SPECIALTY UPDATE

What's New in Orthopaedic Rehabilitation

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Injuries and disorders of the musculoskeletal system cause pain and loss of function, thereby leading to disability. The goal of rehabilitation medicine is to restore function in individuals with disability. This article presents evidence from studies published from March 2015 to February 2016 in the area of orthopaedic rehabilitation. Original articles from the *American Journal of Physical Medicine & Rehabilitation*, *The American Journal of Sports Medicine*, *Archives of Physical Medicine and Rehabilitation*, *The Clinical Journal of Pain*, *JAMA*, *The Journal of Bone & Joint Surgery*, *The Journal of Pain*, *Journal of Shoulder and Elbow Surgery*, *The New England Journal of Medicine*, *Physical Therapy*, and *PM&R* were considered. We screened the manuscript titles and abstracts of these select journals and included articles that were considered to be of high impact and value to readers. This Update is divided into sections based on subspecialty areas in physical medicine and orthopaedic rehabilitation.

Joints and Arthroplasty

Osteoarthritis

Intra-articular administration of hyaluronic acid is a pharmacological approach to the management of knee osteoarthritis. Several formulations of hyaluronic acid are commercially available. Altman et al. performed a meta-analysis of trials assessing the efficacy of hyaluronic acid formulations according to molecular weight¹. Hyaluronic acid products with a molecular weight of $\geq 3,000$ kDa had a pooled effect size of -0.52 (95% confidence interval [CI], -0.56 to -0.48) when pain reduction was the outcome. These were more efficacious than

products that were $<3,000$ and $>1,500$ kDa and those that were $\leq 1,500$ kDa in molecular weight.

Whole-body vibration mediates the activation of alpha (α) motor neurons, which cause muscle contractions, thereby leading to increased muscle strength². A recent meta-analysis of 5 studies showed preliminary data for improved pain and function with whole-body vibration training among patients with knee osteoarthritis compared with controls².

Total Knee Arthroplasty

With increasing emphasis on cost-containment and bundled payment, telerehabilitation has become an attractive strategy for delivering rehabilitation services. A randomized controlled trial found that telerehabilitation via videoconferencing was not inferior to face-to-face home visits after primary total knee arthroplasty when the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) was used as the primary outcome measure³. Another randomized controlled trial showed better pain and functional outcomes for total knee arthroplasty and 12 weeks of rehabilitation compared with only 12 weeks of rehabilitation (without surgery) for patients with knee osteoarthritis⁴.

Hand

A randomized controlled trial compared surgery with physical therapy (manual therapies including desensitization) in females ≤ 65 years of age with clinical and electrodiagnostic evidence of carpal tunnel syndrome⁵. Patients were classified as having minimal, moderate, or severe median neuropathy on the basis of electrodiagnostic criteria. There were no significant differences in pain and functional outcomes at 6 and 12 months between the 2 treatment groups.

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Spine

Back pain accounts for 2% to 5% of all physician visits⁶. While most acute episodes of back pain resolve, many individuals continue to have substantial pain and disability. Early management strategies remain controversial, as increased use of imaging, spinal injections, and prescription medications contributes to rising expenditures⁷. Jarvik et al. performed a prospective cohort study to evaluate early imaging (within 6 weeks of the index visit) including plain radiographs, computed tomography (CT), or magnetic resonance imaging (MRI) for patients ≥ 65 years of age with a new episode of care for back pain⁸. The authors found that patients with early imaging had significantly higher resource use and expenditures compared with matched controls. No significant differences were noted between those who underwent early imaging and those who did not in terms of patient-reported pain and disability up to 1 year after the index visit. This suggests that the value of early imaging is uncertain, and early imaging should not be performed routinely for older adults with acute back pain.

Prescription medications, including opioids, are commonly used to help manage acute back pain. Friedman et al. conducted a randomized clinical trial to compare a 10-day course of muscle relaxants or opioids combined with nonsteroidal anti-inflammatory drugs (NSAIDs) and NSAID monotherapy among patients with nonradicular low back pain⁹. All patients received 20 tablets (500 mg) of naproxen to take every 12 hours. Patients also received 60 tablets (1 to 2 tablets every 8 hours) of either placebo ($n = 107$), cyclobenzaprine (5 mg, $n = 108$) or oxycodone/acetaminophen (5 mg/325 mg, $n = 108$). No significant differences were noted across the groups for pain, functional impairment, and the use of health-care resources at 7 days and at the 3-month follow-up. These results did not support providing oxycodone/acetaminophen in addition to naproxen for patients with acute low back pain. Furthermore, this study suggests that combination therapy is not better than monotherapy.

Goldberg et al. performed a randomized clinical trial to determine whether a 15-day tapering course of oral prednisone was effective in improving function and reducing pain among patients with acute radiculopathy associated with a herniated lumbar disc¹⁰. This study found a small, significant improvement in Oswestry Disability Index (ODI) scores at 3 weeks and 52 weeks in the prednisone group compared with the placebo group. No difference was found for lower-extremity pain scores and the likelihood of undergoing surgery. This suggests that a short course of prednisone (20-mg capsules, 3 daily for 5 days, then 2 capsules daily for 5 days, and then 1 capsule daily for 5 days) may be beneficial for improving patient-reported function among patients with acute radiculopathy.

There is observational evidence to suggest that early referral to physical therapy is associated with lower costs for patients with acute low back pain¹¹. Fritz et al. conducted a

parallel-group randomized clinical trial to examine whether early physical therapy (manipulation and exercise) is more effective than usual care in improving disability in patients with acute low back pain who had no symptoms below the knee¹². Both groups were advised that the prognosis of low back pain is favorable and that they should remain active, and a book on back pain was provided to the participants. The usual care group did not receive any further treatment, whereas the early physical therapy group worked with a physical therapist on an exercise program. Early physical therapy (4 sessions over 3 weeks) resulted in significant improvement in ODI scores relative to usual care, but differences were modest and not clinically meaningful. Health-care resource utilization did not differ between the groups. These results support guidelines that advise delaying referral to physical therapy to allow for spontaneous recovery¹³.

Sports Medicine and Shoulder***Anterior Cruciate Ligament (ACL) Rehabilitation***

Chmielewski et al. compared high-intensity and low-intensity plyometric exercises during rehabilitation after ACL reconstruction¹⁴. They found no significant differences between the 2 groups in functional outcomes and biomarkers of articular cartilage degeneration or metabolism.

Rotator Cuff Symptomatology

The relationship between symptoms and the presence of a rotator cuff tear is not clear, as many people with rotator cuff tears are asymptomatic, patient-reported outcome scores for those with failed repairs are similar to those of patients with intact repairs¹⁵, and nonoperative approaches to treatment have been successful for many patients with a degenerative, full-thickness rotator cuff tear. Two recent studies lend support to the concept that abnormal scapular and glenohumeral kinematics may be responsible for the presence of symptoms. Kolik et al. evaluated shoulder kinematics using 3-dimensional electromagnetic tracking for the humerus and the scapula in 26 patients before and 1 year after rotator cuff repair with a standard postoperative rehabilitation program¹⁶. Using the uninjured shoulder as a control, they found that scapular kinematics normalized after rotator cuff repair with postoperative rehabilitation, with lessening of abnormal scapular internal rotation and upward rotation during arm abduction. Miller et al. used dynamic stereoradiography to measure glenohumeral joint translations and subacromial space during coronal plane abduction in 5 patients with full-thickness supraspinatus tears before and after a 12-week exercise program¹⁷. Abnormal glenohumeral translations decreased and the acromiohumeral interval increased after the exercise program. Patients showed significant improvements in patient-reported outcomes scores, and none of the patients failed the rehabilitation program. These studies suggest that abnormal shoulder kinematics are often seen in patients with symptomatic rotator cuff tears and that both symptoms and

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kinematics can improve with exercise or surgery followed by rehabilitation.

Operative Treatment Versus Rehabilitation for Rotator Cuff Tears

Kukkonen et al. published a report in 2014 in which 173 patients treated by 4 surgeons for supraspinatus tears only were randomized to 1 of 3 groups: physiotherapy; physiotherapy and acromioplasty; and rotator cuff repair, acromioplasty, and physiotherapy¹⁸. They reported no significant differences among the 3 groups in Constant scores at 12 months of follow-up. In 2015, a follow-up study was published to report 2-year outcomes; no significant difference among the 3 groups in pain and function was found¹⁹. However, the mean tear size was significantly smaller in the rotator cuff repair group than in the other 2 groups.

Postoperative Rehabilitation of Rotator Cuff Repair

In a meta-analysis, Kluczynski et al. compared early rehabilitation (<6 weeks after surgical rotator cuff repair) and delayed rehabilitation (≥6 weeks after surgical repair)²⁰. Thirty-seven studies met the inclusion criteria of full-thickness tears undergoing primary repair. The outcome of interest was retearing of the repaired tendon, assessed at 1 year with MRI, ultrasound, or arthrogram. The authors concluded that early active range of motion was associated with a higher risk of retearing of the repaired tendon for small and large tears.

Nonoperative Treatment of Labral Tears

The treatment of superior labral tears has evolved away from surgery and toward nonoperative treatment for many patients, as there are data to suggest that nonoperative treatment can be successful in many patients and that surgical outcomes are not always better²¹. In a retrospective cohort comparison, Jang et al. identified a number of features that are associated with the failure of nonoperative treatment of superior labral tears²². These included a history of trauma (odds ratio [OR], 9.8; 95% CI, 2.0 to 48.1), participation in overhead activities (OR, 19.1; 95% CI, 3.0 to 119.2), and a positive compression rotation test result (OR, 8.8; 95% CI, 1.5 to 51.9). While patients with these features may be successfully treated nonoperatively, they are less likely to have a successful outcome from nonoperative treatment and are more likely to be headed toward surgery.

Management of Psychosocial Factors in Musculoskeletal Disorders

Patient Symptomatology

Robust evidence supports the influence of psychosocial risk factors on patient-reported outcomes among patients with musculoskeletal disorders²³. A majority of studies have focused on patients with spine and knee pain, with few studies evaluating the psychosocial determinants of shoulder pain and disability. In a study involving 139 patients with shoulder pain, Menendez et al. found that high pain catastrophizing and low

pain self-efficacy were associated with worse scores on the Shoulder Pain and Disability Index (SPADI)²⁴. A cross-sectional study by Wylie et al. involving 169 patients with full-thickness rotator cuff tears showed further support for the importance of mental health in patients with shoulder pain²⁵. The authors found that the Short Form (SF)-36 mental component summary (MCS) had the strongest association with shoulder pain and function as well as with the American Shoulder and Elbow Surgeons (ASES) score and an inferior Simple Shoulder Test (SST) score. These studies provide evidence that psychosocial factors are associated with patient complaints in shoulder disorders. Additional prospective research to determine the predictive relationship between psychosocial factors and outcomes is needed.

Patient Satisfaction with Orthopaedic Care

Psychosocial distress has been found to be associated with poor outcomes following spine surgery²⁶. However, the relationship between mental health and patient satisfaction is less understood. Abtahi et al. conducted a retrospective study at a single academic spine surgery center to determine whether psychological distress was associated with outpatient satisfaction scores in a spine surgery population²⁷. One hundred and three patients were classified as either “normal” or having psychological distress using the Distress and Risk Assessment Method (DRAM) questionnaire. Patients having psychological distress reported significantly lower scores than did the “normal” group for overall satisfaction and satisfaction with their provider on the Press Ganey Medical Practice Survey. These results suggest that psychological distress, which is outside the control of health-care providers, may influence patients’ perception of their medical care.

Patient Outcomes

Archer et al. conducted a randomized controlled trial to determine whether a telephone-based, cognitive-behavioral physical therapy (CBPT) program, targeting high fear of movement and low self-efficacy, would improve outcomes for patients following lumbar spine surgery²⁸. The authors found that participants in the CBPT group had significantly greater decreases in pain and disability and increases in general health and physical performance compared with the group randomized to an education program. Similarly, Skolasky et al. examined a brief motivational interviewing-based health behavior change counseling (HBCC) intervention for patients undergoing surgery for degenerative lumbar spinal stenosis²⁹. Participants randomized to the HBCC group demonstrated greater improvements in disability and physical health at 6 months after surgery compared with participants randomized to the control group. The effect of HBCC on outcomes was mediated by participation in rehabilitation. These studies suggest that brief, telephone-based, behavior change interventions have the potential to improve outcomes for patients undergoing spine surgery.

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Pain Medicine***Ultrasound-Guided Injections***

Huang et al. performed a systematic review and meta-analysis of double-blinded, randomized controlled trials to evaluate the effectiveness of ultrasound-guided versus landmark-guided intra-articular and peri-articular injections for the knee, hand, shoulder, and hip³⁰. This analysis demonstrated that ultrasound-guided injections were significantly more effective in decreasing pain in the short term (2 to 6 weeks); however, no difference was seen at 12 weeks and beyond.

Glucocorticosteroid Injections

Bodick et al. performed a multicenter trial with 228 patients to compare the intra-articular administration of single-dose, immediate-release triamcinolone acetonide (40 mg) and extended-release triamcinolone acetonide (FX006) (10 mg, 40 mg, or 60 mg) in patients with Kellgren-Lawrence grade-2 or 3 osteoarthritis³¹. Primary outcomes were assessed with a numerical pain scale at baseline and 8, 10, and 12 weeks. The 10-mg dose of FX006 proved to be equivalent to immediate-release corticosteroid at 2 to 12 weeks; the 40-mg dose of FX006 was superior at 5 to 10 weeks. The 60-mg dosage did not show any improvement over the 40-mg dosage. Despite a significant difference in outcome using 40 mg of FX006 at 5 to 10 weeks, this difference may not translate to a clinically notable difference from the use of immediate-release corticosteroids.

In a randomized controlled trial, Ranalletta et al. compared the use of unguided, single-dose betamethasone injection and oral NSAIDs prior to physical therapy among 74 patients with adhesive capsulitis of the shoulder³². Outcome measures included a visual analog scale (VAS) for pain, the abbreviated Disabilities of the Arm, Shoulder and Hand (QuickDASH) score for function, the ASES Shoulder Score, passive range of motion, and the abbreviated Constant-Murley score at 2, 4, 8, and 12 weeks. Pain and most functional improvement measures were superior from baseline to 8 weeks in the injection group; however, there was no difference seen at the time of final follow-up.

Cannabinoid Use for Chronic Pain and Spasticity

Whiting et al. performed a meta-analysis of 79 trials (6,462 participants) investigating the use of cannabinoids in the management of chronic pain and spasticity as well as for other indications³³. When compared with placebo, the average reduction in the numerical pain rating and in the Ashworth spasticity scale was greater with cannabinoids. Moderate-quality evidence from studies reviewed in this meta-analysis suggested that cannabinoids can reduce chronic pain and spasticity. However, this may come with increased risks of short-term adverse events, such as dizziness, dry mouth, nausea, fatigue, somnolence, euphoria, vomiting, disorientation, drowsiness, confusion, loss of balance, and hallucination.

Amputation, Prosthetics, and Orthotics

Karol et al. assessed the impact of compliance counseling regarding brace use for adolescents with idiopathic scoliosis³⁴. Females <1 year post-menarche and with a spine curvature of 25° to 45° were randomized to either the counseled group (sensors embedded in the brace to provide data on compliance, with counseling from the surgeon and orthotist regarding hours of wear) or the noncounseled group (only encouragement to wear the brace provided, without data on compliance). Patients in the counseled group wore the brace a significantly higher number of hours per day compared with the noncounseled group and also had a significantly lower rate of curvature progression.

Physical Modalities***Transcutaneous Electrical Nerve Stimulation (TENS)***

The evidence for the use of TENS in pain management is conflicting³⁵. Chen et al. performed a systematic review and meta-analysis to determine whether TENS was effective in the management of knee osteoarthritis³⁶. A previous Cochrane review published in 2009³⁷ and the 2014 Osteoarthritis Research Society International (OARSI) guidelines³⁸ had no definitive conclusion. The recent systematic review included 18 randomized controlled trials published between 1983 and 2014, with a total of 1,260 participants. The meta-analysis included a subset of 639 patients from 14 of the studies and demonstrated that TENS significantly decreased pain compared with that in the control groups. No relationship was found between TENS and the WOMAC score, pain-limited range of motion, total passive knee range of motion, and the Timed Up and Go Test.

Other types of electrical stimulation include neuromuscular electrical stimulation (NMES), used for muscle strengthening, muscle retraining, and edema control, and functional electrical stimulation (FES), used in the neurorehabilitation of patients with stroke. Morf et al. performed a randomized, single-blinded, crossover study to compare maximal evoked torque, discomfort, and fatigue-related outcomes between multipath NMES and conventional NMES of the quadriceps muscle in patients after total knee arthroplasty³⁹. Twenty participants were included in this study. Both groups received two 45-minute sessions (7 days apart). The parameters for multipath and conventional NMES included biphasic symmetrical square pulses of 400 μ s with a frequency of 50 Hz and an on:off ratio of 5:10 seconds. Ramp-up and ramp-down times were 1 second each. The authors found that multipath NMES generated stronger contractions and induced lower discomfort and muscle fatigue than conventional NMES in patients after total knee arthroplasty.

Kinesiology Taping

Previous systematic reviews that have included low-quality studies have suggested that the use of kinesiology tape may have limited potential in reducing pain in individuals with musculoskeletal injury⁴⁰⁻⁴². Since the effects are unclear with respect to pain caused by knee osteoarthritis, Cho et al. conducted a

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randomized controlled trial to test whether kinesiography taping ($n = 23$) improves pain, range of motion, and proprioception compared with sham application ($n = 23$)⁴³. They found that the kinesiography taping group had significant improvements in pain during walking, pain-free active range of motion, and proprioception post-treatment, while the sham application group had no significant change in outcomes.

Advancing Clinical Practice

In summary, considerable evidence was published in each of the subspecialty areas of physical medicine and rehabilitation as it pertains to orthopaedic care. A practicing clinician can utilize this evidence to inform patient care and patient outcomes. Several areas of investigation highlighted in this article present the need for additional research in order to further advance evidence-based rehabilitative orthopaedic care.

Evidence-Based Orthopaedics

The editorial staff of *The Journal* reviewed a large number of recently published research studies related to the musculoskeletal system that received a higher Level of Evidence grade. In addition to articles cited already in the Update, 3 other articles with a higher Level of Evidence grade were identified that were relevant to

orthopaedic rehabilitation. A list of those titles is appended to this review after the standard bibliography. We have provided a brief commentary about each of the articles to help guide your further reading, in an evidence-based fashion, in this subspecialty area.

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Evidence-Based Articles Related to Orthopaedic Rehabilitation

Dry Versus Wet Needling

Liu L, Huang QM, Liu QG, Ye G, Bo CZ, Chen MJ, Li P. Effectiveness of dry needling for myofascial trigger points associated with neck and shoulder pain: a systematic review and meta-analysis. *Arch Phys Med Rehabil.* 2015 May;96(5):944-55. Epub 2015 Jan 7.

Needling has become a frequently used adjunct to manual and rehabilitative care. Liu et al. performed a meta-analysis of 20 randomized controlled trials evaluating the effectiveness of dry needling for treating myofascial trigger points associated with neck and shoulder pain. In total, the data synthesis combined the results of 839 patients undergoing dry needling and comparative procedures. Dry needling was found to be effective in the short term (immediate to 3 days), with limited comparison with sham and/or control groups, and therefore, the findings were inconclusive. In the intermediate term (9 to 28 days), wet needling (short or long-acting local anesthetic with or without corticosteroid) outperformed dry needling, but asymmetrical data may suggest publication bias, and therefore, the findings were inconclusive.

Postoperative Rehabilitation Following Distal Biceps Repair

Smith JR, Amirfeyz R. Does immediate elbow mobilization after distal biceps tendon repair carry the risk of wound breakdown, failure of repair, or patient dissatisfaction? *J Shoulder Elbow Surg.* 2016 May;25(5):810-5. Epub 2016 Feb 17.

Distal biceps repairs are not uncommon, and postoperative rehabilitation protocols are highly variable. Smith and Amirfeyz presented a case

series of 22 consecutive distal biceps tendon repairs in which a cortical button was used for fixation. Their postoperative protocol allowed immediate active elbow range of motion and the initiation of physical therapy 3 weeks after surgery, with strengthening exercises allowed as soon as full active motion of the elbow was achieved. They reported no failures or wound complications and excellent patient-reported outcome scores at an average of 16.6 months of follow-up.

Behavioral Approach in Whiplash Injury

Ludvigsson ML, Peterson G, O'Leary S, Dederig Å, Peolsson A. The effect of neck-specific exercise with, or without a behavioral approach, on pain, disability, and self-efficacy in chronic whiplash-associated disorders: a randomized clinical trial. *Clin J Pain.* 2015 Apr; 31(4):294-303.

A behavioral approach to physical therapy was investigated by Ludvigsson et al. among patients with chronic whiplash-associated disorders. Participants were randomized to either supervised neck-specific exercise, supervised neck-specific exercise with a behavioral approach (oral education on physiological and psychological aspects of pain, pain management, and problem-solving activities), or unsupervised physical activity. The results of this randomized controlled trial demonstrated that supervised neck-specific exercise was more beneficial than unsupervised physical activity; however, no benefit was found for the addition of a behavioral approach. Since the study included a heterogeneous group of chronic whiplash-associated disorders, additional research is needed to better understand which patient subgroups would benefit from a behavioral-based physical therapy approach.