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PROJECTED PREVALENCE OF OBESITY

Studies have demonstrated an increasing prevalence of obesity across United States. This study used the Behavioral Risk Factor Surveillance System (BRFSS), an annual, nationally representative telephone survey of more than 400,000 adults, to project the prevalence of BMI in the United States through the year 2030.

The BRFSS data from 1993 through 1994 and 1999 through 2016, were collected for all 50 states and Washington DC. These data were adjusted to align with objectively measured BMI distributions from the National Health and Nutrition Examination Survey (NHANES) study. The body mass index (BMI) categories were defined according to the Center for Disease Control and Prevention. Historical trends were reviewed and projections made of the prevalence of each BMI category from 1990 through 2030.

The authors calculated that the national prevalence of adult obesity and severe obesity will rise to 48.9% and 24.2% respectively by the year 2030. The prevalence of obesity will rise above 50% in 29 states by 2030 and will not be below 35% in any state. By 2030 severe obesity will be the most common BMI category nationwide among women, black non-Hispanic adults, and adults with a household income of less than \$50,000.

Conclusion: This study estimated that by the year 2030 the prevalence of obesity in the United States will be nearly 50%, and that over 24% of the population will be severely obese.

Ward, Z., et al. Projected US State Level Prevalence of Adult Obesity and Severe Obesity. *N Engl J Med.* 2019, December 19; 381(25):2440–2450.

SUCCESSFULLY AGING FROM OLD TO VERY OLD

Successful aging has been defined as the maintenance of physical and cognitive well-being in later life, with no major disease or disability and high levels of engagement in life

including productive activities and interpersonal relations. This study was design to better understand successful aging past the age of ninety.

Data were included from participants in the 1921–1926 birth cohort of the Australian Longitudinal Study of Women's Health. At each survey, physical functioning scores were determined using the Medical Outcomes Study Form-36, and asked "Do you regularly need help with daily tasks because of long term disease, disability or frailty?" Successful aging was determined using three indicators: No arthritis, heart problem, diabetes, asthma or cancer; physical functioning score of greater than 40; no need of regular help. The authors used these data to place participants in one of six categories of ageing.

Of the 12,432 participants at baseline, 67% had died by 2016. Six trajectory groups were identified including managed agers long survivors (9.0%) with disease but little disability, usual agers long survivors (14.9%) with disease and disability, usual agers (26.6%) and early mortality (25.7%). Successful agers were more likely to be married and to have good health behaviors, were better educated and had better social support. Those who died were more likely to have difficulty managing their income, to smoke or have smoked, to be overweight or to never participate in vigorous exercise.

Conclusion: This longitudinal study of Australian women found that only 5% of the very old were free of chronic disease, had no need of regular help and had good physical function scores.

Bytes, J., et al. Successful Aging from Old to Very Old: Longitudinal Study of 12,432 Women from Australia. *Age Ageing.* 2019, November; 48(6):803–810.

VIRTUAL REHABILITATION AFTER TOTAL KNEE ARTHROPLASTY

Rates of total knee arthroplasty (TKA) have doubled in recent years. Given the projected paucity of physical therapists (PTs) in the near

future, especially in rural areas, this study examined the cost and clinical outcomes of virtual PT after TKA.

Adult patients scheduled for TKA for non-traumatic degenerative joint disease were randomized to receive either virtual PT (VPT) or usual care. At baseline and during 12 weeks of follow up, follow up measures included a Knee Injury and Osteoarthritis Outcome Score (KOOS) for self-reported physical function, the Patient Reported Outcomes Measurement Information System (PROMIS) assessment of physical and mental health, and Satisfaction with Physical Function. Those in the VPT group used The Virtual Exercise Rehabilitation Assistant (VERA), a cloud-based virtual telehealth system that functions with use of three dimensional (3D) tracking technology to quantify pose and motion, an avatar (digitally simulated coach) to demonstrate and guide activity, visual and audible instructions and immediate feedback on exercise quality, and a virtual video connection for synchronous telehealth visits. Costs of care and outcomes were recorded for each group.

Data were complete for 306 patients. Those receiving virtual PT had a median total cost at 12 weeks \$1050 compared to \$2805 for the usual care group ($p < 0.001$). Functional measurement scores during follow-up were similar between groups. During 12 weeks of follow-up, rehospitalization occurred in 12 of the treatment group and 30 of the standard group ($p = 0.007$).

Conclusion: This study of patients hospitalized for total knee arthroplasty found that virtual physical therapy after discharge was as safe and effective as traditional physical therapy, with less than half the cost.

Bettger, J., et al. Effects of Virtual Exercise Rehabilitation In Home Therapy Compared with Traditional Care after Total Knee Arthroplasty: Veritas, A Randomized Controlled Trial. *J Bone Joint Surg.* 2020. <http://dx.doi.org/10.2106/JBJS.19.00695>.

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THE CYCLOPS SYNDROME AFTER ACL REPAIR

Following anterior cruciate ligament (ACL) reconstruction, a nodule of fibrovascular tissue anterior to the graft can be observed. This has been described as a cyclops lesion. These phenomena are often accompanied by a snapping and catching while walking. This study evaluated the risks of, and morbidity associated with, a cyclops lesion.

This retrospective study collected data from a prospective study, the SANTI study of a group of patients undergoing primary ACL repair between 2011 and 2017. Subjects were required to have gained full knee extension and to be able to demonstrate adequate quadriceps activation after surgery. All patients received the same postoperative rehabilitation protocol, with the goal of returning to contact sports at eight to nine months.

Physical examinations were conducted preoperatively and at postoperative intervals for up to one year. The presence of a knee extension deficit was evaluated at each follow-up, with an MRI obtained after three months in patients who had symptomatic extension deficits. If a cyclops lesion was present, it was arthroscopically removed.

Of the 3,633 patients in the study, 65 developed a cyclops syndrome, with all recovering full knee extension after treatment. The univariate analysis found that factors reaching the 25% threshold of correlation with the cyclops syndrome included knee extension deficit at three and/or six weeks, body mass index of greater than 25 kg/m² and the presence of bimeniscal lesions. A multivariate analysis indicated that only knee extension deficits at three and six weeks were associated with a significant increase in risk of the development of a cyclops lesion.

Conclusion: This study of patients undergoing ACL repair found that an extension deficit in the early postoperative period was a significant predictor of the development of a symptomatic cyclops lesion.

Delaloye, J., et al. Knee Extension Deficit in the Early Postoperative Period Predisposes to Cyclops Syndrome after Anterior Cruciate Ligament Reconstruction. A Risk Factor Analysis in 3,633 Patients from The SANTI Study Group Database. *Am J Sports Med.* 2020. <https://doi.org/10.1177/0363546519897064>.

DEXMEDETOMIDINE AND POSTOPERATIVE COGNITION

Subjects were 65 years of age or older, all scheduled for a total knee

arthroplasty (TKA). The group was randomly assigned to receive anesthesia with either propofol or dexmedetomidine. The primary outcome measure was the incidence of post-operative delirium (POD), as assessed during the first week after surgery. Venous blood was assessed for indicators of inflammation including concentrations of interleukin -6 (IL-6), tumor necrosis factor-alpha (TNF-alpha) and S100 beta, conducted before anesthesia and at 12, 24- and 48-hours post-surgery.

The incidence of POD was less in the dexmedetomidine group than in the propofol group (p=0.032). Compared to the propofol group, scores on the Mini-Mental State Examination (MMSE) were better in the dexmedetomidine group on days three and day five (p<0.0001, p=0.002). The plasma concentrations of TNF-alpha and IL-6 were significantly increased in both groups at 12, 24, and 48 hours after surgery (all p<0.05), with no difference between the two groups.

Conclusion: This study of elderly patients undergoing knee replacement surgery found that post-operative delirium occurred less frequently among those anesthetized with dexmedetomidine than among those anesthetized with propofol.

Mei, B., et al. The Benefit of Dexmedetomidine on Postoperative Cognitive Function is Unrelated to the Modulation on Peripheral Inflammation. A Single-Center, Prospective, Randomized Study. *Clin J Pain.* 2020, February; 36(2): 88–95.

GASTROCNEMIUS BOTULINUM FOR PLANTAR FASCIITIS

Conservative management for plantar fasciitis (PF) includes orthotics, night splints, ice, stretching, injection with steroids and, more recently, botulinum toxin A (BTA). In 2013, a novel surgical procedure was introduced involving the release of the medial head of the gastrocnemius, with improved PF symptoms. This study assessed the efficacy of a BTA injection at the head of the gastrocnemius as a non-surgical correlate of this procedure.

Subjects were 32 patients with chronic PF. The subjects were randomly assigned to receive injections into the proximal third of the medial head with either 50 international units of BTA or a similar volume of normal saline. All injections were followed by six weeks of physiotherapy. The patients were assessed for pain using a 10-point visual analog scale (VAS) and for function with the American Orthopedic Foot and Ankle Society

(AOFAS) Hindfoot Score, with assessments performed at baseline and up to 12 months following the injection.

Pain scores improved in the BTA group from an average of eight at baseline to 0.33 at one year, while pain scores in the placebo group improved from 7.8 at baseline to four at one year ($p < 0.001$). Improved function at one year, as measured by the AOFAS, was also superior in the BTA group, as compared with the placebo group ($p < 0.001$).

Conclusion: This study of patients with chronic plantar fasciitis found that BTA injections at the medial head of the gastrocnemius significantly improve pain and function.

Abbasian, M., et al. Outcomes of Ultrasound-Guided Gastrocnemius Injection with Botulinum Toxin for Chronic Plantar Fasciitis. **Foot Ankle Int.** 2020, January; 41(1): 63-68.

ALENDRONATE AND THE ROTATOR CUFF TENDON

Alendronate, a commonly used bisphosphonate, has been reported to be cytotoxic to some cells, including oral keratinocytes, gingival fibroblasts, periodontal ligament fibroblasts, and endothelial cells. As inadequate bone mineral density (BMD) has been reported as an independent determining factor of postoperative rotator cuff healing, this *in vitro* study evaluated the effect of alendronate, on rotator cuff tendon fibroblasts.

Supraspinatus tendon tissue was collected from three patients undergoing arthroscopic rotator cuff repair. From this tissue, fibroblasts were harvested and cryopreserved. The cells were then exposed to a placebo or alendronate at concentrations of 0.1 μM , 1 μM , 10 μM , 100 μM , for one to five days. Cell viability was assessed for each group.

Cell viability was significantly decreased, in a time dependent manner, in the 100 μM alendronate group ($p < 0.001$), reaching 25% of the total cells in five days. The decreased cell viability was mainly caused by apoptosis involving the caspase-3 pathway. In a scratch wound healing analysis, all the wounds healed well within 48 hours except the 100 μM group ($p < 0.001$).

Conclusion: This *in vitro* study of rotator cuff tendon cells found that exposure to high concentrations of alendronate resulted in a significant reduction in cell viability.

Sung, C., et al. *In Vitro* Effects of Alendronate on Fibroblasts of the Human Rotator Cuff Tendon. **BMC Musculoskelet Disord.** 21, 19 (2020). <https://doi.org/10.1186/s12891-019-3014-1>.

EFFECT OF GRAFT CHOICE ON REVISION AFTER ACL RECONSTRUCTION

The patella tendon has previously been described as the gold standard graft for anterior cruciate ligament (ACL) repair due to its fast healing time and reduced risk of graft rupture. However, some have identified evidence of an increased rate of injury to the contralateral, healthy ACL following this procedure. This study compared the risk of revision and contralateral ACL reconstruction between patients undergoing ACL repairs using the patella tendon and those using the hamstring tendon.

Data were obtained from the New Zealand ACL registry, a mandatory, national registry that prospectively captures data concerning patient, surgical and follow-up variables. The data includes patient demographics, data regarding surgery and follow-up evaluations using the Marx Activity Questionnaire, collected preoperatively, at six months and at years one, two and five.

The analysis included 7,155 primary ACL reconstructions. Of these, a hamstring tendon graft was used in 77.7% and a patella tendon graft in 22.3%. The crude rates of revision were 2.7% in the hamstring group and 1.3% in the patella tendon group ($p = 0.002$). In an adjusted analysis, revision was 2.51 times higher in the hamstring tendon group than in the patellar tendon group ($p < 0.001$). The crude rates of contralateral ACL reconstruction were 0.9% in the hamstring tendon group and 1.8% in the patellar tendon group ($p = 0.004$). In an adjusted analysis, the risk of contralateral reconstruction was 1.91 times higher in patients with a patellar tendon graft.

Conclusion: This New Zealand study of ACL reconstruction found that, compared with a hamstring tendon, those using patella tendons had a lower rate of revision, but had a greater risk of contralateral ACL repair.

Rahardja, R., et al. Effect of Graft Choice on Revision in Contralateral Anterior Cruciate Ligament Reconstruction: Results from the New Zealand ACL Registry. **Am J Sports Med.** 2020. doi: 10.1177/0363546519885148.

LONG-TERM FOLLOW-UP OF TRANSCUTANEOUS PROSTHESES

For patients with high transfemoral amputations, prosthetic fit can be challenging. One option for these patients is a surgically placed, bone anchored system. This study evaluated

long-term outcomes of patients treated with these devices.

Subjects were 111 patients with unilateral transfemoral amputation (TFA) who received the Osseointegrated Protheses for the Rehabilitation of Amputees (OPRA) implant system. This included a surgically placed intramedullary, threaded titanium fixture, an abutment (percutaneous component) press-fitted into the distal part of the fixture, and an abutment screw that connects the abutment to the fixture. The surgery occurred in two stages, six months apart. The subjects were followed using a patient-reported outcome measure, the Questionnaire for Persons with Transfemoral Amputation (Q-TFA), as well as clinical and radiographic measures.

At two, five, seven and 10 years, Q-TFA scores demonstrated significantly more prosthetic use, better motility, fewer problems and improved global situation, as compared with baseline. The survival rate of the implant was 72% at 15 years. Sixty-one patients had at least one mechanical complication, resulting in a change of the abutment and/or abutment screw.

Conclusion: This study of patients with transfemoral amputation found that these devices can improve long-term mobility, with a 15-year survival of 72%.

Hagberg, K., et al. A 15-Year Follow-Up of Transfemoral Amputees with Bone-Anchored Transcutaneous Protheses. Mechanical Complications and Patient Reported Outcomes. **Bone Joint.** 2020; 102-B (1): 55-63.

BRAIN-DERIVED NEUROTROPHIC FACTOR AND OSTEOARTHRITIS

Recent clinical evidence supports a peripheral role of brain-derived neurotrophic factor (BDNF) in osteoarthritis (OA). BDNF acts through the tropomyosin receptor kinase B (TrkB) receptor, with data showing that synovial expression of TrkB is associated with higher OA pain. The aim of this study was to use *in vitro* and animal models to explore the potential contribution of knee joint BDNF/TrkB signaling to chronic OA pain.

Human OA synovium was obtained from 30 patients with knee OA, collected during total knee joint replacement surgery. Measurements were made of synovitis, messenger RNA expression of BDNF and NTRK2 (which encodes TrkB).

In a separate animal study OA was chemically created in Sprague-Dawley rats. The animals were anaesthetized before undergoing intra-articular injection of either 100- ng/50-[micro]L BDNF ($n = 6$), 1-[micro]g/50-[micro]L BDNF ($n = 7$), 10-[micro]g/50-

[micro]L BDNF (n = 7), or 50-[micro]L 0.9% saline (n = 8). Weight-bearing asymmetry and paw withdrawal thresholds were measured one and three hours after injection. A separate group of rats (n = 30) received the same injections as well as TrkB-Fc chimera (highly potent and selective for BDNF) in doses of 100-ng/50-[micro]L TrkB-Fc chimera (n = 15) or 100-ng/50-[micro]L human IgG (n = 15).

A significant positive correlation was noted between mRNA expression of NTRK2 (TrkB) and the proinflammatory chemokine fractalkine in the OA synovia. In addition, higher levels of BDNF in the synovial fluid were found in the OA group than in the controls. The blocking of BDNF with the TrkB-Fc chimera acutely reversed OA pain behavior, while intra-articular injection of BDNF further exacerbated pain responses in the rat model of OA.

Conclusion: This study suggests that inhibition of peripheral BDNF could represent an exciting new therapeutic target for the treatment of OA pain.

Gowler, P., et al. Peripheral Brain-Derived Neurotrophic Factor Contributes To Chronic Osteoarthritis Joint Pain. *Pain*. 2020, January. 61- 73.

RETURN TO SPORT AFTER BILATERAL HIP ARTHROSCOPY

Several studies have reported on the return to sport after hip arthroscopy. This study assessed return to play of competitive athletes after bilateral hip arthroscopy (BHA).

Subjects included high school, college and professional athletes who were treated by BHA. Patient history was completed, including level of participation in sports within one year of the surgical date. After surgery, all underwent a structured rehabilitation protocol, with a predetermined goal of return to sport at six months from the time of the second surgery. Patient-reported outcomes were completed at a minimum of one-year post surgery.

Data were complete for 69 patients, with intraoperative findings of labral tears in over 97%. At one-year follow-up, 53.7% of the cohort had returned to their sport, including 100% of the professional athletes, 66.7% of the college athletes and 40.2% of the high school athletes. Of those not returning to sport, 42% reported graduation (high school and college) as the reason, while 45% reported hip symptoms. Of those who did return to sport, 56%

reported performance at the same ability or higher.

Conclusion: This study of athletes who underwent bilateral hip arthroscopy found that over 50% returned to sport, with over half of these returning at the same level or higher.

Rosinsky, P., et al. Rate of Return to Sport and Functional Outcomes after Bilateral Hip Arthroscopy in High-Level Athletes. *Am J Sport Med*. 2019, December ;47(14): 3444-3454.

ANTEROLATERAL C7 TRANSFER FOR BRACHIAL PLEXUS AVULSION

Previous studies have demonstrated that the C7 nerve root has enough nerve fibers for two or more recipient nerves, and that its sacrifice on the uninjured side is usually well tolerated. This study describes a new technique for brachial plexus avulsion patients, involving bridging the C7 nerve root to the ulnar nerve and the medial antebrachial cutaneous nerve (MACN).

This retrospective study included 16 patients with a brachial plexus avulsion, who underwent surgery. In a two-stage surgery, the C7 from the unaffected side was cut and separated into its anterior and posterior divisions. The posterior division was attached to a portion of the ulnar nerve (all but the dorsal cutaneous branch), with the anterior branch of C7 attached to both, the remaining portion of the ulnar nerve (the dorsal cutaneous branch) and the MACN. After verifying connectivity by EMG, a second surgery connected the MACN, and thus restoring the damaged musculocutaneous nerve. Then, the ulnar nerve was connected to the ipsilateral median nerve restoring the function of the median nerve in the ipsilateral arm. The median interval between the two stages was 3.59 months. Strength at follow-up was measured on the five-point British Medical Research Council (MRC) grading system.

After the first surgery, five of the 16 patients noted weakness in the triceps of the donor arm, with all having recovered by five weeks. At follow-up, elbow flexion was scored as M3 in seven, M4 in four, M1-2 in four and M0 in one patient. Wrist and finger flexion were scored as M3 in seven of 16 with M0 (no movement) in two, and M1-2 in the remaining.

Conclusion: This study of 16 patients with avulsion of the brachial plexus found that a two-stage nerve graft, using C7 of the unaffected side, restored the injured arm to

antigravity strength at the elbow in 10 of 16 patients, and antigravity strength at the wrist and fingers in seven of 16. None recovered full strength.

Li, S., et al. Contralateral C7 Transfer via Both Ulnar Nerve and Medial Antebrachial Cutaneous Nerve to Repair Total Brachial Plexus Avulsion: A Preliminary Report. *Br J Neurosurg*. 2019; 33(6): 648-654.

TRANSCRANIAL DIRECT CURRENT STIMULATION FOR LOW BACK PAIN

Chronic low back pain (CLBP) is a common disorder, often resistant to effective treatment strategies. Transcranial direct current stimulation (tDCS) is a noninvasive brain stimulation technique, shown to be effective in treating patients with various pain disorders. This study evaluated the efficacy of tDCS on pain intensity among patients with CLBP.

This prospective, double-blind, randomized, sham controlled study recruited patients, 18 to 65 years of age, with nonspecific CLBP. All subjects received 20 minutes of either real or sham tDCS. Pain intensity was measured before and after treatment by a numerical rating scale (NRS), with muscle activity assessed by surface electromyography (sEMG). For both groups, the dry anode electrode was placed over C3/ C4 and the cathode over M1. The active tDCS was applied at a constant current of 2mA, delivered for 20 minutes.

Data were gathered for 26 patients in the tDCS group and 25 in the sham tDCS group. NRS scores decreased from 5.1 to 3.3 in the tDCS group (p<0.000) and from 4.6 to 4.4 in the sham group (p=0.670). After the treatment session, pain relief was demonstrated in 17 of 26 in the tDCS group, and in eight of 25 in the sham group. EMG data revealed no difference between groups.

Conclusion: This study of patients with chronic low back pain found that a single episode of transcranial direct current stimulation can reduce back pain severity.

Jiang, N., et al. Effect of Dry Electrode Based Transcranial Direct Current Stimulation on Chronic Low Back Pain and Low Back Muscle Activities: A Double-Blind, Sham Controlled Study. *Restor Neurol Neurosci*. 2020. Pre-press. 10.3233/RNN-190922.

DYNAMIC ULTRASOUND IN ANTERIOR CRUCIATE LIGAMENT TEARS

For diagnosing complete anterior cruciate ligament (ACL) tears, an MRI has been found to have a sensitivity of 87% and a specificity of 93%. When diagnosing partial tears, the sensitivity is much less. This study assessed the efficacy of dynamic high-resolution ultrasound (US) imaging of the knee for diagnosing ACL tears.

Subjects were adult patients who underwent arthroscopy and at least one preoperative US with an 8-12 MHz broadband linear array transducer. The findings of this ultrasound were compared with findings during arthroscopic surgery.

Of the 247 patients evaluated, 120 knees showed evidence of ACL tears during US examination, with 60 described as partial and 59 as complete tears. At arthroscopic surgery, 108 ACL tears were found, of which 60 were partial, and 48 were complete tears. Sensitivity of US for the detection of complete ACL tears was 79%, with a specificity of 89%, a positive predictive value (PPV) of 63%, and a negative predictive value (NPV) of 95%. Partial ACL tears were correctly identified with a sensitivity of 52%, specificity 85%, a PPV of 52% and an NPV 84%.

Conclusion: This retrospective study of patients undergoing arthroscopic surgery found that ultrasound may be useful in diagnosing ACL tears, with a higher sensitivity for complete ACL tears than for partial ACL tears.

Breukers, M., et al. Diagnostic Accuracy of Dynamic Ultrasound Imaging in Partial and Complete Anterior Cruciate Ligament Tears: A Prospective Study in 247 Patients. *BMJ Open Sport Exerc Med.* 2019.5(1): e000605.

MICROFRACTURE AT THE TALUS

Osteochondral lesions of the talus (OLT) may have symptoms such as swelling and locking sensation with deep ankle pain. As conservative treatments are frequently effective, arthroscopic microfracture may be recommended. This study evaluated the long-term functional outcomes of arthroscopic microfracture for OLT.

Subjects were consecutive patients, 18-60 years of age with OLT who had failed non-operative treatment, and subsequently underwent microfracture surgery. All were assessed at baseline and follow-up with the Foot and Ankle Outcome Score (FAOS) a Visual

Analog Scale (VAS) for pain and a 36 item Short Form Health Survey (SF-36). X-rays of the ankle were taken preoperatively and at one, three, six and 12 months postoperatively and then annually.

Follow-up data were completed for 165 ankles at a mean of 6.7 years. The VAS pain scores improved from 6.2 preoperatively to 1.7 postoperatively ($p < 0.001$). Significant improvements were also noted in the SF 36 ($p < 0.001$) and the FAOS ($p < 0.001$). While body mass index, age and lesion size were not related to functional outcomes, symptom duration was found to be negatively correlated with FAOS improvement.

Conclusion: This study of patients with recalcitrant osteochondral lesions of the talus found that microfracture could be effective in reducing pain at up to 6.7 years.

Choi, S., et al. Arthroscopic Microfracture for Osteochondral Lesions of the Talus: Functional Outcomes at a Mean of 6.7 Years in 165 Consecutive Ankles. *Am J Sports Med.* 2020, January; 48 (1): 153-158.

POLYNUCLEOTIDES AND HYALURONIC ACID KNEE INJECTIONS

Hyaluronic acid (HA) is a natural component of soft connective tissue with the ability to restore the viscoelastic properties of the synovial fluid (SF) and joint lubrication. It also has antiapoptotic, anti-inflammatory, antiangiogenic, and antifibrotic properties. In addition, polynucleotides (PNs) are a mixture of purines, pyrimidines, and deoxyribonucleosides, which have shown positive results in musculoskeletal tissue regeneration. This study compared the efficacy of intraarticular knee injections with PNs mixed with HA (PNHA) to that of HA alone.

This study included 100 patients with a diagnosis of knee OA. Patients were randomized to receive injections of the knees with PNs (10 mg/mL) of controlled natural origin (fish sperm) and 10 mg/mL of an HA of biotechnological origin, with a total content of active ingredients of 40 mg in two mL. Subjects received injections of two mL of PNHA or HA every week for a total of three injections. At baseline and up to five months from the first treatment clinical function and pain were measured by the WOMAC score and the Knee Society Score (KSS). Biochemical and immunoenzymatic analysis were performed at baseline and at two weeks.

The KSS total scores showed significantly better results in the

PNHA group compared with HA at follow up weeks three and four ($p < 0.05$) and at week five ($p = 0.009$). No significant differences were observed for the WOMAC score between groups during the follow-up. The biochemical evaluation showed that synovial fluids of all the patients were normal for color, clarity, and density (mucin clot test).

Conclusion: These findings suggest that a joint injection with PNs, in combination with HA, is more effective in improving knee function and pain, in a joint affected by OA, compared with HA alone.

Dallari, D., et al. Efficacy of Intra-Articular Polynucleotides Associated with Hyaluronic Acid Versus Hyaluronic Acid Alone in the Treatment of Knee Osteoarthritis: A Randomized, Double-Blind, Controlled Clinical Trial. *Clin J Sport Med.* 2020, January; 30(1):1-7.

PHYSICAL ACTIVITY LESS THAN THE RECOMMENDED DOSE AND BIOLOGIC RISK FACTORS

Current physical activity (PA) guidelines recommend that adults perform at least 150 minutes per week of moderate intensity PA or 75 minutes of PA at vigorous intensity. This study examined the dose-response relationship between PA and incidence of biological cardiovascular risk factors.

Data were obtained from the MJ Cohort Resource involving adults in Taiwan. This cohort has enrolled more than 600,000 participants since 1994. Participants completed a self-administered health and lifestyle questionnaire, underwent a physical exam and provided biologic samples. All were encouraged to return annually with data updated every year. For this study, adults were chosen with baseline information collected during the period of 1997 to 2016.

Participants were asked to report the intensity, frequency and duration of PA during the past weeks. A metabolic equivalent (MET; 3.5 mL/kg/min) value of 2.5 was designated as light PA, 4.5 as moderate PA, 6.5 as medium vigorous PA and 8.5 as high vigorous PA intensity. In addition all were assessed for cardiovascular risk factors, including obesity ($\geq \text{BMI } 25 \text{ kg/m}^2$), systolic blood pressure/diastolic blood pressure of $>140\text{mmHg}/90 \text{ mmHg}$, serum total cholesterol $\geq 240 \text{ mg/dL}$, triglycerides $\geq 150 \text{ mg/dL}$, high density lipoprotein cholesterol $< 40\text{mg/dL}$ in men and $< 50 \text{ mg/dL}$ in women. The level of PA was

compared to the change in cardiovascular risk factors.

During a mean follow-up of six years, 13.5% developed obesity 11.3% hypertension, 12.0% hypercholesterolemia, 8.3% atherogenic dyslipidemia, 15.2% metabolic syndrome, and 4.3% type II diabetes. The PA was inversely associated with all of the risk factors (all $p > 0.01$). Compared to the inactive, those with activity of at least 3.75–7.49 MET-h/week realized health benefits in obesity, hypertension, atherogenic dyslipidemia, metabolic syndrome and type II diabetes.

Conclusion: This study found that physical activity of less than half of the usually recommended amount improved the risk factors for cardiovascular disease.

Martinez-Gomez, D., et al. Physical Activity Less Than the Recommended Amount May Prevent the Onset of Major Biological Risk Factors for Cardiovascular Disease: A Cohort Study Of 198,919 Adults. *Br J Sport Med.* 2020 Feb;54(4):238-244.

ECCENTRIC BLOOD FLOW RESTRICTION EXERCISE AND THE CONTRALATERAL LIMB

Resistance training has been associated with increases in muscle strength and neuromuscular function in the contralateral, untrained limb. In addition, blood flow restriction (BFR) training has been shown to result in increases in muscle strength with lower weights than traditional exercise. Unlike concentric muscle actions which rely, in part, on muscle spindles to modulate force production, eccentric muscle actions must inhibit the muscle spindle reflex to allow the muscle to lengthen under tension, a process requiring greater cortical activation. This study investigated whether cortical activation differs between those engaged in concentric (Con-BFR) and eccentric (Ecc-BFR) loading.

Subjects were 36 healthy adult women who were randomly assigned to receive four weeks of unilateral Ecc-BFR ($n = 12$), Con-BFR ($n = 12$) or control (no intervention, $n = 12$) group. Resistance training occurred three times per week and included 75 isokinetic muscle actions. At weeks zero, two and four, tests were made of eccentric peak torque, concentric torque and maximal voluntary isometric contraction torque. Tests of the untrained arm were made for eccentric peak torque, concentric peak torque, and maximal voluntary

isometric contraction torque. Muscle thickness, and muscle activation were assessed at baseline, and up to week four.

After four weeks of training, increases in muscle strength of the untrained arm were 13% in the eccentric group and 11.2% in the concentric group ($p < 0.05$). This gain of strength from baseline reached significance only in the eccentric group. There was no significant difference between the two groups in the change in muscle size or EMG amplitude.

Conclusion: This study found that eccentric but not concentric resistance training could significantly increase strength in the contralateral limb.

Hill, E., et al. Eccentric, But Not Concentric Blood Flow Restriction Resistance Training Increases Muscle Strength in The Untrained Limb. *Phys Ther Sport.* 2020, 43 (2020) 1-7.

BLOOD-FLOW RESTRICTED VERSUS HEAVY-LOAD STRENGTH TRAINING

Lower limb muscle weakness is associated with reduced gait speed, increased risk of disability, and falls in the elderly. To improve muscle strength, the American College of Sports Medicine recommends regular heavy load resistance training (HLT) using resistance loads of 60-90% of the one repetition maximum. Blood flow restricted exercise using 20-30% of the one repetition maximum (LL-BFR) has also been used to improve maximal muscle strength. This literature review and meta-analysis compared the effect of LL-BFR to that of conventional HLT on maximal muscle strength among healthy individuals.

Literature was reviewed through September 23, 2019. Studies were included if focused on post intervention changes in maximal muscle strength. From this search were chosen 16 papers totaling 153 participants completing HLT, and 157 completing LL-BFR. The strength gains were compared between the groups.

No significant differences were noted between the two groups on the magnitude of gain in maximal muscle strength. In addition, the groups were similar in producing gains in muscle mass.

Conclusion: This meta-analysis comparing the efficacy of low load blood flow restriction resistance training and high load strength training found that improvements in strength and muscle mass were not

statistically significant between the two.

Grønfeldt, B., et al. Effect of Blood Flow Restricted Versus Heavy Load Strength Training on Muscle Strength: Systematic Review and Meta-Analysis. *Scand J Med Sci Sports* 2020 Feb 7. doi: 10.1111/sms.13632.

VIBRATION VERSUS CRYOTHERAPY FOR ACHILLES TENDINOPATHY

Achilles tendinopathy (AT) is a common overuse injury characterized by pain, swelling, morning stiffness and impaired function during sports activity. In addition, some have suggested that the multifidus muscle has an important role in controlling the spinal segments, and plays an important role in patients with lumbopelvic pain. This study assessed whether a load program with vibration or cryotherapy intervention could have influence in the morphology of the paraspinal muscles and lower limb function among individuals with AT.

This randomized study including adults with AT of at least three months duration. All subjects were engaged in an eccentric exercise program involving 90 repetitions twice a day for seven days per week. Those randomized to the vibration group (VG) performed the exercises while standing on a vibration platform with a frequency of 35 Hz and an amplitude of four mm for five minutes. Just prior to the exercise, those in the cryotherapy group (CG) immersed the affected lower limb in water cooled to $8 \pm 2^\circ\text{C}$ for 17 min. All were assessed for disability related to Achilles tendon dysfunction using the Victorian Institute for Sport Assessment (VISA-A). The thickness of the multifidus muscle was recorded at the levels of the L4-5.

Multifidus thickness measures showed a significant ($p < 0.05$) decrease at 12-weeks in both groups with no significant differences between groups. Multifidus cross-sectional area (CSA) increased more in the vibration group than in the cryotherapy group ($p < 0.05$). Scores on the VISA-A were increased at four and 12-weeks in both groups, with no significant differences ($p > 0.05$) between them.

Conclusion: This study of patients with achilles tendinopathy failed to show a difference in outcome between those in an

eccentric strengthening program plus cryotherapy and those treated with eccentric strengthening plus vibration.

Romero-Morales, C., et al. Vibration Increases Multifidus Cross-Sectional Area versus Cryotherapy Added to Chronic Non-Insertional Achilles Tendinopathy Eccentric Exercise. *Phys Therap Sport*. 2020, March; 42: 61–67.

CATHEPSIN K INHIBITION FOR OSTEOARTHRITIS

Cathepsin K is a cysteine protease involved in bone resorption and cartilage degradation. Early trials of a reversible inhibitor of Cathepsin K, MIV-711, have shown a significant reduction in biomarkers of bone resorption and cartilage loss. This study assessed the effect of MIV-711 on the symptoms of osteoarthritis (OA).

Eligible subjects were 40 to 80 years of age with a diagnosis of primary OA of the knee, and with an average knee pain score of at least four on a ten-point visual analogue pain scale. The participants were randomized to receive MIV-711 100mg, MIV-711 200mg or placebo once daily for 26 weeks. The primary outcome variable was change from baseline to week 26 and average pain severity over the previous week. The key secondary outcome measure was the change from baseline to week 26 in the medial femoral bone area in the target knee joint on MRI.

The average pain severity in the target knee decreased from baseline to week 26 by a mean of 1.4 in the placebo group, 1.7 in the 100 mg group and 1.5 in the 200 mg group. None of the comparisons reached the mean change (deterioration) from baseline bone area was 23.3 mm² in the placebo, 7.9 mm² in the 100 mg group and 8.6 mm² in the 200 mg group. An attenuation of thinning of the medial femoral joint cartilage was observed in both treatment groups as compared with the placebo. Significance was reached for the 100 mg but not the 200 mg group. At week 26, significantly better changes in bone biomarkers including serum CTX-I and urine CTX-II levels were observed in the treatment groups as compared with the placebo group (p<0.001). Adverse events were reported in similar numbers in all groups.

Conclusion: This study of patients with osteoarthritis of the knee found that an inhibitor of Cathepsin K

could significantly reduce bone and cartilage deterioration, though no improvement in pain was achieved.

Conaghan, P., et al. Disease Modifying Effects of a Novel Cathepsin K Inhibitor in Osteoarthritis: A Randomized Controlled Trial. *Ann Intern Med*. 2020, January 21; 172: 86–95.

EFFECT OF PRIOR COGNITIVE EXERTION ON PHYSICAL PERFORMANCE

Studies have shown carryover effects of cognitive tasks on subsequent physical performance. This study was design to summarize the findings of that literature.

This literature review and meta-analysis included studies of adults involved in cognitive exertion, followed by a physical task. Data were extracted from 79 articles with a total of 2,581 participants. From these data, physical performance was categorized into five groups including aerobic, dynamic resistance, isometric resistance, maximal anaerobic, and motor performance.

Overall, the meta-analysis revealed a small to medium negative effect size prior cognitive exertion on physical performance (p<0.001). The largest significant negative effects were those of prior cognitive exertion on isometric resistance, motor and dynamic resistance performance. Following exposure to cognitive manipulations for under 30 minutes, the largest significant negative effects were observed for isometric resistance, dynamic resistance, and motor performance tasks, whereas a smaller significant negative effect was found for aerobic performance.

Conclusion: This literature review and meta-analysis found that central executive tasks requiring cognitive exertion, performed prior to physical performance resulted in a deterioration of that performance.

Brown, D., et al. Effects of Prior Cognitive Exertion on Physical Performance: A Systematic Review and Meta-analysis. *Sport Med*. 2020; 50(3):497–529.

INFLAMMATORY MARKERS AND KNEE OSTEOARTHRITIS

Once thought to be a non-inflammatory disease, recent findings indicate that chronic, inflammatory processes may be a driver in the progression of osteoarthritis (OA). This study used

a proteomic approach to better understand inflammatory processes evident in the serum of patients with knee OA.

Subjects were 127 patients with OA of the knee (KOA), scheduled for knee replacement. Those patients were evaluated with the Knee Injury and Osteoarthritis Outcome Score (KOOS) and serum labs to assess the relative levels of 92 inflammation-related proteins. The distributions of these proteins were compared between the patients and 39 matched controls.

Fifteen markers were significantly different when comparing KOA patients with healthy participants. A positive relationship was seen between clinical pain and fibroblast growth factor-21, (p=0.008) and the expression of Eukaryotic translation initiation factor 4E-binding protein 1 (p=0.008). A linear regression model revealed that intensity of pain was significantly related to interleukin-6 (p<0.001), notch-like epidermal growth factor-related receptor (p=0.05), macrophage colony-stimulating factor 1 (p=0.015), fibroblast growth factor-21 (p=0.002) and tumor necrosis factor superfamily member 12 (p=0.001).

Conclusion: This study of patients with severe osteoarthritis of the knee, identified 10 cytokines with significantly lowered expression in the serum, and five cytokines with higher expression levels as compared to controls.

Giordano, R., et al. Serum Inflammatory Markers in Patients with Knee Osteoarthritis: A Proteomic Approach. *Clin J Pain*. 2020, April; 36(4): 229-237.

NEUROMUSCULAR ELECTRICAL STIMULATION PRESERVES LEG LEAN MASS IN GERIATRIC PATIENTS

Age-related loss of muscle mass is associated with poor mobility, loss of independence and increased mortality. The number of nonconsecutive days spent in the hospital during a year is associated with loss of muscle mass and strength in the elderly. This study investigated the effect of neuromuscular electrical stimulation (E-stim) on changes in muscle mass and muscle fiber size in hospitalized, geriatric patients.

Patients admitted to a geriatric ward, 65 years or older, were assessed at admission and discharge with muscle scans, muscle biopsies and tests of muscle function. The intervention consisted of a daily, 30-minute session of E-stim applied to the vastus lateralis and vastus medialis muscles of one leg (E-stim). The contralateral leg

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served as a control (CON). Stimulation was increased as tolerated, to a peak of 89 mA at the end of the last session. Lean mass was assessed with whole-body, dual-energy, x-ray absorptiometry. Muscle thickness was measured by ultrasound, with immunohistochemistry used to assess muscle fiber cross-sectional area, fiber type and satellite cell (SC) proliferation.

Thirteen patients completed the study. Lean muscle mass declined in the CON leg by 2.8% and in the E-stim leg by 0.5% ($p < 0.05$). No significant differences were noted between the legs on tests of muscle power, torque or muscle fiber size. Compared with the CON leg, stimulation resulted in a down regulation of several atrophy signaling pathways and an upregulation of connective tissue and cellular remodeling processes in the E-stim leg.

Conclusion: This study of hospitalized geriatric patients found that 30 minutes of electrical stimulation to the lower extremity helps preserve lean muscle mass.

Anders, K., et al. Neuromuscular Electrical Stimulation Preserves Leg Lean Mass in Geriatric Patients. *Med Sci Sports Exerc.* 2020, April; 52(4): 773-784.

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