2</sup>). The FIM efficiency was compared by weight category.

During the study 444 patients with a mean age of 53.6 years were admitted to the brain injury unit. Adjusting for age and gender, the overweight and obese patients had the lowest FIM efficiency followed by the underweight and normal weight subgroups, though these differences did not reach statistical significance ( $p=0.93$ ). In addition, the adjusted FIM efficiency for the FIM motor subset, as well as the FIM cognitive subset did not differ significant by weight category ( $p=0.99$  and  $p=0.67$  respectively).

**Conclusion:** This study of consecutive patients admitted to a specialized brain injury unit at an acute rehabilitation hospital demonstrated that the functional progress per day of hospitalization did not differ by BMI category.

Burke, D., et al. The Effect of Body Mass Index on the Functional Prognosis of Traumatic Brain Injury Patients. *PM&R.* 2019, January; 11 (10): 1045–1049.

### SHOE CHARACTERISTICS AND LOWER EXTREMITY INJURIES

Lower extremity musculoskeletal injuries during fitness training are a primary source of injury and disability in the United States military. This study explored the association between shoe characteristics and injury risk among military cadets.

This prospective cohort study included data from 827 participants who were incoming cadets at the United States Military Academy. A baseline questionnaire was used to obtain a comprehensive history of lower extremity injuries. The make, model and length of each participant’s right running shoe was recorded, and then assessed for stiffness during torsion. All cadets then underwent nine weeks of basic training with injuries recorded and evaluated at the sports medicine and orthopedic clinics. Lower extremity injuries were defined as injuries occurring during basic training resulting in physical limitations for three days or more.

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The cumulative incidence of lower extremity injury during basic training was 18%, with 59% diagnosed as overuse injuries. Subjects wearing shoes with moderate lateral torsional stiffness were 51% less likely to incur a lower extremity injury compared to those wearing shoes with minimal lateral torsional stiffness. In a regression analysis, compared to those wearing shoes with minimal lateral torsional stiffness, those wearing shoes with mild or moderate lateral torsional stiffness were 36% and 49% less likely to sustain a lower extremity injury. In a regression analysis, compared to those wearing shoes with minimal heel height, those wearing shoes with mild heel height were 39% less likely to sustain a lower extremity injury.

**Conclusion:** This study of military cadets undergoing basic training found that running shoe lateral torsional stiffness and heel height were significant factors in the risk of injury training.

Helton, G., et al. Association between Running Shoe Characteristics and Lower Extremity Injuries in United States Military Academy Cadets. **Am J Sports Med.** 2019, October; 47 (12):2853-2862.

*Rehab in Review (RIR)* is produced monthly by physicians in the field of Physical Medicine and Rehabilitation (PM&R), with the cooperation and assistance of Emory University School of Medicine, Department of Rehabilitation Medicine. 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.

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ISSN # 1081-1303



## REHAB IN REVIEW

Produced by the Department of  
Rehabilitation Medicine, Emory  
University School of Medicine



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Expanding the frontier of rehabilitation sciences in research, teaching, and patient care