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Improving Care for Individuals in Pain Through a Biopsychosocial View

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Key Phrases
Biopsychosocial, psychosocial factors, persistent pain, patient-centered care

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EDITORIAL

Everyone experiences pain to some degree during their life. It is a universal part of the human experience. Pain can be a critical protective mechanism, as it warns us to change behaviors and move away from danger. It can serve to protect an injured tissue from further damage. Pain can also be the source of suffering, and in cases of persistent pain, it can become the disease itself in the absence of other tissue involvement. The burden of pain on society is well documented and involves a significant economic impact.[1] The individual impacts of suffering and distress are unmistakable, and the effects of pain on the individual do not reside there alone. Interpersonal relationships are often strained and societal roles go unfulfilled. As healthcare providers, we have each personally seen the burden of pain shouldered by our patients and sometimes our friends, family, and co-workers. The individual and subjective, yet universal nature of pain are what make it particularly challenging to treat.

It has been a decade since the Institute of Medicine released the report *Relieving Pain in America: A Blueprint for Transforming Prevention, Care, Education, and Research*.[2] This report outlined the multiple challenges related to reducing the burden of pain in the United States. The challenges included rising rates of chronic pain, increased opioid use, and inadequate access to treatment for the most vulnerable patients.[2] Despite upward trends in the prevalence of pain, healthcare providers identified ongoing gaps in their education regarding the treatment of pain and a lack of confidence in their ability to care for individuals with more complex pain conditions. Due to these findings, the report called for a cultural transformation in the way the public and clinicians view pain and its treatment. The transformation called for a more thorough understanding of pain in to improve the prevention, assessment, and treatment of pain.[2] The public health burden of pain along with self-reports of inadequate preparedness by healthcare providers to treat pain motivated this recommendation.

The Institute of Medicine's report urged clinicians treating patients in pain to adopt a more complete view of the patient. This more complete view incorporates aspects of culture, beliefs, previous experiences, knowledge, expectations, and values.[2] This perspective aligns with a biopsychosocial model of pain, and it integrates the traditional biomedical model with its tissue pathology focus into a much broader view of the patient that includes psychosocial factors.[3] The biopsychosocial view emphasizes the role of psychological and social factors play combined with biological factors involved in the prevention, assessment, and treatment of pain. This is not a new perspective on how to be most effective at caring for people in pain, but it has been slow to be embraced into our biomedical culture. Engel

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made a case for the biomedical model being outdated and lacking validity in his 1960 paper stating, "[on outdated models,] a disease, then, has substantive qualities, and the patient can be cured if the diseased part is removed. That this often proves to be the case, as attested to by the successes of surgery, is actually not evidence for the validity of such a point of view."[4]

Traditional training for healthcare professionals has focused on a biomedical view of pain that would support the idea that a tissue-based pathology is the cause of pain and disability. Prevention, assessment, and treatment of pain within this biomedical view center on identifying the pathological tissue and promoting healing of the involved tissue. Limitations of the biomedical view include a poor ability to explain persistent pain and a lack of congruency with recent evidence highlighting the importance of psychosocial factors in pain and disability.[5] The biomedical view has been increasingly challenged as imaging has advanced and tends to find pathological tissues in the majority of people. Unhealthy tissues are present in people who have never had an injury or pain in the region of the findings.

This biomedical view is at odds with more complex pain presentations and the majority of individuals with persistent pain. Patients with persistent pain often present with minimal tissue based pathology or have long since healed from a tissue pathology but continue to experience pain and disability. Much of the focus of the biopsychosocial view has been on applying it to patients with persistent pain.[6] While this is valid, it does ignore the reality that all chronic pain begins as acute pain. Psychosocial factors that play a role in the persistence of pain are often present in acute pain presentations. Adopting a view of acute pain that incorporates psychological and social factors along with tissue based factors is the way to accepting this view for chronic pain. Many prognostic indicators for the progression of acute to chronic pain are psychological and social in nature.[7] After a whiplash injury, for example, perceived injustice and pain catastrophizing are predictive factors for poor recovery.[8] Patient expectations of recovery after an injury also play an important role in prognosis. For individuals with acute injuries similar in nature, those with higher expectations of recovery are less likely to develop persistent pain.[9] Pain-related fear of movement, a common maladaptive pain behavior after acute injury, was the single strongest contributing factor to disability in a group of patients with foot and ankle pathology.[10] We should not ignore that tissue pathologies more severe in nature take longer to heal, but the extent of injury alone is a poor predictor of who will transition to persistent pain and ongoing functional loss.[11,12] Only a more complete accounting of a patient's culture, beliefs, previous experiences, knowledge, expectations, and values can begin to account for this transition from acute pain to persistent pain.

So what does this biopsychosocial view of pain look like? It looks a lot like compassionate, patient-centered care. It involves a skilled interview that moves beyond the state of the tissue to understand contributing factors to the pain experience.[13] It involves a thorough physical examination that by itself can reduce pain and improve the patient's psychological orientation to treatment.[14] It also involves using standardized patient self-report questionnaires to help you get a more complete understanding of the multidimensional factors that contribute to your patient's pain experience.[15] It may involve referral or collaboration of an interprofessional or intraprofessional nature. Most of all it involves compassionate care and building a meaningful therapeutic alliance with your patient.[16] These are within the skill set of many healthcare providers, but those of us in rehabilitation have some specific advantages. We see patients repeatedly over an episode of care, which allows us to build a working relationship while we consistently reevaluate the patient's

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status. We spend a significant amount of training on developing our physical examination skills, and we tend to have more time with our patients than our physician colleagues.

The development of new imaging techniques, less-invasive surgeries, and novel pharmaceuticals as ways to treat pain have not moved the needle on the burden of pain in society. In some cases, as is often true for advanced imaging, these tools have resulted in increased downstream costs and maladaptive pain beliefs that result in harm to patients.[17] Advanced imaging and many novel interventions cling to the biomedical view and are lacking when it comes to addressing the psychosocial issues related to persistent pain. Effective treatment for persistent pain incorporates the biopsychosocial view through graded activity, addressing maladaptive behaviors, and educating patients with an emphasis on self-management and understanding the individual factors that influence their pain.[18,19] Embracing the biopsychosocial view is integral to enhancing the role athletic trainers and other healthcare providers play in reducing the burden of pain on society. I encourage you to take a moment and consider your view of pain. Reflect on what you are doing to incorporate psychological and social factors into how you prevent, assess, and treat pain. If we are going to be more effective in our role treating pain, it has to occur one person at a time through a view that incorporates psychosocial aspects into our patient management. It must involve a change in culture that is long overdue.

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An Exploratory Analysis of a Treatment Based Classification Algorithm to Treat Patellar Tendinopathy

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ABSTRACT

The general and athletic populations commonly experience patellar tendon pain, which is frequently treated with a gold standard 12-week eccentric exercise protocol. The present research study was designed to determine the effects of a treatment based classification (TBC) algorithm utilizing indirect treatment techniques in patellar tendinopathy participants. Ten participants (seven females, three males, mean age = 19.6 ± 1.07, mean symptom duration = 2.14 years with a range of one week to six years) with patellar tendinopathy were evaluated and included in this study. Each participant underwent a thorough evaluation process to aid in determining inclusion: participant medical history, range of motion measurements, orthopedic tests, a scan for soft tissue tender points, neurodynamic tests, and a local Mulligan Concept technique to determine diagnosis, study inclusion, and treatment classification. The following outcome measures were collected to establish baseline scores and assess participant improvement: the Disablement in the Physically Active Scale (DPA Scale), Numerical Rating Scale (NRS), Victorian Institute of Sports Assessment for the Patellar Tendon (VISA-P), Global Rating of Change (GRC), Nirschl Phase Rating Scale, and Blazina Knee Scale. Paired *t*-tests with 95% confidence intervals, were analyzed on NRS, DPA Scale, and VISA-P to determine the effectiveness of all treatment from initial exam to discharge. Cohen's *d* was also computed to determine the effect size of each of the aforementioned outcome measures. Descriptive statistics were computed for the GRC at discharge. The mean change for the NRS ($M = 4.7$, 95% CI[3.57 to 5.82], $p < .001$), DPA Scale ($M = 21.8$, 95% CI[12.43 to 31.16], $p = .001$), and VISA-P ($M = 22.70$, 95% CI[33.71 to 11.68], $p < .001$) were statistically significant. The mean for the GRC ($M = 5.3$) was clinically meaningful. All of the participants (100%) met discharge criteria. The results of this case series demonstrated an increase in function and decrease in pain for participants with patellar tendinopathy within three office visits when utilizing a TBC algorithm.

Key Phrases
Patellar tendinopathy, manual therapies, treatment-based classification, patient-reported outcomes

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INTRODUCTION

Tendon related pathologies comprise 30 to 45% of sport related injuries,[1] and frequently cause impairment in the general population.[2] Patellar tendinopathy accounts for 7 to 40% of tendon related pathologies in sport[3] and is characterized clinically by tendon pain, tendon dysfunction,[4,5] decreased performance in association with tendon swelling, morning stiffness,[4,6,7] palpable crepitus,[3,6,7] and localized swelling.[4] Pain over a tendon is the key clinical diagnostic criteria used by clinicians to diagnose tendinopathy.[8] The use of advanced diagnostic imaging/testing (e.g., diagnostic ultrasound) is not common clinically, but is necessary to determine the exact physical state of the tendon.[5]

Though the clinical exam is the accepted standard for tendinopathy diagnosis, varying patient presentations and injury states make it difficult to identify the origin of tendon pain.[9] Previously, tendon pain was thought to be a mechanical overuse injury, which caused inflammation in the tendon, and was classified as a *tendinitis*.[10] Due to a lack of inflammatory markers being present

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during histological tests, the term *tendinopathy* has generally become the preferred diagnostic term for tendon pain,[2,11] while *tendinosis* is utilized for a degenerative tendon diagnosed using diagnostic imaging.[2] As tendon pathology research has elucidated other causative factors for the presentation of tendon pain (e.g., mechanical, neural, vascular),[10] other researchers have proposed the use of the terms *reactive tendinopathy* and *tendinalgia* when classifying a patient with tendon pain.[12, 13] The use of the term tendinalgia would allow clinicians to acknowledge the patient complaint of pain at the site of a tendon without predetermining a state of tissue pathology.[13]

The risk of using terminology focused on a specific causative factor is that it may lead to treatments that are not optimal for a specific patient or situation.[9] Due to the previous acceptance of an inflammatory condition being present when diagnosed as tendinitis, most interventions have been aimed at treating the inflammatory process. Most of these strategies do not produce effective long-term results (i.e., improvement past six weeks).[14-16] Commonly used conservative treatments for patellar tendinalgia include: rest, nonsteroidal anti-inflammatory drugs (NSAIDs), stretching, eccentric exercises, and corticosteroid injections.[2,7,17] The current treatment gold standard is the use of eccentric exercises. The Alfredson et al. protocol has become the foundation of most eccentric exercise protocols with participants performing the exercises two times a day, seven days a week, for 12 weeks.[18-24] For many patients, however, compliance is difficult due to the length of the treatment, muscle soreness, and/or the pain experienced with treatment.[18,23,25] Other concerns with the protocol, such as tendon rupture rates, are not well understood as researchers do not always report treatment complications. Upon return to activity, participants who complete the protocol also report a high recurrence rate.[15,26]

Another treatment option is to utilize manual therapies theorized to address the different causative factors of tendon pain; however, few research studies have been conducted to assess the effectiveness of manual therapy for the treatment of patellar tendinalgia. While there are a variety of manual therapy options that have been proposed to treat this disorder, clinicians could theoretically address the causative factors by applying the Mulligan Concept (MC), Positional Release Therapy (PRT), and/or neurodynamics in these cases. The MC techniques for knee dysfunction are based on applying a pain free glide (mobilization) to the joint while the patient actively moves into a position that was painful prior to the glide being applied.[27] Positional Release Therapy (PRT) is theorized to restore the muscle or tendon to normal function by increasing oxygen and decreasing inflammatory metabolites.[28] To determine if a peripheral neural sliding or tension dysfunction is present, neurodynamics is performed. Neurodynamics is the movement of the nervous system on other body structures.[29] The use of these techniques in isolation, or combination, might better target the individual differences in patient presentation.

The use of manual therapies and tendon classification have been proposed as a means to improve the treatment of tendon pain[12,13] due to the high rate of tendon pathology recurrence[15,26] and patient non-compliance.[23,25] Researchers have proposed that many patients classified with tendinalgia may not actually have a true tissue pathology that must be addressed with tissue remodeling[13] and that classifying patients based on their response to sub-therapeutic doses of intervention techniques may improve patient outcomes.[9,13] Thus, it is important for clinicians to consider alternative examination and treatment strategies to better identify and treat these patients. The purpose of this study was to determine if a novel treatment based classification (TBC) algorithm could be used to classify tendon pain, participants, and what the effects of using the algorithm would be in participants diagnosed with patellar tendinalgia.

PARTICIPANTS

Case Description

A convenience sample of participants diagnosed by athletic trainers with patellar tendinalgia at four clinical sites across the United States of America participated in the study. The Texas Lutheran University Institutional Review Board approved the research project. All participants signed an informed consent form; if the participant was under the age of 18 years old, the legal guardian signed the informed consent and assent was provided by the minor. During the evaluation period, a total of 10 participants (seven females, three males, mean age = 19.6 ± 1.07, mean symptom duration = 2.14 years with a range of one week to six years) presented for possible inclusion in the study. All of the potential participants were diagnosed with patellar tendinalgia according to the inclusion criteria (Table 1), agreed to participate in the study, and completed the study through discharge. All participants reported with patellar tendon pain, increased pain and stiffness in the morning and after sitting for long periods of time with a decrease in symptoms after warm up for physical activity.[35]

Examination

Each participant was examined using a pre-determined clinical evaluation to ensure consistency in patellar tendinalgia diagnosis and classification with the TBC Algorithm. Inclusion criteria included: tendon pain before, during, or after patella loading activities; point tenderness over the patellar tendon upon palpation; pain near patella origin; impaired function; and tendon focal or generalized swelling. Exclusion criteria included: cortisone injection (<six weeks), fluoroquinolones ciprofloxacin use (<12 months), post-operative participants unable to perform the treatment (<eight weeks), wore orthotics, currently healing or suspected fractures, or receiving physical therapy for the tendon of concern. Participants who met the inclusion criteria then completed a thorough history, range of motion (ROM), and special test examination. Special tests performed included: Clark's sign, patellar grind, patellar compression, prone knee bend, slump, a quarter screen for tender points (TP),[28] and the application of the MC technique for the knee (an internal rotation glide followed by an external rotation glide if pain was not resolved during application). [27] Clark's sign, patellar grind, and patellar compression tests were performed to rule out patellar dysfunction as the source of pain. The prone knee bend and slump tests were performed to rule in neurological tension and sliding dysfunctions. [29] The quarter screen was performed to determine the presence of TPs; while the MC Technique was performed last to determine classification into the MC treatment.

Treatment-Based Classification Algorithm

The TBC algorithm consisted of a MC technique, PRT, neurodynamics, and eccentric exercise. If the participant reported a resolution of his or her symptoms when the MC technique was applied during the exam, then the participant was classified as being a responder to the MC treatment. If the application of the MC did not resolve symptoms during the exam and the participant presented with TPs in the lower extremity, which could be reduced by moving the participant into a position of comfort (POC), then the participant was classified as being a responder to the PRT treatment. If the application of the MC did not resolve symptoms and a POC could not be identified with PRT, the participant would be classified into the neurodynamic treatment if a positive neurodynamic test was found during the initial exam. In the case where the participant could not be classified into the MC, PRT, or neurodynamic group, the participant was classified into the eccentric exercise treatment protocol (Figure 1).

Once the clinician determined the appropriate treatment classification, the participant underwent three bouts of treatment within 10 days. The participant was re-assessed to determine if discharge criteria had been met at the conclusion of the third visit. Discharge criteria included: phase

Table 1. Participant Presentation and Treatment

Participant #	Symptoms	Symptom Duration	Positive Special Tests
Participant 1	Pain mid-patellar tendon; unable to sit for more than 30 minutes without pain; pain interferes with competition; intermittent pain at rest; increase pain with stairs and squats; worst pain in the morning	1 Week	TP: patellar tendon, tibialis anterior MWM: lateral rotation – lunge
Participant 2	Pain mid-patellar tendon; pain interferes with competition; intermittent pain at rest; increase pain with stairs, cutting, and squats; worst pain in the morning	2 Weeks	TP: Flexor digitorum longus MWM: medial rotation – squat
Participant 3	Pain slightly inferior to patella; increase pain when sitting with knees bent, squatting, lunging, going up stairs; pain at start of activity; worst pain in the morning	2 Months	TP: patella and ACL MWM: lateral rotation – lunge
Participant 4	Pain slightly inferior to patella; increased pain when sitting with knees bent longer than 30 minutes, squatting, lunging, and going upstairs; pain at start of activity; worst pain in the morning	2 Months	TP: patellar tendon MWM: lateral rotation – lunge
Participant 5	Pain mid-patellar tendon; pain during ADLs, lunging, stairs, single leg hops; pain at onset of activity but able to perform; difficulty maintaining same position for extended period of time; pain at start of activity; worst pain in the morning	6 Months	TP: ACL and patellar tendon MWM: lateral rotation – squat
Participant 6	Pain mid-patellar tendon; pain during ADLs, lunging, stairs, single leg hops; pain at onset of activity but able to perform; difficulty maintaining same position for extended period of time; worst pain in the morning	6 Months	TP: patellar tendon MWM: lateral rotation – single leg squat
Participant 7	Pain inferior to patella; unable to sit longer than 10 minutes without pain; unable to perform squats due to pain; difficulty with running and jumping; pain with ADLs and competition; worst pain in the morning	4 Years	ND: prone knee bend TP: medial hamstring MWM: medial rotation – squat
Participant 8	Pain slightly superior to tibial tuberosity; unable to sit longer than 10 minutes without pain; unable to perform squats due to pain; difficulty with running and jumping; pain with ADLs and competition; worst pain in the morning	4 Years	ND: prone knee bend TP: patellar tendon MWM: medial rotation – squat
Participant 9	Pain mid-patellar tendon; unable to perform single leg hops due to pain; difficulty with running and jumping; unable to compete due to pain; worst pain in the morning	6 Years	TP: patella, patellar tendon, ACL, and medial hamstring
Participant 10	Pain slightly superior to tibial tuberosity; intermittent pain at rest; unable to compete due to pain; worst pain in the morning	6 Years	TP: patella and patellar tendon MWM: lateral rotation - squat

ND: neurodynamics, TP: tender point, Positive MWM: achieved PILL effect; ADLs: activities of daily living

1 on the Nirschl Phase Rating Scale, phase 1 on the Blazina Knee Scale, and met minimal clinical important difference (MCID) for Global Rating of Change (GRC), and acute MCID for the Disablement of the Physically Active Scale (DPA Scale). Additionally, participants had to report a worst pain score equal to or less than two out of ten on the Numerical Rating Scale (NRS) during the discharge evaluation. If the participant was not discharged, a re-evaluation using the TBC algorithm was conducted to determine the participant's treatment classification for the next three visits. The participant was only able to be re-classified into the initial treatment classification if the participant demonstrated enough improvement to meet 50% of each discharge outcome criteria; if not, the participant was classified into the eccentric exercise treatment. Following discharge, each participant was sent a one-month follow up survey to collect follow-up scores on the NRS post-discharge.

OUTCOME MEASURES

Disablement and global participant outcome measures were utilized in this study to determine participant perceptions of their condition and recovery. The six outcome measures utilized in this study were the: NRS, GRC, DPA Scale, VISA-P, Nirschl Phase Rating Scale, and the Blazina Knee Scale.

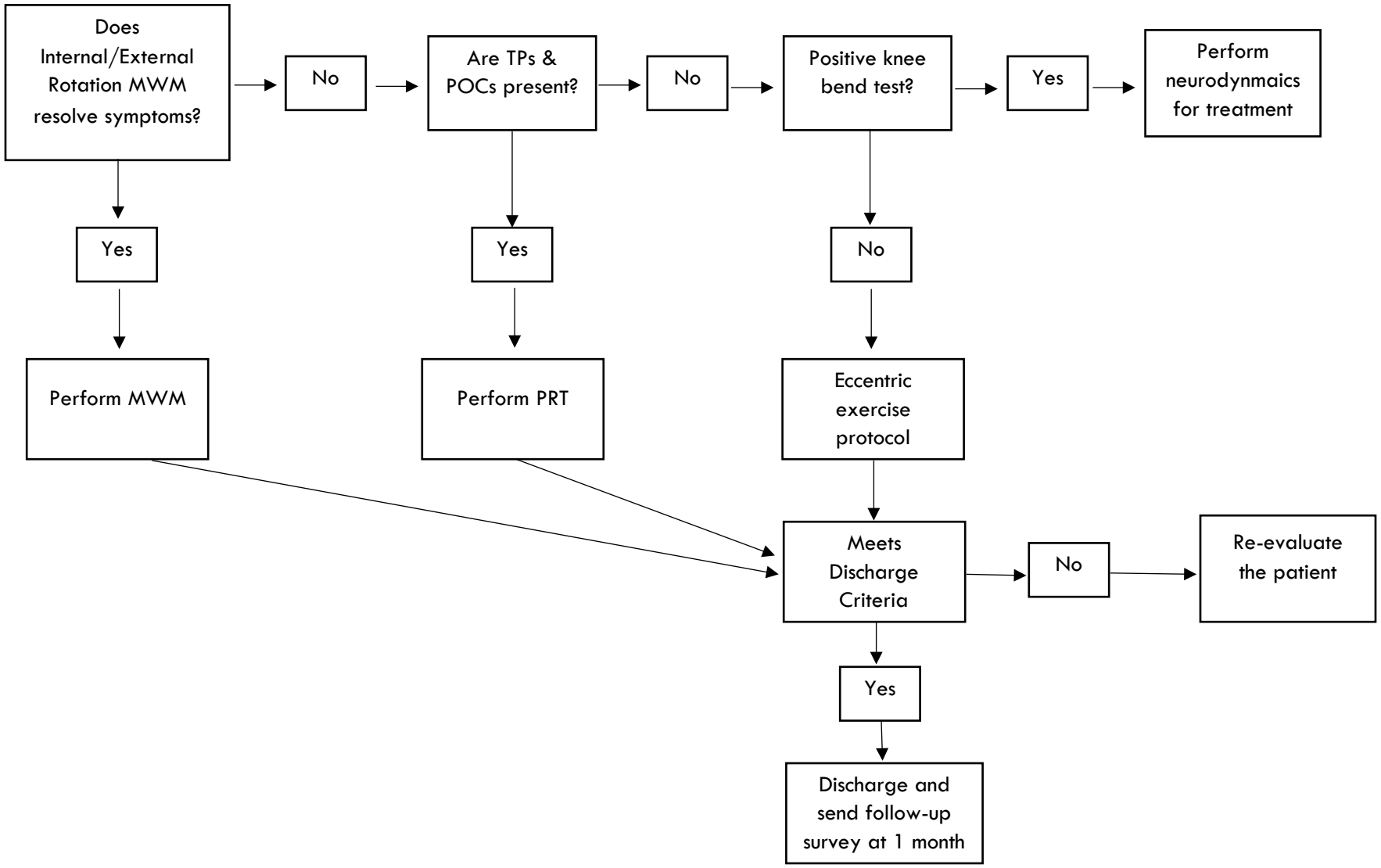
The NRS is a rating scale a clinician can utilize to determine a participant's perception of his or her pain from zero, no pain, to ten, worst pain imaginable.[30] Each participant of this case series was asked to rate his or her pain at best, worst, and rest before and after each treatment. The recorded NRS scores represent the participant's reported worst pain. The participant was also asked to rate his or her pain while the clinician performed a quarter screen for TPs. The GRC was utilized to determine participant's perception of his or her improvement or deterioration over time.[31] The GRC was reported at every third visit for each participant. The (MCID) has been established at two points for both the NRS[32] and GRC.[31]

The DPA Scale was developed to determine the participant's perception of how his or her injury has effected disablement.[33] A participant reported his or her perception on a scale of one, no problem, to five, severe, on 16 questions across multiple domains: pain, motion, muscular function, stability, changing directions, daily actions, maintaining positions, skill performance, overall fitness, participation in activities, and well-being. The rating for each item on the scale is summed and 16 points are subtracted to produce a final score that ranges from zero to 64 points. The DPA Scale was administered upon the first visit, third visit, and every third visit after until discharged. The MCID has been established for the DPA Scale as nine points for acute injuries and six points for chronic injuries.[33] The range of scores for healthy patients on the DPA Scale has been reported to be between zero and 34 points.[33]

The VISA-P was created to determine functional impairment in a participant with patellar tendon pain.[34] The participant recorded responses to questions regarding his or her function on a numerical scale from zero, unable to perform, to ten, fully functional. All responses were then summed and recorded on a scale from zero, no function, to 100, fully functional. Each participant recorded VISA-P score upon the first visit, third visit, and discharge visit. Currently, a MCID has not been established for VISA-P.

The Nirschl Phase Rating Scale and Blazina Knee Scale were both developed to help classify participant symptoms. The Nirschl Phase Rating Scale was created for all tendon pain participants,[2,35] whereas the Blazina Knee Scale was created to determine dysfunction specifically for participants with patellar tendon pain.[36] All participants reported his or her symptoms in accordance with both scales upon the first visit, third visit, and discharge visit. Currently, the Nirschl Phase Rating Scale, and Blazina Knee

Figure 1. Treatment Based Classification Algorithm for Patellar Tendinopathy



Scale do not have an established method for evaluating patient improvement on the scales.

INTERVENTION

If the participant was classified into the MC treatment subgroup, the participant was treated with the Mobilization with Movement (MWM) (internal or external rotation glide) to resolve the participant's pain complaint.[27] The internal or external rotation glide was applied by having the participant perform a movement that exacerbated the chief complaint. Once the painful movement was established, the clinician gently placed her hands just below the tibiofemoral joint line, around the tibia and fibula and applied the appropriate glide to the tibia in association to the femur (Figure 2). Simultaneously, the participant performed the previously established painful movement. The MWM was performed through three sets of 10 repetitions of pain-free movement.[27]

If the participant was classified into the PRT treatment subgroup, the dominant TP was monitored while the participant was passively moved into a POC.[28] The clinician would begin with the participant in a supine position on a plinth with a bolster under their ankle to allow full knee extension. The clinician would then apply tibial rotation with the hand not palpating the TP. The POC was defined as a position resulting in the resolution of pain (zero out of 10 on the NRS) during palpation of the TP. If a POC was achieved, the participant received PRT for the dominant TP only. The dominant TP was treated while the clinician maintained the POC (Figure 3). The POC was held for a minimum of 30 seconds, and a maximum of 90 seconds.[28] The participant was then returned to the normal anatomical position while the clinician continued monitoring the TP. The TP was reassessed by determining pain to palpation (using the NRS) in the normal anatomical position. If the participant still reported tenderness to palpation of the TP after one set of treatment, the clinician repeated the treatment; if the patient reported resolution of pain to palpation, the treatment was concluded for that session. A patient could receive a maximum of three treatment sets per visit.

If the participant was classified into the neurodynamic treatment subgroup, the participant was instructed on the proper technique to perform a general neural slider in the prone knee bend position (Figure 4).[29] As the participant released tension at the head (head moved from cervical extension to neutral), tension was increased at the knee (knee moved from extension to flexion).[29] Each participant completed three sets of 10 repetitions, through a slow and controlled movement.

If the participant was classified into Eccentric Exercise (EE) treatment subgroup, the participant completed a monitored EE protocol two times a day, seven days a week for 12 weeks.[37] Participants completed one set of 15 repetitions of a single leg squat on a 25-degree decline board for each session.[37] The participant was instructed to keep the trunk in the upright position, slowly flexing the knee to 90 degrees and returning to the starting position with the uninjured leg.[37] The participant was then instructed to squat into pain without exceeding seven out of ten on the NRS during the eccentric portion (knee flexion). If the participant's pain decreased to less than or equal to two out of ten on the NRS while performing EE, an external load by use of a dumbbell was added to increase the difficulty of the exercise.

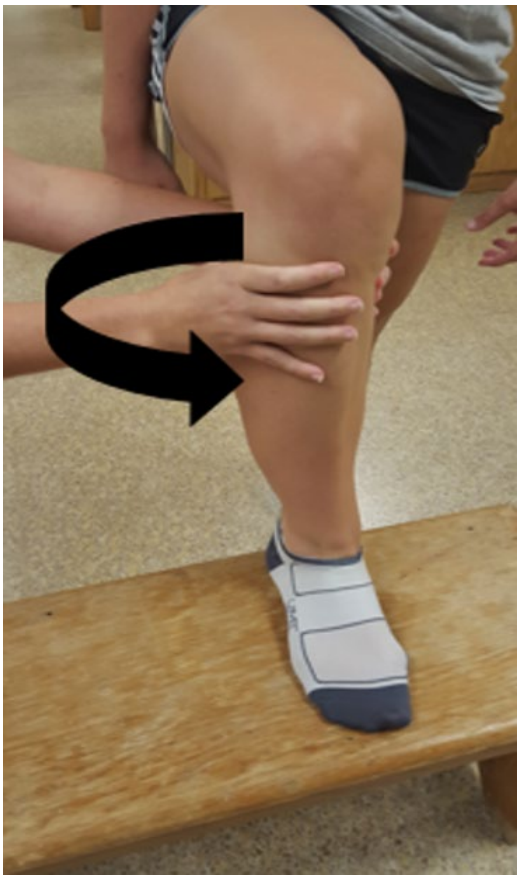


Figure 2. Example of the Mobilization with Movement

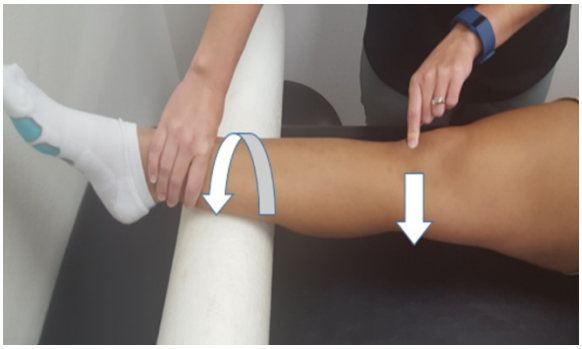


Figure 3. Example of Positional Release Therapy Position of Comfort

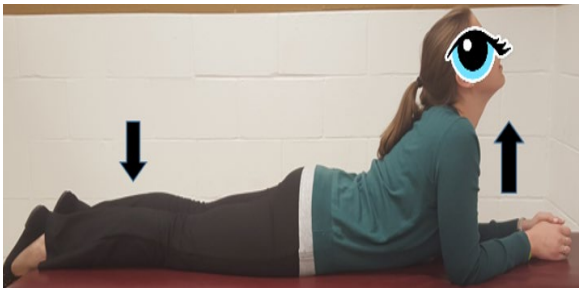


Figure 4. Example of Neurodynamic Slider Technique

Statistical Analysis

All data was analyzed using SPSS version 23.0 (SPSS Inc., Chicago, IL, USA). Paired *t*-tests were performed on the NRS, DPA Scale, and VISA-P to determine the effects of classifying and treating participants with this novel TBC algorithm for patellar tendinalgia. Mean differences from the initial visit scores and 95% confidence intervals (CIs) were calculated for the NRS, DPA Scale, and VISA-P for discharge. Cohen's *d* was also computed to determine the effect size, or maximum likelihood, of each of the aforementioned outcome measures. For Cohen's *d* an effect size of 0.2 to 0.3 was considered a "small" effect, around 0.5 a "medium" effect and 0.8 to infinity, a "large" effect.[38] Descriptive statistics were performed on the GRC scores reported at discharge.

RESULTS

During the initial examination, all participants were classified into a manual therapy treatment sub-group (MC = 9, PRT = 1). All participants were successfully treated through discharge with the initial treatment classification and no participants met the criteria for classification into the EE subgroup at any point of time during treatment. The number of treatments each participant received was three over a mean of 4.8 ±1.4 days to discharge.

Numerical Rating Scale

The use of the TBC algorithm resulted in a significant mean change in pain from initial visit to discharge, M = 4.7 ± 1.64 (95% CI [3.57 to 5.82], $p < .001$) with a large effect size (Cohen's $d = 2.41$) (Table 2). The mean difference in pain

scores from initial visit to discharge, as well as the lower boundary CI, exceeded the MCID of "much better" for the NRS.[26] The mean change was accomplished in just three visits that took place within 4.8 ± 1.4 days. At discharge, 60% of participants (6/10) reported a complete resolution of their pain. The remaining 40% of participants (4/10) reported their "worst" pain as a one (20%, 2/10) or two (20%, 2/10) on the NRS. One-month post discharge data demonstrated that all participants who completed the follow-up survey (n = 2) continued to experience a resolution of pain with full return to activity.

Disablement in the Physically Active Scale

Statistically significant changes on the DPA Scale from initial evaluation to discharge were recorded M = 21.8 ± 12.3130, (95% CI [12.43 to 31.16], $p = .001$), with a large effect size (Cohen's $d = 1.98$) when using the TBC algorithm (Table 2). The mean change from initial visit to discharge, as well as the lower boundary of the CI, exceeded the MCID for acute conditions, a reduction of nine points or greater, which is greater than the MCID for chronic conditions (six points).[33] All of the participants (100%) met MCID for both acute and chronic conditions prior to discharge, as well as being discharged within the healthy range (zero to 34 points).[33] Published data for DPA Scale scores for return to activity for chronic conditions does not exist; however, the reported mean for participants who returned from acute injury is M = 8.82 ± 6.71 (R = 0 – 23 points). All of the participants (100%) in this case series were discharged below the reported mean score for returning to activity after an acute injury (M = 8.5 ± 9.11; R = 0 - 22). Consequently, participants in this case series perceived less disablement than has been reported in the previous literature on the DPA Scale.[33]

Victorian Institute Sport Assessment - Patella

The use of the TBC algorithm resulted in a significant increase in scores on the Victorian Institute of Sport Assessment-Patella outcome measure from initial exam to discharge (M = 22.70 ± 16.07, 95% CI [33.71 to 11.68], $p < .001$), with a large effect size (Cohen's $d = 1.37$) (Table 2). Of greater clinical importance, 80% (8/10) of the participants reported a VISA-P score for "completely recovered" within three days of initiating treatment.

Global Rating of Change

A clinically meaningful increase on GRC scores from initial visit to discharge was reported (M= 5.7 ± 2.11) (Table 2). The GRC scale ranges from -7 (a very great deal worse) to +7 (a very great deal better).[31] All (100%) of the participants exceeded a MCID for the GRC scale (≥ 2) upon discharge.[31] More clinically relevant, 50% (5/10) of participants reported a +7 (a very great deal better), 10% (1/10) reported a +6 (a great deal better), and 40% (4/10) reported a +4 (moderately better) at discharge.[31]

Nirschl Phase Rating Scale

During initial evaluations, 30% (3/10) of participants reported a phase three on the Nirschl Phase Rating Scale meaning "pain that is present during activity without causing activity modification",[35] 40% (4/10) reported a phase five "pain that is present during all activities and occurs with activities of daily living",[35] and 30% (3/10) reported a phase six "intermittent rest pain that does not disturb sleep".[35] All participants (100%, 10/10) reported a phase one ("mild stiffness or soreness after activity with resolution of symptoms within 24 hours") on the Nirschl Phase Rating Scale prior to discharge. More clinically relevant, 60% (6/10) of the participants did not feel a phase one rating on the Nirschl Phase Rating Scale was applicable due to their experience of full resolution of symptoms.

Table 2. Outcome Results

Outcome Measure	Intake Score	Discharge Score	Mean Change	95% CIs	*P-value*	Effect Size (Cohen's *d*)
NPRS	5.30±1.94	0.60±0.84	4.78±1.64	3.52, 6.04	0.000	2.41
DPA Scale	30.3±11.02	8.50±9.12	19.89±12.31	10.42, 29.35	0.001	1.98
VISA-P	53.60±16.58	76.30±18.36	-23.56±16.71	-35.91, 11.20	0.002	1.37

NPRS: Numeric Pain Rating Scale; DPA Scale: Disablement of the Physically Active Scale; VISA-P: Victorian Institute of Sport Assessment for Patellar Tendon; CIs: Confidence Intervals

Blazina Knee Scale

During the initial evaluation, 50% (5/10) of participants reported a phase two on the Blazina Knee Scale "pain/discomfort during and after activity with the subject still able to perform at a satisfactory level (does not interfere with participation)";[36] while the other 50% (5/10) of participants reported a phase three "pain during and after activity with more prolonged, with subject having progressively increasing difficulty in performing at a satisfactory level (interferes with competition)".[36] All of the participants (100%) reported a phase one on the Blazina Knee Scale prior to discharge ("pain after activity only").[36] More clinically relevant, 60% (6/10) of participants did not feel a phase one rating on the Blazina Knee Scale was applicable due to their experience of full resolution of symptoms.

DISCUSSION

Currently, eccentric exercise is the gold standard treatment for patellar tendinalgia. Several researchers have demonstrated positive results with the use of a 12-week protocol.[18-21,23-25,38,39] Jonsson and Alfredson[40] compared an eccentric exercise group to a concentric exercise group for the treatment of "jumper's knee" and reported nine out of 10 participants who completed the study were "satisfied" and discharged with a mean Visual Analogue Scale (VAS) of 23 out of 100 and a VISA-P score of 83 points with the use of a 12-week eccentric exercise protocol. Similarly, Purdam, et al.[24] reported a mean VAS score of 28.5 points at discharge for participants who performed eccentric exercises on a decline board, compared to a mean VAS score of 72 points at discharge for participants who performed traditional squat eccentric exercises for 12 weeks. In these studies, however, not all participants reported being "satisfied" at discharge (10%,[40] 25%[24]). The participants, who did report being "satisfied" did not, on average, experience a full resolution of pain at discharge after 12 weeks of therapy.[24,40] Although NRS and VAS are measured on different scales, the values of the numbers are similar. The clinicians of the present study were able to discharge participants with mean NRS scores of .05 out of 10 (0/10=6, 1/10=2, 2/10=2), which is lower than the aforementioned studies. Although the mean VAS of the present study was lower, the mean VISA-P (M = 78.11) of this study is also lower than the aforementioned study, which is potentially indicative of participant perception of more function from the EE protocol.

Although EE has been found to produce beneficial results when the protocol is completed, there are still concerns over the effectiveness of the protocols for all patients and a lack of a clear understanding of the mechanism of action. Thus, there is a need to determine if tendinalgia participants should be screened prior to using an EE protocol in a one-size fits all model.[8,9] The lack of a screening process for identifying patients likely to respond to EE and the extended time required for patients to become symptom free has created a need for improved assessment methods.[8,9] One potential solution to improve tendinalgia outcomes is the use of a TBC system or more novel manual therapy techniques. Lewis[9] has suggested a series of four mechanical techniques,

or a combination of interventions, to be used as a TBC system to produce improved patient classification and treatment outcomes for patients with rotator cuff tendinalgia. The manual therapies used in the TBC algorithm in this study also have evidence of effectiveness on tendinalgia patients in other research studies.[13,42-44]

Researchers have found promising results with the use of the MC when treating lateral epicondylalgia.[41-43] Bisset, et al.[43] observed favorable outcomes for the use of MC mobilizations in combination with exercises over corticosteroids and a "wait and see" method. Although corticosteroid injections were more statistically significant

While the preliminary results of this case series are important, the limitations of this study must also be noted. Although many attempts were made to decrease the risk of bias, there could have been a bias created because the clinician and participants were not blinded to the treatment or collection of outcome measures. Additionally, a control or placebo group was not used in the study. The lack of control group and long term follow-up made it difficult to definitively determine if the outcomes were the result of treatment or the natural course of healing; however, a number of participants presented with chronic symptoms (mean symptom duration = 2.14 years with a range of one week to six years) unlikely to have spontaneously healed over the treatment period. The lack of comparison group made it difficult to determine if one treatment intervention was superior to another within the TBC algorithm, but the purpose of the study was not to identify the "best" intervention. Instead, the focus was on determining the effectiveness of classifying patients using sub-therapeutic doses on indirect manual therapies. Additionally, it could be argued the treatments provided as part of the TBC algorithm were provided at sub-therapeutic doses (e.g., not treating multiple TPs with PRT, etc.) and the interventions could be more effective if treatment dose was maximized. Furthermore, the specific techniques utilized (e.g., internal rotation and external rotation MWM, etc.) for this TBC algorithm were limited to increase usability of the algorithm; however, other techniques within the different intervention paradigms have the potential to maximize the effectiveness of each paradigm (e.g., MC taping technique, other glides, etc.). The full examination of the original TBC was not fully assessed due to the lack of diverse treatment subgroups. There were nine participants classified in the MC subgroup, one in the PRT subgroup, and zero in the ND and EE subgroups. The final limitation is that the participants may not have fully represented patellar tendinalgia patients and those who volunteered may have been motivated to improve.

As this study is an initial examination of a TBC algorithm for patellar tendon pain, it is possible that altering the order or adding other treatment paradigms may be appropriate to maximize the effectiveness of the TBC algorithm. The results of this study do provide support for the utilization of a TBC algorithm for patellar tendinalgia patients because all 10 participants experienced statistically and clinically significant improvements in pain and function in three visits. Future research should compare this TBC algorithm with a control or placebo group and utilize long-term follow-up with the participants. Forthcoming research should also include diagnostic imaging or histological exams, which would benefit the understanding of the physiological changes in the tendon following treatment utilizing the TBC algorithm.

CLINICAL APPLICATION

The TBC algorithm used in this study was designed because the clinicians could observe participant response to potential interventions while in a painful state and to utilize manual therapy techniques that could potentially produce rapid changes. Patient response enabled the clinician to classify the participant to an intervention that was designed to be matched to their dysfunction. In theory, matching tendinalgia patients to therapies

through classification could improve outcomes. In this study, all of the participants were classified as being a responder to either the MC or PRT and were able to meet the pre-established discharge criteria without a single participant needing to be classified into the EE protocol sub-group at any time. Thus, a TBC algorithm may be more effective at matching participants to appropriate treatments that do not require extended therapy or a painful experience to produce effective outcomes. Additionally, the use of a TBC algorithm may allow clinicians to identify which participants actually need to participate in an EE protocol or when to add this protocol as an adjunct therapy to provide complete resolution of participant complaints.

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Dry Needling and Management of Trigger Points with Low Back Pain: An Evidence to Practice Review

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ABSTRACT

Low back pain is a common health concern. The development of myofascial trigger points due to low back pain can cause debilitating pain and loss of functional movement in patients. Dry needling is a minimally invasive procedure that has shown to be useful in the treatment of myofascial trigger points when used with other forms of treatment. However, the literature surrounding dry needling and myofascial trigger points in patients with low back pain is lacking. The guiding systematic review and meta-analysis sought to analyze the effectiveness of dry needling for patients with low back pain. The review utilized eight databases for randomized controlled trials and selected 11 of 784 articles for analysis based on inclusion and exclusion criteria. A 6-subgroup meta-analysis was conducted on these studies, and 6 of the 11 studies were found to have high risk of bias. The included studies used both pain measurements and functional measurements including the visual analogue scale (VAS), Oswestry Disability Index (ODI), and the Roland-Morris Disability Questionnaire (RDQ). The studies did not include objective functional measurements. Overall researchers found a clinically meaningful decrease in outcome scores in the short-term, but there were no significant differences in pain or functional outcomes through long-term follow-up. This seems to correlate with the current literature on dry needling and its inflammatory effects on the body, suggesting that dry needling alone does not provide any long-term effect on myofascial trigger points in patients with low back pain. Dry needling should be combined with other treatments and high-quality rehabilitation to provide longer-lasting results and better treatment outcomes for patients with low back pain.

Key Phrases
Functional testing, manual therapies, patient-reported outocmes

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ORIGINAL REFERENCE

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SUMMARY

CLINICAL PROBLEM AND QUESTION

Low back pain (LBP) is a common healthcare concern worldwide for both the patient and the healthcare system itself. This has subsequent burden, both socially and economically, to the patient and the healthcare system.[1] In many cases, the development of myofascial trigger points (MTrPs) due to chronic LBP can cause debilitating pain and loss of function in patients. MTrPs are defined by Simons et al. as a hyperirritable nodule within a taut band of muscular fibers, and these are typically painful to palpation.[2] Dry needling (DN) is a minimally invasive therapy that uses small monofilament needles to produce physiological changes in the patient, most often targeted at muscle tissue.[3] It is widely accepted that the needle causes microtrauma in the tissue, resulting in a cascade of physiologic events that produce changes in the body. These changes include pain modulation (via gate-control and descending pain control theories), increased blood flow, and reduction in taut band activity in the muscle.[4, 5] Current physiological theory states that taut bands of muscle and MTrPs cause ischemic conditions within the muscle leading to the increase in acetylcholine left in the interstitial tissue. This causes sensitization of peripheral pain receptors,

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and it is hypothesized that long-term peripheral sensitization can cause central nervous system sensitization in the spinal cord leading to chronic pain.[6, 7]

Previous literature suggests that DN treatment improves the outcomes in patients with MTrPs when combined with other treatments.[8] However, current literature on utilizing DN treatments on MTrPs in patients with LBP is lacking. Further, the quality of evidence is low due to low sample sizes. The guiding systematic review and meta-analysis sought to provide a quantitative analysis on the effectiveness of DN for patients with MTrPs when compared to other treatments individually and in combination with other treatments.

SUMMARY OF LITERATURE

The guiding review used eight databases and searched for randomized controlled trials that included patients with diagnosed LBP and MTrPs, DN used as a treatment alone, and pain and or functional movement used as an outcome measure. While this review evaluated studies that compared DN to other treatments, these studies must have studied DN alone as well. This review did not include studies that compared different types of dry needling to each other, randomized control trials had no data, full text could not be obtained, or did not define MTrPs by the criteria set by Simons et al.[2] Two blind reviewers evaluated the validity of studies based on the methodologic quality criteria list. Of the original 784 articles identified by the original search, 11 randomized control trials were selected for analysis. A 6-subgroup meta-analysis was conducted on the selected randomized control trials that evaluated pain outcomes and functional disability outcomes at post-intervention and follow-up. Of the 11 studies included, 6 presented with high risk of bias due to lack of blinding of practitioners and patients, low trial numbers, or low patient recruitment. There is also limited information on objective measurement of functional scores or pain due to lack of integration in the studies reviewed.

SUMMARY OF OUTCOMES

The outcomes used within the included studies were pain intensity scores either by visual analogue scale (VAS) or an alternate Likert scale, and functional disability with either the Oswestry Disability Index (ODI) or the Roland-Morris Disability Questionnaire (RDQ). One study utilized a custom Likert scale model for pain intensity and functional disability. Both ranged from 0-3, with 0 being no pain or restriction, respectively, and 3 being severe pain or restriction, respectively.[9] Overall, 10 studies utilized the VAS,[10-19] 3 studies utilized the ODI,[16, 17, 19] and 7 studies utilized the RDQ.[10-15, 19] In the original studies, researchers identified clinically meaningful improvements in the outcome scores in all recorded outcome measures after the use of DN intervention. However, the differences ranged between studies, where some studies only found moderate changes and others showed large improvements. One study did not assess functional disability, focusing only on VAS scores.[18]

FINDINGS AND CLINICAL IMPLICATIONS

At post-intervention, DN alone saw significant improvements in pain and functional disability outcomes compared to other treatments.[20] However, at follow-up evaluation there were no significant differences in pain and functional disability outcomes between the two groups. Only two of the studies compared DN alone with DN used in combination with other treatments. These studies found significant improvements in pain scale scores in the short term for DN used in combination with other treatments when compared to using DN alone. This evidence illustrates the usefulness in DN as a treatment in the short-term improvement of pain and functional disability, which could provide an opportunity for patients to see greater improvements during therapeutic exercise sessions.

The results from treatment are mostly local physiological responses, similar to an acute laceration in the tissue. While there is no current literature on the healing response to dry needling specifically, it seems to reason that because DN has an acute inflammatory mechanism in the body, in terms of direct tissue disruption, the effects would only last for a short time. Thus, without further treatment such as therapeutic exercise to solidify tissue changes due to this disruption during the subsequent healing phases, the relief gained from dry needling would only be short lived, and this is reflected by the results in both clinical trials and meta-analytical research both physiologically and functionally.[5, 21]

Interestingly, current literature also shows that DN has been effective in eliciting higher passive peak torque, muscle compliance, and stretch tolerance in target tissues at immediate follow-up and at 15 minutes post-intervention compared to static stretching, and this may account for the improvement in functional disability scales immediately after treatment but not during long-term follow-up.[22] This seems to be a distinct effect of DN separate from the local tissue disruption and inflammatory response, however other research suggests that DN has the same moderate to long-term effects on peak torque, muscle compliance, and stretch tolerance as static stretching.[23] Therefore, it seems that the DN response would not continue past the short-term without further stimulation such as follow-up therapeutic exercise. These factors shed light onto the short-term effects seen by studies investigating DN alone. Furthermore, low back pain is often a multifactorial pathology. The multiple mechanisms of treatment that occur from DN may explain why there are beneficial effects for patients with LBP within the short-term window as shown by the guiding review.[20]

A majority of studies in this review had a high risk of bias due to lack of blinding of patients or practitioners. However, it is nearly impossible in clinical outcomes research, specifically with manual therapy, to blind study participants to the treatment. In addition, the clinicians must know what treatment they are performing to actually perform the treatment. While single-blind randomized controlled trials could be performed, there is still a necessary unblinding required for this type of research.

CLINICAL BOTTOM LINE

Dry needling, while useful alone in the short-term to decrease pain and dysfunction, should be combined with other treatments and rehabilitation to provide longer-lasting results and better treatment outcomes in both the short-term and long-term treatment of LBP. While the risk of bias within manual therapy research is high, future research should endeavor to continue with highly rigorous research with focus on the physiological effects of dry needling.

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Effectiveness of Take-Home Naloxone Programs in Athletic Training: An Evidence-to-Practice Review

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ABSTRACT

The number of opioid overdoses (ODs) has risen in recent years and has become more complex due to the co-involvement of both prescription and illicit opioid drug use. Provisional programs for take-home naloxone (a medication designed to rapidly reverse opiate OD symptoms) kits have been distributed to combat this potentially fatal epidemic. Although there is strong evidence to support the efficacy of naloxone in the reversal of opiate OD, there is limited evidence to support the efficacy of take-home naloxone (THN) kits. The purpose of this evidence-to-practice review was to summarize a systematic review on the efficacy of THN programs. The authors aimed to include studies of THN programs that both trained opioid users in OD prevention and reported on OD outcomes. The Bradford Hill criteria (strength of association, temporality, consistency, specificity, dose-response relationship, biological plausibility, coherence, experimental evidence, and analogy) and five additional criteria (measure cost-effectiveness, absence of negative consequences, feasibility of implementation/expansion/coverage, unanticipated benefits, and special populations) was used as dependent variables to determine the impact of public health intervention where randomized control trials (RCTs) are not ethically feasible or operationally practical. All 22 studies included provided empirical support using the Bradford Hill Criteria for community based THN programs. Despite being unable to deduce whether death would have occurred without the administration of THN, the studies combined accounted for an estimated 2316 successful opioid OD reversals. Thus, there is a strong association between THN administration and overdose survival. Additionally, there was a low rate of adverse events: withdrawal symptoms (2.8%), vomiting (2.2%), agitation (2.1%), seizures (0.1%). Consequently, we recommend that athletic trainers include opioid crisis management equipment and procedures in a site-specific policies manual. Clinical relevance is highly dependent on patient population and geographic location, considering 90% of reversed ODs were heroin induced. Application to individuals in organized sport is minimal, but nonetheless, individuals who are prescribed opioids for pain management should be candidates for THN programs. Athletic trainers and guardians of minors prescribed opioid medications should be educated on dispensing medication, best practices for opioid crisis management, and distribution of naloxone/THN.

Key Phrases
Public health, patient education, triage and emergency care

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ORIGINAL REFERENCE

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SUMMARY

CLINICAL PROBLEM AND QUESTION

From 1999-2017, 56.8% of the 702,568 drug overdose (OD) deaths in the United States involved opioids.[1] The number of opioid ODs has risen in recent years, and combating the epidemic has become more complex due to the co-involvement of both prescription opioid and illicit opioid (e.g. heroin, illicit fentanyl) drug use.[2] Opioid ODs can be reversed and lives saved with the timely administration of naloxone.[3,4] Naloxone is a mu-opiate antagonist that rapidly reverses opiate-induced respiratory depression.[3] A provisional program for take-home naloxone (THN) kits was first introduced in 1996.[5] These THN programs typically involve training drug users and/or family members and peers on risk

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awareness, emergency management, and naloxone administration. Both the World Health Organization (WHO)[3] and the U.S. Surgeon General[6] have released statements emphasizing the importance of '*[opioid users], health care practitioners, family and friends of people who have an opioid use disorder, and community members who come into contact with people at risk for opioid OD, knowing how to use naloxone and keeping it within reach.*'[6] As such, athletic trainers are healthcare providers and should be trained on the identification and management of opioid crises. Adolescents who participated in sports were found to have approximately 17% increased odds of non-medical opioid use as compared to peers who did not participate in sports.[7] When looking across sport-specific use, adolescents who participated in football or wrestling had a 50% increased risk of non-medical opioid use as compared to peers who did not participate in sports.[7] Among elite athletes, opioids are one of the most used substances.[8]

Athletic trainers are recommended to educate and train those at risk of opioid OD on use of THNs. If resources are not available in the athletic training facility, it is recommended that patients be educated on options available to obtain THNs and other counseling services. The purpose of this guiding systematic review was to answer the clinical question: *are take home naloxone programs effective?* The primary purpose of this evidence-to-practice review was to examine the applicability of THNs in athletic training clinical practice.

SUMMARY OF LITERATURE

A systematic review was conducted to find the effectiveness of THN programs. The electronic databases searched included Medline, PsychInfo (both via OVID), and PubMed. The following Boolean search query was used: (*opioid* OR *opiate*) AND *overdose* AND *prevention*. Original quantitative (or mixed method) studies of randomized or observational trials articles from January 1946 to June 2015 were identified, yielding 1397 articles. To be included in the review, studies were screened using the title and abstract. Studies had to include THN programs that trained opioid users in OD prevention AND reported on OD outcomes. After eliminating duplicates, non-English, and irrelevant articles, 36 papers were found. The exclusion criteria included: 1) case studies, 2) papers that reported on buprenorphine/naloxone, 3) papers that did not report primary research data, and 4) papers that did not report on heroin/opioid users, naloxone, or OD.

Upon final analysis, 22 articles were identified to be used in the systematic review. Data was extracted using the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist and analyzed for study quality. Fifteen of the 22 articles were conducted in the United States, two in Canada, four in the United Kingdom, and one in both the United Kingdom and Germany, providing a geographically diverse population. There was a large variation between studies in terms of size (n=24-2912; median=203) and quality (study quality score=4-7 out of 8). Authors reported that many articles were more descriptive reports rather than structured study designs. Although these reports were beneficial for communications to other practitioners, these reports lacked structure in design and analytic rigor. Only 9 of the 22 studies included systematic follow-ups with participants after THN administration. Since the sample sizes were so small, follow-up data was not included because it was not representative of all studies, posing a threat to external validity. The inconsistency in study design and reporting posed a threat to the internal validity and as a result, small variances exist within the methods of the studies included. A narrative synthesis was used instead of a meta-analysis for the analysis of the 22 studies.

SUMMARY OF INTERVENTION

This systematic review analyzed studies that distributed THN programs. Although RCTs are considered best practice in research, this would not be ethical for determining the effectiveness of THN. Consequently, none of the studies included a control group of individual participants selected to not receive THN. Instead, some studies used community-based control comparison groups, or communities in which THN had not been implemented or offered. Studies were analyzed under the assumption that communities had equal variances. All the studies evaluated were retrospective and examined the overall effectiveness of THN for participants that used it after overdosing. Included studies reported descriptive statistics on the number of THN administrations, overdose reversals, and adverse events. These values were used as a proxy to represent the effectiveness and safety of THN.

SUMMARY OF OUTCOMES

The authors of the guiding systematic review used the Bradford Hill Criteria and the WHO "Evidence to Action Report" to analyze the included studies. The Bradford Hill Criteria is a list of nine items analyzed to determine causality when only correlational data is available.[9] The nine items (**Table 1**) included strength of association, temporality, consistency, specificity, dose-response relationship, biological plausibility, coherence, experimental evidence, and analogy. The Bradford Hill Criteria is often used to assess impact for public health interventions when random control trials are not practicable.[9] Analysis of five additional criteria were included and related to feasibility and implementation: cost-effectiveness, absence of negative consequences, feasibility of implementation/ expansion/ coverage, unanticipated benefits, and special populations (**Table 2**). These additional criteria have been valuably applied in a WHO "Evidence to Action" report analyzing the effectiveness of needle-exchange interventions in reducing HIV.

FINDINGS AND CLINICAL IMPLICATIONS

All 22 studies analyzed provided empirical evidence to meet all nine of the Bradford Hill criteria in support of THN intervention in non-specific healthcare settings explained in the following sections. In 17 of the 22 studies reporting THN administrations following an OD, 2336/2249 (96.3%) successful OD reversals were reported. This implies a strong association between THN and successful opioid OD reversals.

Studies that lacked control groups make it hard to definitively conclude that OD reversals happened because of THN rather than the body filtering and metabolizing the drug. An interrupted time series analysis (regarded as the strongest design for quasi-experimental research) done in Massachusetts distributed THN programs to 2912 participants across 19 communities.[10] Each community with a THN program served as its own geographic control prior to implementation, and those without THN served as time controls. This study revealed the temporality of THN and significant reduction in OD mortality in communities that had THN programs.

Consistency for THN programs effectiveness is demonstrated through the stability of OD reversal rates across the various geographical regions that data was collected from. 15 different regions, states and countries provided significant support for the consistency of THN programs. Biological plausibility, known as the biological or pharmacological mechanism to explain the outcome of a treatment, is significant in the therapeutic effect of naloxone. Naloxone is an opioid antagonist that binds to opioid receptors and blocks the effects of the drug. The successful reversal of 2249 opioid ODs across all but one of the analyzed studies shows the strong support of biological plausibility.

Table 1. Bradford Hill criteria and application to take-home naloxone

Criterion	Take-home naloxone (THN)
Strength of association	How strong is the association between THN and OD reversal?
Temporality	Did the distribution of THN precede a reduction in OD deaths?
Consistency	Have there been multiple observations of OD reversals because of THN provision?
Specificity	Does THN have the unique effect of reversing opioid ODs?
Dose-response relationship	Does increased THN supply go together with more OD reversals?
Biological plausibility	Is it biologically plausible that a reduction in OD deaths occurs when THN is available?
Coherence	Are there documented examples of opioid OD mortality declining without THN availability? If so, does this empirical evidence conflict with the assumed association between THN and OD prevention?
Experimental evidence	Is there (semi)experimental evidence to support the hypothesized impact of THN on OD mortality?
Analogy	Is there a treatment like THN that leads to an outcome like OD reversal?

An Australian study demonstrated the decline in opioid OD between 2001 and 2002 before naloxone became available in 2011. However, 21 studies reported successful reversal rates of opioid OD which contributes to the coherence criteria. The specificity of THN throughout the studies analyzed that naloxone is specifically for opioid reversal and has no effect on those suffering from a cocaine OD or other type of drug OD. All 22 studies reported on heroin use and one with long-acting opioid use, all displaying strong specificity for naloxone and opioid reversal.

Dose-response relationship criteria was only assessed in one of the 22 studies, resulting in only partially fulfilling the criteria. In the Massachusetts study, the 19 communities broken into three categories for THN implementation: zero, low (1-100 enrollments) and high (>100 enrollments). Low and high implementation resulted in reduced deaths from ODs compared to communities without implementation, providing limited, but supporting evidence for dose-response impact.

In athletic training practice, take-home naloxone programs may be compared to other emergency medications such as adrenaline (epinephrine) injection kits for allergic reactions or glucagon for insulin OD. Training in the use of naloxone is also compared to the use of automatic external defibrillators and cardiopulmonary resuscitation for those likely to experience these emergencies regardless of their medical background. Like these, time is critical in administration and thus fulfills the analogy criteria.

The WHO "Evidence to Action" criteria were all fully or partially fulfilled in support of THN programs. Studies conducted in the United States and Russia revealed THN interventions are cost-of opioid ODs).[11,12] Across the studies analyzed in this systematic review, THN interventions had a low number of adverse events. The studies which did report adverse events showed these to be associated more with symptoms of withdrawal rather than due to the naloxone. The implementation of THN programs across several

Table 2. Feasibility and implementation criteria and application to take-home naloxone

Criterion	Take-home naloxone (THN)
Cost-effectiveness	Is THN for lay OD reversal cost-effective compared to treatment as usual (no intervention)?
Absence of negative consequences	Does the distribution of THN to users bear the risk of adverse events?
Feasibility of implementation/expansion/coverage	Is it feasible to introduce THN distribution in diverse settings, including resource-poor settings, and scale up implementation?
Unanticipated benefits	Does the distribution of THN to users lead to unanticipated benefits?
Special populations	How successful are THN programs in reaching special populations that have been identified as particularly 'at-risk' opioid users?

locations and circumstances shows the feasibility of implementation, expansion, and coverage. The rapid expansion of community naloxone distribution programs was observed in San Francisco in the 2000s especially in places with low resources.[13] Unanticipated benefits were seen in a few studies, ranging from participants entering treatment (25%) and decreasing drug use following their OD reversal (53%), to participants being tested for comorbid conditions and family members being educated on the use of naloxone (28%).[14] Take-home naloxone programs were implemented in several different opioid populations including patients who were detoxing, the homeless, users of methadone, and the incarcerated. This provides evidence for THN programs to be used in special populations across several settings and various demographic populations.

All these criteria provide support for athletic trainers to implement naloxone or THN programs at their clinical sites as a tertiary prevention strategy, or harm reduction, to opioid OD. Because athletic trainers have experience in the primary and secondary prevention of many health conditions, implementing other opioid OD prevention strategies would not only be feasible but beneficial to combat the public health epidemic within their clinical practice and community. Athletic trainers may do this through education and policy development and implementation. Depending on different geographical locations, heroin use may be more prevalent in the community, and organization-wide education on naloxone administration may be valuable. Regardless of location, long-acting opioid use remains of high concern. Athletic populations prescribed these drugs as pain killers are at risk for dependence and OD without the proper education on how to use them. In addition to the education provided by the prescribing practitioner, athletic trainers typically see their patients more frequently and should reiterate medication adherence. Establishing clear guidelines in collaboration with other healthcare practitioners on how to properly administer and take opioid medication is important to prevent OD.

Athletic training as a profession is already considered an aid to improving public health, by providing health services to various patient populations.[15] To assist in the public health sector on opioid use, athletic trainers should focus on patient, organization member, and stakeholder education for prevention strategies and crisis response, as they do for other high-risk injuries like concussion management for athletes, coaches, and parents. Effective policy development and implementation on opioid use and OD prevention will help reinforce athletic training as a valuable

allied health profession. This systematic review supported the feasibility and benefits of implementing THN to reverse opioid OD and should be considered by all athletic trainers due to its benefits to patients and the community

CLINICAL BOTTOM LINE

Overall, THN programs were found to be effective in reducing deaths from opioid-induced ODs. We recommend that athletic trainers include opioid crisis management equipment and procedures in a site-specific policies manual. Naloxone administration may be compared to epinephrine-injections used for anaphylaxis or AED and CPR for cardiac emergencies. More than 90% of the ODs witnessed (and reversed) in the review were heroin-induced, therefore clinical relevance is highly dependent on patient population and geographic location. Recommendations from this review do not address applicability for individuals involved in organized sport where substances are regulated by a governing body.

The authors suggest individuals in physically active settings who are prescribed opioids for pain management should be candidates for THN programs, particularly in areas highly affected by the opioid epidemic. Primary preventative screening using self-report questionnaires (e.g. Opioid-Related Overdose Risk Behavior Scale [ORBS][16] or Alcohol, Smoking and Substance Involvement Screening Test [ASSIST][17]) should be implemented by or in collaboration with prescribing physicians to assess patient need for THN. Prior OD risk screening may be especially useful if THN programs are not feasible for the patient due to socioeconomic factors and/or availability. If opioid medication is prescribed, patients should be thoroughly educated on medication adherence. Guardians of minors prescribed opioids should be educated and encouraged to dispense the medication as instructed by a physician or pharmacist. Athletic trainers involved in the care of individuals prescribed opioid medications should be educated on best practices for opioid crisis management and aware of state legislature regarding administration and distribution of naloxone/THN programs. If improvements in athletic training education and professional development on opioid use are executed, then the public may see improved patient safety and positive community-based responses.

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Community Opioid Overdose Prevention and Naloxone Distribution Programs: An Evidence-to-Practice Review

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ABSTRACT

According to the Centers for Disease Control and Prevention, 100 people die of drug overdose in the United States every day. This frighteningly high mortality rate has created the need for community-based opioid overdose prevention programs (OOPPs). Currently, there are more than 188 community-run programs operating in the United States. These programs teach individuals how to distribute naloxone and respond properly to a drug overdose situation. This guiding systematic review depicts the current literature available on OOPPs and their effectiveness. The authors performed an article search to discover the most relevant and recent articles, which were graded using a quality assessment score. The search uncovered 19 articles deemed appropriate to investigate the effectiveness of OOPPs. Out of the 19 articles, 14 of these articles were cohort studies with large sample sizes that did a baseline and follow-up survey at two different time periods. Almost 50% of participants in this review stated they personally experienced an opioid overdose in their life. Furthermore, there was 79.2% of participants (across the 8 studies that report this data) to witness a drug overdose. Nonmedical bystanders is defined as individuals who could properly reverse an opioid overdose when OOPP training was completed. Eleven studies detected a 100% survival rate post-naloxone administration with the remaining 8 studies not far behind with a survival rate range of 83-96%. The current evidence available suggests that OOPPs are successful in teaching their participants how to properly treat an opioid overdose with the administration of naloxone.

Key Phrases
Drug overdose/drug therapy, program evaluation, opioid-related disorders/drug therapy, naloxone/therapeutic use

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SUMMARY

CLINICAL PROBLEM AND QUESTION

According to the World Health Organization, the three main symptoms for an opioid overdose (generally termed "opioid overdose triad") are pinpoint pupils, unconsciousness, and respiratory depression.[1] This fatal combination can ultimately result in death. In fact, 128 people die every day in the United States from opioid overdose.[2,3] According to the Centers for Disease Control and Prevention, opioid overdose is a rising issue in the United States with a 9.6% increase in the age-adjusted rate in overdose deaths from 2016 to 2017.[4] In 2017, there were a total of 70,237 drug overdose deaths.[2]

To combat this public health emergency, opioid overdose prevention programs (OOPPs) were created to educate the public about how to recognize and manage an opioid overdose with treatment training using naloxone.[2,5] Naloxone, which is commonly referred to by its brand name Narcan, is an opioid antagonist used to temporarily reverse a drug overdoses in an emergency situation. However, the drug is relatively new, and the opioid issue has continued to grow. In addition, OOPPs cover the risk factors of opioid overdose, as well as, the procedure of how to properly respond to an overdose with or without naloxone.[1,2,4] Opioid overdose prevention

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programs are essential since they advocate for prevention efforts such as encouraging people (e.g., people at risk, the family members of people considered 'at risk', and healthcare providers) to learn how to manage a drug overdose.

Opioid overdose prevention programs have been utilized in the United States for 24 years; though, there is very limited research on the programs' impact and outcomes of the training.[5-7] This evidence-to-practice review summarizes a systematic review to analyze the impact of OOPPs by evaluating if naloxone distribution reduces the instances of overdose among their participants.[3] This review also compared the United States OOPPs effectiveness on increasing bystander knowledge on prevention, risk factors, and detection of and response to an opioid overdose.[3] Lastly, it appraises how OOPPs participants respond to opioid overdose. Overall, this systematic review organizes the available current literature on opioid overdose to observe the general impact of OOPPs.

SUMMARY OF LITERATURE

The guiding systematic review searched databases including PubMed, MEDLINE, and PsychINFO, using the Boolean search query: (*opioid* OR *opiate*) AND *overdose* AND *prevention*. The search was limited to English language, which returned 360 different citations. The citations were sorted and included only original, peer-reviewed articles examining community OOPPs that detected a training impact. This consisted of reports of overdose reversal rates, overdose fatalities, or any measure of overdose rate among program participants. Exclusion criteria included OOPPs that did not incorporate training on the use or distribute naloxone, data that was unable to separate into program-specific information, and program evaluations that focused more on health care personnel training. Thirty-eight articles were identified for full-text review; however, 19 articles fit the exact inclusion conditions and were included in this review. The remaining 17 were excluded because these articles did not assess a community OOPP (11), did not report a training outcome (2), did not have naloxone training (1), or were based on grouped or clumped data (2). A quality appraisal was completed on the articles involved in this systematic review. The quality score had a possible range of 4 – 8 and this set of studies used in the review had a mean of 6.1, median of 6.5, and a mode of 7. Although majority of these studies scored a 0 for randomization and low rates for follow-up, 18/19 of these studies got a maximum score for sample size and outcomes. Overall, the studies were graded as fair based off descriptive quality.

SUMMARY OF INTERVENTION

The intervention investigated in the systematic review were OOPPs. The systematic review focused on the effectiveness of the OOPPs and their outcomes within the respective communities. The OOPP intervention ranged in duration from 10-60 minutes. The laws for prescribing naloxone varied by state, as well as, the physician involvement with the OOPPs. Because of this, the qualifications of the personnel instructing the interventions differed between programs and in most studies the qualifications of the instructors were not specified. Naloxone prescription is variable between states so involvement with physicians in OOPPs ranged from notification of program completion to meeting with a physician in order to receive a naloxone kit.[8-10]

A majority of the programs include a curricula based on five components including: 1) recognizing overdose (78.9%), 2) preventing overdose (73%), 3) risk factors of overdose (63%), 4) appropriate response to overdose (84%) and, 5) administration of naloxone (100%) with some variation and deviations in the material provided. The response to overdose, such as

rescue breathing, cardiopulmonary resuscitation (CPR), and the recovery position (**Figure 1**), were addressed in the majority of OOPPs. In addition, administering naloxone in a variety of ways and at varying levels of practice was a part of the curricula in each of the intervention programs. Fifteen of the articles provided training with needle-based administration, however, some programs provided training practice by injecting into an orange and while other programs used nasal naloxone. [11-13]

SUMMARY OF OUTCOMES

The guiding systematic review analyzed outcomes of the OOPPs. The first analysis was for the outcomes associated with the reduction of fatal and nonfatal overdose rates for those who participated in an OOPP intervention. Naloxone was used successfully 1,949 times by those who attended OOPPs. This review identified heroin as the most frequently reported overdosed drug, despite the National Vital Statistics System indicating opioid analgesics as the highest drug used. The studies reported that the survival post-naloxone administration rate ranged from 83%-100% with 11 of the studies reporting a 100% survival rate. Two of the articles that reported lower survival rates attribute the findings to unknown overdose outcomes.[10,14] In addition, two studies found that areas with higher OOPP enrollment demonstrated decreased opioid overdose mortality at a population level. [13,15] With the majority of studies demonstrating 100% survival after administration of naloxone by those who attended OOPPs, we conclude that OOPPs have the ability to reduce fatal and nonfatal overdoses among participants.

Next, the review analyzed the outcomes on the effectiveness of OOPPs to increase nonmedical bystander knowledge of prevention, risk factors and recognition of opioid overdose and correct response. Just under half of the studies in the review reported pre- and post-training measures

Figure 1. Demonstration of the recovery position in drug overdose management

regarding the knowledge surrounding opioid overdose. The consensus among these studies is that those who participated in OOPPs had an increase in their knowledge of prevention, risk factors, and recognition of opioid overdose. [16-21]

In terms of response, participants in OOPPs displayed a behavior change with an increase in appropriate responses like rescue breathing, administering naloxone, initiating recovery position, and performing a sternal rub.[10,14, 17, 22] However, in two studies there were reports of non-recommended responses, such as using ice and cold water to revive patients.[21, 22] These results display that the curriculum in studies that utilized pre- and post-training measures increased the knowledge of nonmedical bystanders.. This finding can be interpreted to show that nonmedical personnel have the ability to learn prevention, risk factors, and recognition of opioid overdose and therefore expand the population of those who can respond to opioid overdoses.

When considering the following outcomes associated with the reduction of fatal and nonfatal overdose rates for those who participated in an OOPP intervention and effectiveness of OOPPs to increase nonmedical bystander knowledge of prevention, risk factors and recognition of opioid overdose and correct response the literature shows that OOPPs may have the ability to create meaningful change within communities. OOPPs can reduce fatal and non-fatal overdoses. The data suggests the ability for non-medical bystanders to learn about and properly respond to opioid overdoses. However, due to the nature of the studies and the way they have been conducted these, conclusions are limited due to the lack of randomization.

FINDINGS AND CLINICAL IMPLICATIONS

Due to the lack of randomization and systematic measures, it is difficult to create generalizable statements and conclusions of the effectiveness of the programs when the specific content is not documented. Although the evidence is not concrete, we can deduce that OOPPs have the potential to reduce opioid overdose morbidity and mortality. Clinically, to reproduce similar outcomes within our communities, athletic trainers and non-medical bystanders need to be educated on the five components of OOPPs: recognizing overdose, preventing overdose, risk factors for overdose, appropriate response to overdose, and administration of naloxone. We know that a 100% survival rate can be achieved by attending OOPPs, and communities should focus on administration of naloxone as responses to overdose such as rescue breathing and CPR.

Naloxone education and administration should be integrated into standards and practices of all first responder and healthcare providers. Standard 70 in the 2020 Commission on Accreditation of Athletic Training Education (CAATE) standards describe that professional athletic training programs must teach how to evaluate and manage patients with acute conditions, including triaging conditions that are life threatening or otherwise emergent including drug overdose.[23] This includes the administration of naloxone. However, the goal should be to ensure that all ATs that completed formal education before this standard was implemented are also comfortable with the skill. This goal can also be achieved by incorporating elements of OOPPs into continuing education. By introducing OOPP education and training into athletic training continuing education we ensure athletic trainers can carry out the skills themselves as well as teach the skills in their communities. By educating athletic trainers we can use them as a bridge to educate their respective communities. Athletic trainers serve unique roles that allow for them to be very involved within their surrounding communities, especially those in the secondary school settings. Communities should take advantage of this role that athletic trainers hold and use them as a liaison to instruct OOPPs in the communities they serve. Studies show that non-medical bystanders have been deemed efficient and successful in administering naloxone to those who have overdosed.[16-21] This means that athletic trainers can teach anyone the OOPP curriculum and they have the potential to be successful in carrying out those skills. Athletic

trainers can be extremely valuable by encouraging the high-risk populations that they know and interact with to attend OOPPs and help to cultivate better outcomes within the community.

Moving forward, the development of a standardized OOPP could be used to effectively educate groups across the country about opioid overdose and naloxone administration. Before a standardized OOPP is created, there is an opportunity for an OOPP assessment tool to be used to validate current programs. This tool would work towards deeming OOPPs efficient in education covering the five components; recognizing overdose, preventing overdose, risk factors for overdose, appropriate response to overdose, and administration of naloxone. OOPP could be designed like first aid or CPR (cardiopulmonary resuscitation) certification programs that require vetted instructors to educate the participants on standardized information. No matter who teaches the course or where one takes the course, each participant will walk away with the same knowledge and abilities regarding opioid overdoses and naloxone administration. Again, this is where athletic trainers can come in and use the information and skills they have gained in their continuing education course to teach and carry out the OOPPs. The systematic review highlights a need for OOPPs. It explains that opioid overdose is common, and naloxone is efficient and safe in reversing opioid overdoses. Although these data are not methodologically sound, this guiding systematic review identifies a trend towards OOPPs having the potential to decrease morbidity and mortality with an opioid overdose.

CLINICAL BOTTOM LINE

Opioid overdose prevention programs have worked towards reversing opioid overdoses, but research has reported mixed findings for its overall effectiveness in reducing the number of opioid incidences. This current systematic review was not able to determine this general effectiveness because of the lack of consistent measures and methodological limitations; however, the chief finding presented throughout the articles was that OOPPs were effective, specifically in the treatment of an opioid overdose and the administration of naloxone.

Evidence in this review detected that heroin was the most frequently reported drug before an overdose; however, the leading cause cited was opioids.[24] This fact is essential to health care providers, since many injuries are prescribed with opioid analgesics to reduce injury pain. Because of this athletes are an at risk population for the misuse of these prescription opioids. Athletic trainers are suggested to monitor post-operative patients, or any patient given opioids, and check-in on their pain levels. The patient should not be reliant on opioids long term, so there should be a plan of action and timeline for gradually waning the patient off prescription pain relievers. The literature also did confirm that the majority of OOPP participants used non-recommended strategies, such as not call emergency medical services for an overdose. This is a factor that athletic trainers should emphasize in educating their patients, whether they believe medical assistance is needed or not, because there could be medical complications from the restricted respiration occurring in an overdose.[23,24] The fear of police was indicated as the main reason for not preparing; however, the studies displayed more positive interactions than negative.[16,17] Athletic trainers should direct attention to the prolonged medical issues an overdosed individual could have and attempt to ease the fear of utilizing EMS personnel. [21,22]

It is key that athletic trainers, much like the OOPP, are able to prevent, recognize, and respond to opioid overdose using pharmacological and non-pharmacological interventions. We suggest that athletic trainers consider taking an OOPP, or a formal opioid overdose training course, if

unfamiliar with the management techniques described in this review. Additionally, athletic trainers can play a role in preventive efforts by spreading opioid overdose information to their population, including signs and symptoms of overdose, red flags to look out for, how to recognize an overdose, and how to respond if they are the non-medical bystander in an overdose situation. If opioid overdose education was accessible, or even mandatory prior to sport participation, for athletes and parents, then such education could improve the awareness and discourage opioid abuse. With the knowledge on how to deal with an opioid overdose, athletes can offer life-saving assistance in responding to a family member's or roommates' overdose situation. An athletic trainer should distinguish how to respond with or without a naloxone kit present, so individuals are prepared for both scenarios. Overall, there is evidence that supports OOPPs may benefit how to effectively handle an overdose situation. However, research is needed on this subject with more of a standard instrument for measuring how well these programs assist their participants in managing a drug overdose.

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Opioid Medication Use and Education Following Sports Medicine Procedures: An Evidence-to-Practice Review

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ABSTRACT

According to the Centers for Disease Control (CDC), illicit and prescription drug overdoses are responsible for 128 deaths every day in the United States. In 2018, 70% of all overdose related deaths involved opioids. Efforts to minimize the opioid epidemic focus on community education, research, partnership, and healthcare support. Under the CDC guidelines, current practices include monitoring trends of drug use and drug related deaths, conducting research to recognize areas in need of improvement and to analyze effectiveness of current treatments, partner with community organizations and healthcare systems that deal firsthand with opioid users, and educate the public on drug use, misuse, and overdoses. People are commonly uneducated on the proper use and disposal of their prescription opioids. Consistent and appropriate communication among surgeons and their patients can decrease this risk associated with prescription drugs. The purpose of this evidence-to-practice review was to summarize a systematic review on the current data and findings related to postoperative opioid prescribing and consumption behaviors after a common sports medicine operation. The guiding systematic review explored several ways to reduce the risk of patients developing opioid dependence and abuse due to physicians overprescribing opioids. First, educating each patient about pain management during pre- and postoperative phases, how to store opioids safely, and how to dispose of opioids properly need to be created to help reduce the risk of the patient abusing opioids. Secondly, having the prescribing provider create an extensive history that reveals any red flags for opioid abuse for each patient. Thirdly, the prescribing provider should prescribe the lowest dose and shortest regimen to limit the number of opioids left over. These protocols may help slow the current opioid epidemic.

Key Phrases
Drug overdose/drug therapy, program evaluation, opioid-related disorders/drug therapy, naloxone/therapeutic use

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SUMMARY

CLINICAL PROBLEM AND QUESTION

In the United States, orthopedic surgeons are responsible for 7.7% of all prescribed opioids.[1] When investigating the effects of these practices, two main factors that are studied are mean prescription and consumption values, and appropriate disposal procedures. The guiding systematic review examines these factors following three common procedures: knee, shoulder, and hip arthroscopies. With the increase in the level of skill and competition in athletics, there comes an increased need in medical and surgical knowledge. Studies have shown that there are close to 2 million knee arthroscopic surgeries performed every single year in the United States.[2] The incidence for the other common injuries (hip and shoulder) are increasing dramatically as well. The drastic increase of these injuries has directly impacted the prescribing patterns of orthopedic surgeons in the United States. Patients and surgeons often assume the use and duration of opioid treatment, that the decision to determine the extent to which the patient needs an opioid prescription, is often overlooked. Regardless of how common the surgery is, or how many times the specific surgeon has performed the surgery, postoperative opioids should be prescribed

based on the individual patient and with prior research in mind. Supporting research has shown that large percentages of prescribed postoperative opioids are not consumed and/or disposed of properly.[3,4] In addition to less individualized prescribing patterns, education on proper disposal medication was not always provided.[6] A lack of awareness of proper disposal can often lead to the patient stockpiling their unused medications. The act of collecting pills poses a great risk for future drug abuse or suicidal means. These subsequent behaviors threatened the health and wellbeing of patients, their support systems, and adds to the burden of the current drug epidemic in the United States. Therefore, the purpose of this evidence to practice review was to summarize a systematic review on the current data and findings related to postoperative opioid prescribing and consumption behaviors following three common sports medicine procedures.

SUMMARY OF LITERATURE

A systematic search was conducted using EMBASE, MEDLINE, and PubMed databases. The keywords searched included arthroscopy, sports medicine, opioids, and other related wording. Inclusion criteria consisted of studies containing patients experiencing an arthroscopic procedure of the knee, hip, or shoulder. Other significant inclusion criteria included evaluation of postoperative opioid prescribing behaviors and evaluated opioid consumption rates.[2] Studies also needed more than 10 participants and had reports of patient-specific data to be accepted. Quality of the studies was determined using the Methodological Index for Non-Randomized Studies. For these studies; the highest possible score is a 16. All studies had a score of 10 or higher, assigning them high quality. The initial search identified 119 studies. After screening, 8 studies meet the inclusion criteria and were deemed eligible.

SUMMARY OF OUTCOMES

Five variables were examined in the various studies including opioid prescribing practices, postoperative opioid consumption, duration of opioid use, opioid disposal, and refill rate. During statistical analysis, the guiding review's authors referred to the accepted conversion table from the Centers for Medicare and Medicaid Services.[5] With the oral morphine milligram equivalent conversion factors, the quantity of opioids prescribed, used, and leftover were converted to milligram morphine equivalents (MMEs) for standardized reporting.[6] In the studies converting opioid prescribing patterns, MMEs are identified for arthroscopic procedures of the shoulder, hip, and knee.

FINDINGS AND CLINICAL IMPLICATIONS

Among 195 patients (3 studies) undergoing the shoulder procedure, there was a mean of 610 MMEs prescribed and 418 MMEs consumed. For 451 patients (4 studies) undergoing the knee procedure, there was a mean of 197 MMEs prescribed and 131 MMEs consumed. For 96 patients (2 studies) undergoing hip procedure, there was a mean of 613 MMEs prescribed and 223 MMEs consumed.[2] To summarize these findings, the percentage of prescribed opioids going unused are: 31% for shoulder procedures, 34% for knee procedures, and 64% for hip procedures. Out of the three surgical procedures, 30mg tablets of oral codeine were prescribed most frequently. The other most frequently prescribed opioids were a 5mg tablet of oral hydrocodone and a 5mg tablet of oxycodone.[6] Two additional studies (277 patients) focused on how frequently post-op patients refill their prescription. The studies concluded that 26% of these patients asked for a prescription refill following their procedure. This review found overwhelming evidence that opioids are overprescribed for patients that have undergone shoulder, knee, and hip arthroscopic surgery

despite that evidence has shown that more than one third of opioids prescriptions went used and more than half of the patients do not take the opioids after 3 days following their surgery. Five studies (348 patients) looked at opioid disposal methods or if the patient had any prior education on how to properly dispose of the excess prescription. Out of those 348 patients, only 36% of patients were given instruction on how to dispose of their medications when they no longer needed them for pain management.[1]

After finding that only 36% of patients were given instruction on how to properly dispose of their unused medications, there is an increased emphasis on developing strategies to better inform guidelines for both the doctors and the patients.[1] An increased focus on better prescribing patterns for doctors along with a more consistent patient education program are two critical components needed to evoke change. One strategy that has been suggested is for surgeons to prescribe the lowest dosage for the shortest duration period.[7] Several studies have made dosage recommendations on these three specific procedures as well as alternate strategies for controlling postoperative pain.

The authors of the guiding systematic review discussed the growing risk of the over prescribing patterns of opioids and demonstrated that sports medicine procedures are no exception. The opioid use concerns are not just limited to providers prescribing more than needed, but also to the lack of education given to their patients. Overprescribing and improper disposal methods leads to more opioid medications in the hands of people they don't belong, in turn becoming a contributing factor to the opioid epidemic. This heightens the need for athletic trainers and other healthcare providers to be aware of signs and symptoms of opioid abuse. If the problem can be identified early on, there is more time for an appropriate intervention or referral to be made. This additional time can be the difference between a healthy post-operative experience and one with long term complications. The guiding systematic review found overwhelming evidence that opioids were overprescribed to patients that have undergone shoulder, knee, and hip arthroscopic surgery. Even with doctors overprescribing opioids, only 36% of the surgical patients were educated on how to dispose of the medication(s) when they were no longer needed for pain management.[1] These statistics are not unique to these three surgeries. Over prescription is also seen in foot, ankle, and even upper extremity surgical literature.[8]

CLINICAL BOTTOM LINE

Due to the ongoing battle with the opioid epidemic, which includes misuse and abuse of opioids, focus has been shifted on creating safer prescription practices. An initial in-depth preoperative medical history can aid the clinician with a more appropriate pain management consideration. Each patient would be assessed for not only past opioid use but other drug dependencies as well.[1] In addition, each patient would be educated using handouts about the expectations of pain throughout the preoperative and postoperative phases as well as storing and disposing of the medication. According to one systematic review, 5% of the patients were educated on how to dispose of medication properly, 3 out of 4 patients stored the medication in an unlocked location, and less than 30% planned to or disposed of any unused opioids. Of that, less than 10% disposed of the opioids by returning to the pharmacy or flushing down the toilet.[8,9] The best option for disposing of unused medications is to return them to an official take back location. Take back locations can include pharmacies, police stations, or other approved sites. The Drug Enforcement Agency website allows individuals to enter their zip code and find locations within their area that allow medication take backs. The DEA website also has a "flush list" of what medications are safe to be

flushed down the toilet. If the medication is not listed on the flush list, the only disposal method is to return to a take back location. Take back locations are the safest option because it minimizes the risk that someone within the home will get a hold of the medication. It also eliminates the risk of a drug contaminating the water if it is flushed down the toilet. If the medication is not on the flush list and there are no take back locations in the area, medications can be disposed of in the trash. The FDA suggests mixing the medication with a substance like cat litter, dirt, or food waste in a sealed plastic bag before placing it in the garbage.[10] All personal information should be scratched off or removed from the prescription bottles as well before disposal.[10] Another review suggested method to limit over prescription is for providers to administer other analgesics via different intake methods. Several studies within the review have shown decreased opioid use after surgery on patients treated with multiple analgesics during the perioperative phase.[7,11] The guiding systematic review determined there was evidence of a correlation of risk factors that correlates with long-term opioid use such as suicide, other drug dependency, mood disorders, and chronic pain.

Despite not having control of postoperative prescriptions, athletic trainers can be a valuable resource for patients to help them understand their procedure and prescriptions. Athletic trainers can be an advocate for patients to help facilitate proper use and ensure clarity of use through discussions with the prescribing provider and members of the sports medicine team. Ensuring that their patient is aware of proper consumption and disposal is an easy task that can prevent addiction or abuse in the future. The providing prescribers can implement this into practice by establishing communication with a patient throughout the entirety of their surgical process. Early and consistent communication among the orthopedic surgeon, athletic trainer, and the patient can mitigate the risk of opioid addiction. Athletic trainers are in a unique position to help educate patients on how to properly consume, store, and dispose of their opioids. Athletic trainers can also work with their collaborating physician to develop a plan to avoid post-operative opioid abuse and misuse.

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Disablement Model Case Study: Running with Postural Orthostatic Tachycardia Syndrome

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ABSTRACT

A 17-year-old high school female cross-country runner and basketball player presented with syncope following long-endurance exercise. The syncope episodes started when the patient was 13 years old during a basketball game. After the first episode, the patient fainted every time she crossed the finish line of a cross-country meet. Her symptoms included increased heart rate, shortness of breath, and paresthesia in her hands and legs during exercise. The patient also experienced some dizziness when quickly sitting or standing during activities of daily living. The patient was first misdiagnosed with exercise induced asthma and prescribed a rescue inhaler to take prior to competition races, however the syncope episodes persisted. A referral was made to a cardiologist who performed the Q sweat response (QSR) and tilt table tests. The test results, and clinical symptoms were consistent with a diagnosis of Postural Orthostatic Tachycardia Syndrome (POTS). Metoprolol was prescribed to slow her heart rate and fludrocortisone to increase blood volume. The patient took these medications daily and also took an extra half-a-tablet of metoprolol before exercising in hot conditions. The patient's syncope following long endurance races was managed by a coach who would catch the patient after she crossed the finish line, lay her down and elevate her legs until she regained consciousness. Once consciousness was regained, her heart rate and oxygen were monitored using a pulse oximeter. POTS is a unique condition that can be managed with strong communication between healthcare professionals. Proper management allows for continued competition with some modifications made by the athlete and close monitoring by the athletic trainer. It is important for athletic trainers to be educated on the signs and symptoms of POTS and understand that it can affect each athlete differently.

Key Phrases
Diagnostic testing and physical examination: non-musculoskeletal conditions; interprofessional practice; secondary schools patient population

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INTRODUCTION

Postural Orthostatic Tachycardia Syndrome (POTS) is an autonomic nervous system (ANS) disorder which can cause symptoms the following symptoms: light-headedness, fatigue, sweating, anxiety, heart palpitations, exercise intolerance and near syncope when standing.[1] POTS is a unique condition affecting approximately 500,000 people in the United States, with predominance in young females.[2] There are two classifications associated with POTS: primary POTS and secondary POTS. Primary POTS is thought to be idiopathic, occurring on its own without association with another disease, whereas with secondary POTS symptoms are experienced as a results of another disease diagnosis.[3] Primary POTS can be classified deeper into partial dysautonomia and hyperadrengic.[3] Proper classification of POTS can help with better management of the patient's symptoms. Clinicians should conduct a thorough history to determine if a patient may be experiencing primary or secondary POTS.

When the ANS is functioning properly, orthostatic stability is maintained when moving from supine or prone to seated by increasing heart rate by 10 to 20 beats per minute (bpm).[1] The increase in heart rate allows the body to maintain blood pressure and supply oxygenated blood to the brain and other vital organs.[1] This orthostatic stability is achieved within 60 seconds under normal conditions.[1]

In a patient diagnosed with POTS, the innervation of the veins or the vein's response to sympathetic stimulation is impaired. [1] This dysfunction leads to

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over-dilation of the blood vessels and venous pooling in the legs, thereby reducing venous return to the heart, which subsequently reduces the arterial flow of oxygenated blood to the brain.[1,4] For approximately 10 minutes after standing, someone with POTS will experience a heart rate increase of 30 bpm or more resulting in a heart rate greater than 120 bpm as the ANS attempts to increase cardiac output and blood pressure to supply the brain and vital organs with oxygenated blood. With the increase in heart rate, a decrease in blood pressure can occur. This will lead to less blood flow to the brain and result in symptoms such as light-headedness, fatigue, sweating, anxiety, palpitations, exercise intolerance, and in some cases syncope.[1] Symptoms of POTS can impair a patient's ability to engage in physical activity and activities of daily living, and therefore, can greatly affect the patient's overall quality of life.

PATIENT INFORMATION

A 17-year-old female cross-country runner and basketball player presented with syncope following long-endurance exercise. The patient's other symptoms included increased heart rate, shortness of breath, and paresthesia in her hands and legs during and after exercise. The syncope episodes first started during a middle school basketball game in 2014, at the age of 13 years old. The patient stated that while playing in the game, she was running backwards and she tripped and fell. When she got back up, she had trouble breathing, so she was substituted out of the game. Her mother came down from the bleachers and as they were walking out of the gym, the patient fainted. The patient's mother took her to a primary care physician where the patient was first misdiagnosed with exercise induced asthma and given a rescue inhaler. The following year, at the age of 14, the patient used the prescribed rescue inhaler following cross-country practices when she continued to experience symptoms of increased heart rate, shortness of breath, and paresthesia in her hands and legs. The inhaler treatment provided no symptom relief. The patient returned to her primary care physician and was referred to a specialist at a children's hospital where she was then misdiagnosed with a "once in a lifetime throat spasm." The patient continued to participate in cross-country, but when she had two more syncope episodes during practice, the coach and athletic trainer decided that she would be unable to continue participation without a proper diagnosis. The patient was finally referred to a cardiologist who specializes in POTS and the correct diagnosis was made in 2016, two years after her symptoms began.

Activity and Participation

Throughout the patient's high school career, she competed in two sports: basketball and cross country. The symptoms of her POTS diagnosis impacted her participation in practices and competition in different ways. Throughout her freshman and sophomore year, she had fainting spells during all activity until she received a proper diagnosis in 2016. With the correct diagnosis and medication, most of her symptoms were under control; however, one symptom, syncope, persisted and continued to plague her at the end of each cross-country competition. She was able to finish her race but would faint into the arms of her coach at the finish line. The nature of a cross-country finish line- an abrupt stop, caused a quick drop in the patient's blood pressure, which decreased blood flow to the brain and triggered a syncope episode. After which, the patient explained that she felt numbness and tingling in her hands and feet for about ten minutes before her symptoms would improve. During basketball practices and games, the patient did not experience syncope episodes but did have increased heart rate, shortness of breath, and paresthesia in hands and feet. When she began having these symptoms, she was able to stop participating, sit down, and hydrate while slowly decreasing her heart rate, thus avoiding a

syncope episode. The patient was able to work through and manage her symptoms with proper recognition and recovery techniques. The support of medications and other modifications to her routine also helped her to manage her symptoms and allowed her to continue participating in physical activity.

Differential Diagnosis and Evaluation

The differential diagnosis list for this case included: tachycardia syndrome, chronic fatigue syndrome, anxiety, asthma, vasovagal syncope, orthostatic hypotension, or cardiac arrhythmias. The patient was first misdiagnosed with exercise induced asthma and treated with a rescue inhaler which did not improve her symptoms. The patient then saw a cardiologist, whom after evaluating her signs and symptoms, performed a series of tests to help determine a correct diagnosis. The cardiologist was able to rule out chronic fatigue syndrome, anxiety and orthostatic hypotension based on evaluation of the patient's signs and symptoms. The patient's EKG results were unremarkable, which helped rule out tachycardia syndrome and cardiac arrhythmias. The cardiologist suspected she may be suffering from POTS and ordered several tests to confirm the diagnosis. The Q sweat response (QSR) test was performed to evaluate the sweat response of the sympathetic nervous system. The QSR test uses iontophoresis to stimulate the sweat glands to release acetylcholine, resulting in and increased sweat response.[5] The standard testing sites include forearm, proximal leg, distal legs, and dorsum of the foot.[6] The amount of sweat is measured by the change in humidity in the sweat capsule from baseline to 15 minutes post stimulation.[6] In normal individuals, the sweat output increases for about 5 minutes until it reaches an inflection point and then slowly decreases. If a patient has a loss of sympathetic nerve terminals, the terminals will not release as much acetylcholine resulting in decreased sweat.[5] The results of this patient's QSR test showed a normal volume of sweat on the forearm and proximal leg, increased volume on the distal leg, and decreased volume of sweat on the foot compared to the proximal leg. The decreased volume of sweat on the foot compared to the proximal leg shows that the patient has a sympathetic nervous system abnormality. The cardiologist summarized these results to indicate abnormal postganglionic sudomotor function showing a mild impairment in the autonomic nerves, a result that is consistent with a diagnosis of POTS.

The tilt table test measures heart rate and blood pressure while the body is in different positions.[7] The test is meant to mimic the sudden change in posture resulting in syncope. The test begins with a 10-15 minute baseline period of lying in a supine position.[7] The table is slowly raised to seventy degrees while blood pressure and heart rate are measured.[7] With the tilt table test the doctor is looking for two changes, a decrease in blood pressure and/or heart rate as the table is tilted upright.[7] If the patient can lay at seventy degrees without symptoms the clinician will introduce a sympathetic medication called isoproterenol. This patient was tested with a sympathetic medication that caused the heart to beat stronger and faster. The patient's results with the medication showed an abnormal response to seventy degrees head-up tilt, increased heart rate during the second ten minutes of upright tilt, and variable blood pressure during upright tilt compared to supine baseline. Her tilt table test showed that she has hyperadrenergic POTS because her results varied after the sympathetic drug was introduced. The cardiologist's summary of these findings stated that the patient had normal cardiovagal function, but she was abnormal when the medication was introduced. This is consistent with the fact that she only experienced syncope episodes when under stress such as long-endurance events.

Body Structure and Function

POTS affects the ANS, which is the reflexive and involuntary division of the central nervous system.[8] It is responsible for conducting nerve impulses from the central nervous system to cardiac muscle, smooth muscle, and glands.[8] The basic functions of the ANS include regulation of one's heart rate and contraction of smooth muscle in the digestive tract.[8] POTS causes an exaggerated sympathetic response when changing orthostatic positioning.

Environmental and Personal Factors

Additional factors that may exacerbate the symptoms of POTS include, decreased fluid intake, dehydration, exercise, morning hours, fever and high ambient temperatures.[7] Prior to running in hot conditions, the patient would take an extra dose of Metoprolol. In extreme heat, the sympathetic nervous system dilates the blood vessels, which brings the blood closer to the skin's surface and heat is lost through radiation from the body's surface. The body also reacts to heat by sending a signal, via the sympathetic nerves, to the sweat glands in the skin and then heat is lost by sweat evaporation.[9] One of the main symptoms of POTS includes increased heart rate so the extra half-a-tablet of Metoprolol was needed to decrease the patient's heart rate when exercising in hot conditions. Metoprolol is a beta-1 adrenergic receptor blocker which decreases one's heart rate by decreasing the force of contraction in the heart.[10] This allows the blood to flow easier, preventing tachycardia. When exercising in hot conditions, sweating and tachycardia is exacerbated warranting the need for an extra half-a-tablet of metoprolol for this patient.

The patient came from a healthy, supportive family who encouraged her to do what she loves. In the patient's mind, quitting was not an option and she was willing to do what it took to compete while staying healthy. The patient was diligent in taking her medications and performing modifications if needed. The communication between physician, athlete, parents, and the athletic trainer was strong, which helped the patient to manage her conditions while still participating in her sport.

INTERVENTIONS

Upon being accurately diagnosed with POTS, the patient was prescribed Metoprolol to aid in slowing her heart rate and fludrocortisone to increase blood volume. The patient was asymptomatic at rest and during daily activities. During and after exercise is when the patient's symptoms become problematic. It was recommended that she prolong her cross-country race finish to slowly decrease her heart rate without a sudden drop in blood pressure. Due to the nature of a cross country race, the athletes have approximately 10-20 yards to stop following crossing the finish line. This made it difficult for the athlete to slowly decrease her speed and heart rate without a sudden stop. The coach, patient and her parents, and the athletic trainer discussed the patient's situation and needs and it was determined that an assistant coach would provide support to the patient at the finish line by catching her at the conclusion of her races. After catching the patient at the finish line, the coach would lay her down and the athletic trainer would help to monitor her heart rate and oxygen levels. Once the patient's heart rate was below 130 beats per minute, she was able to stand. Following each race, the patient's heart rate returned to normal and she recovered approximately 10 minutes after finishing the race.

OUTCOMES

This patient's freshman and sophomore years of high school athletics were challenging in managing her symptoms until a correct diagnosis was obtained. When the correct doses of medication were prescribed and the patient and her healthcare team better understood her condition, the patient did not experience any episodes of

syncope while participating in basketball. In her junior and senior year, the episodes of syncope were only experienced after completing a cross-country race. Her coach was able to catch her following her finish. The coach and athlete would monitor her heart rate and oxygen levels via pulse oximeter. Support provided by the cross-country coaches and the athletic trainer at the finish line helped her to recover quickly and she was able continue competing throughout her high school career.

DISCUSSION

This case is unique because it is endurance and adrenaline driven. In fact, 50% of POTS patients show signs of a hyperadrenergic or high adrenaline state.[11] Hyperadrenergic POTS patients have high levels of nor-epinephrine in their blood which are natural stimulants in the body.[11] This can lead to an increase in heart rate and blood pressure. This patient experienced syncope episodes following long-endurance cross-country races due to the abrupt stop at the finish line and resultant rapid drop in heart rate . Her tilt table test showed that she has hyperadrenergic POTS because her results varied after the sympathetic drug, isoproterenol, was introduced. Additionally, the patient would always pass the finish line before fainting, supporting the hyperadrenergic POTS diagnosis. Following the correct diagnosis and dosages for the patient's medication, she would only faint after running a cross-country race. During cross country practices or basketball games, the patient was able to slowly decrease activity and reduce her heart rate through breathing techniques. During basketball games and practices, she was able to tell when her heart rate was too high, so she would let her coach know she needed a substitution. After coming out of the game or practice she would sit on the bench and hydrate until her heart rate was under control.

Compared to other cases, this patient had a mild case of POTS, which was managed through medications and modifications to sport participation. Some cases of POTS are more severe and have a greater effect on the patient's daily activities. For example, two cases were presented detailing the symptoms of two young, Caucasian females. The first case included a 20-year-old female who showed acute onset episodes of fainting upon sitting up, dizziness, slowing of speech, and the inability to contract muscles in the bladder.[12] This patient was treated with 20 mg of propranolol, which is similar to the beta blocker the patient in the current case was prescribed. With the help of the medication, the patient only had short periods of dizziness following the diagnosis.[12] The second case included a 19-year-old who showed acute onset of dizziness with syncope events.[12] This patient was first treated with fludrocortisone and compression stockings. The patient also received 500 mg of methylprednisolone for five days for suspected autonomic neuropathy.[12] These two cases were unique because they started with an acute onset and the symptoms were fully disabling. Variation in onset, intensity and type of symptoms in those experiencing POTS could make diagnosis difficult. If POTS is not properly treated, the syndrome can greatly impact not just athletic activity, but activities of daily living. Proper communication between providers on the healthcare team can speed the delivery of an accurate diagnosis, aid in the development of a patient care plan, and assist the athlete in managing their symptoms.

This case presented with strengths and limitations. Overall, the patient and her family were very well informed and cooperative in providing information to inform this case. For being so young in experiencing a health condition such as POTS, this patient was a very good communicator and became an advocate for her own healthcare. Educating and empowering high school patients to communicate and manage their own health

conditions is extremely important. Athletic trainers, parents, and coaches can work together to help the high school patient-athlete in how to best manage their condition to be able to compete at a desired level. This patient took time to understand her condition, understand her condition, learned how to manage her symptoms, and she communicated well with all athletic trainers involved in her care – at home, and while traveling for competitions.

CLINICAL BOTTOM LINE

Although POTS is not extremely prevalent in athletic training clinical practice, it is vital for athletic trainers to be educated on the signs and symptoms of POTS and understand that it can affect each patient differently. The signs and symptoms of POTS may mimic many other pathologies which may lead to misdiagnoses and ineffective treatments. Athletic trainers should urge patients and their parents to seek several opinions when symptoms include light-headedness, fatigue, sweating, anxiety, palpitations, exercise intolerance and syncope or near-syncope when standing or after exercise. When correctly diagnosed, POTS can be managed with patient education, advocacy and strong communication. Further, collaboration between healthcare providers to create an individual plan for the patient can also contribute to the management of POTS. In this case, the patient's cardiologist, parents, coaches, athletic trainers, and the patient were all closely involved in her care plan. With a few simple modifications to an athlete's procedure, close monitoring by athletic trainers, and routine checkups with a cardiologist, POTS symptoms can be managed and patient-athletes can continue competing at high levels in various endurance sports.

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The Functional Movement Screen and Injury Risk in Sporting Populations: An Evidence-to-Practice Review

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ABSTRACT

The Functional Movement Screen (FMS) is a functional test, which aims to identify dysfunctional, asymmetrical, and painful movements that could contribute to future injuries. Medical professionals can clinically use this information to implement appropriate, specialized prehabilitation training aimed at reducing the dysfunctional, asymmetrical, and painful movements, to help prevent injury risk. Research on this tool, however, has contradictory findings regarding FMS composite score and future risk of injury. It is unclear to what extent FMS can predict those with future injury risk, and whether there are factors, such as age, sex, or sport-type, which may be contributing to these varying findings. Therefore, the purpose of this review was to identify which factors, if any, may contribute to the contradictory findings regarding the relationship between FMS composite score and subsequent injury risk in physically active populations. The review aimed to include any study which performed an FMS test at baseline on physically active individuals competing at any level, and determined risk groups based on composite scores, using odds ratios, sensitivity, and specificity as outcome measures. Subgroups were assessed based on athlete age, sex, sport-type, injury definition and injury mechanism. Reviewed participants were split into two age groups, senior (18+ years old) and junior (9-18 years old) athletes. It was found that age, sex, and sport-type explained some of the variable findings in the literature, however, effect sizes were often small in magnitude. Functional Movement Screen composite scores and asymmetry seemed to be the most useful in estimating injury risk for senior athletes, as well as individuals participating in rugby, American football, and ice hockey. There were many gaps identified in the research that may help get a consensus on optimal populations and uses for FMS. Thus, we recommend utilizing appropriate clinical judgment when determining if FMS would be a beneficial tool for identifying those with higher injury risk at your clinical site and with your patient population.

Key Phrases
Preparticipation exams and screening, functional testing, injury risk reduction

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ORIGINAL REFERENCE

Moore E, Chalmers S, Milanese S, Fuller JT. Factors Influencing the Relationship Between the Functional Movement Screen and Injury Risk in Sporting Populations: A Systematic Review and Meta-analysis. Sports Med. 2019;49(9):1449-1463

SUMMARY

CLINICAL PROBLEM AND QUESTION

Musculoskeletal screening tests such as the Functional Movement Screen (FMS), are designed to identify modifiable risk factors so that healthcare providers can implement appropriate training strategies to reduce the incidence of injury.[1,2] The FMS is composed of 7 subtests, including the squat, step over, in-line lunge, reach, leg raise, push-up, and rotary stability, where each test is scored on a scale 1-3, to produce a maximum score of 21. Functional Movement Screen pain and asymmetry are dichotomous outcomes based on the presence or absence of pain during FMS testing and at least one FMS test difference between left and right sides of the body, respectively. While FMS is one of the more popular injury risk screening tools, there is little agreement on what factors of the test contribute to injury risk; therefore, the primary purpose of this meta-analysis was to identify factors that contribute to the investigated relationship

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between FMS and injury risk in sporting populations, especially the difference between the senior (18+ years old) and junior (9-18 years old) athletes. The second aim of this study was to examine the results of studies that have assessed the relationship between FMS asymmetry and injury risk.

SUMMARY OF LITERATURE

The authors for the guiding systematic review and meta-analysis conducted a systematic search of Medline, Scopus, EBSCOhost (including SportDiscus, Academic Search Premiere, Health Source: Consumer Edition, Health Source: Nursing/Academic Edition), Embase and Web of Science databases, to identify whether participant age, sex, sport-type, injury definition and mechanism contributed to the variable findings. Studies that were included in the systematic review had to meet the following inclusion criteria: 1) peer reviewed and published in the English language, 2) participants were competing at any level of sporting competition, 3) prospective cohort study design that assessed FMS performance at baseline using the complete FMS test battery and subsequently observed participants during sports training and competition, 4) identified risk groups based on FMS composite score, asymmetry or pain, and 5) outcome measures were injury incidence that could be categorized within the six injury level classifications provided by Orchard and Hoskins.[3]

Systematic database searches identified 1028 potential studies that, after screening, resulted in 36 studies included in the systematic review. Nine of 36 studies did not explicitly state that participants were injury-free at the time of testing. Five of 36 studies were deemed to not describe the injury surveillance method in enough detail. Four of 36 studies used a follow-up period that was less than one complete competitive season. Twenty-three studies were unclear whether follow-up was completed for all participants, and 18 were unclear whether strategies to account for incomplete follow-up were implemented. Six studies did not utilize statistical analysis that resulted in the reporting of injury-risk statistics.

SUMMARY OF OUTCOMES

This review looked at the odds ratio for injury risk given a specific criteria of FMS testing, to see if any differences in effect size existed between participant age, sex, sport type, injury definition or injury mechanism. The review also looked at the sensitivity and specificity based on risk groups determined by the different FMS testing criteria. The FMS criteria analyzed included a 1) FMS composite score threshold of ≤ 14, 2) ≥ 1 subtest with reported asymmetry, or 3) ≥ 1 subtest with reported pain. Injury mechanism was grouped as either all-cause injury or non-contact injury. Injury definitions were divided into tissue damage or presentation to medical staff, limited or loss of training/match, and limited or loss of match only.

FINDINGS AND CLINICAL IMPLICATIONS

This review looked to identify factors that contribute to the contradictory findings regarding FMS composite score and subsequent injury risk in sporting populations. Kiesel et al found that individuals with a composite score of ≤ 14 have an 11 times greater injury risk, while a systematic review by Bonazza, et al. reported a 3-fold or smaller increase in injury risk.[4,5] There could be a few reasons for the differences in the findings between these studies. For example, the systematic review mentions how only 2 other studies replicated the findings of Kiesel, et al. via independent ROC curves. The review also identifies how there may be an effect of sex and population characteristics on a cutoff. This could have contributed to the differences between the studies, as Kiesel, et al. focused only on male professional football players who form one individual team, while Bonazza, et al. included studies with men and women, as well as athletes

and non-athletes. Overall, this review identified that there were few studies that show a significant relationship between composite scores and subsequent future injury risk, and many of the results that were significant were only of small effect size. While the general understanding is that FMS testing's purpose is to identify dysfunctional, asymmetrical, and painful movements that could contribute to future injuries, more focused research is needed investigating which aspects of FMS testing work best at identifying risk and for which subgroups of individuals.

There are several gaps in the literature that still need to be identified to justify FMS use in many settings. First, of the studies used in this review, 3 studies used only female participants,[1-3] while 18 used only males,[4-21] which leaves a sex bias in the literature, making it difficult to generalize females. It should also be considered that individual subtests of the FMS may have stronger association with injury risk due to the differing demands and injury risks presented in varying sports. More consideration should be focused on whether poor scores for specific subtests are more strongly associated with injury to the region of the body that was tested. While there are a few studies which investigate this,[6-9] there is still a general lack of literature looking into subtests and their relation to specific injury types and body regions. Finally, the results of this study showed a smaller effect for junior athletes (OR = 1.03 [0.67–1.59]; p = 0.881) compared to senior athletes (OR = 1.80 [1.17–2.78]; p = 0.008), however, there is little research that explains why we see this difference.

Based on the findings of this meta-analysis, our own review of the evidence, and clinical expertise, we suggest that clinicians consider their patient population and possible contributing risk factors which may lead to injury in their setting before implementing FMS. The contradictory findings of research on this topic, as well as the lack of clinically significant findings of this meta-analysis, identify various gaps in the research on FMS testing. A composite score threshold of $\leq$ 14 was only found to have significant increase in injury risk for males, senior athletes, male and female rugby players, and baseball players. Composite scores were also found to be a better predictor of all-cause injuries, than non-contact injuries. There is not enough evidence to support a relationship between subtest and corresponding injury to subtest body region, though we recommend looking at the individual subtest scores, rather than just the composite score to best understand where an individual's movement deficiencies lie. Because of these findings, we suggest clinicians consider FMS testing for senior male athletes, especially those who participate in rugby or baseball. Although the findings were not significant for other sport-types and subgroups, we recommend that sports or groups which have higher incidence of all-cause injuries should consider FMS testing as well. Functional Movement Screen testing is a feasible test, so the general loss and harm of implementing FMS, even for subgroups that did not have a significant relationship to injury risk prediction, is minimal.

CLINICAL BOTTOM LINE

Functional testing has the potential to be a helpful tool in identifying at-risk individuals for future injury, thus allowing healthcare providers to create tailored prevention programs to address movement disparities identified by the screening tool. It should be considered, however, that full-body movement screens, such as the FMS, may not be the best tool for all population groups. Due to inconsistent and unclear methodology of the various research into FMS testing, it is difficult to create a clear consensus on the effectiveness of the tool as a predictor for future injury in many subgroups of individuals. Overall, most effect sizes were only small in magnitude and unlikely to be clinically meaningful in most sports, except for rugby, American football, and ice hockey. This could be due to the similarities between these

sports mentioned and the 7 components of the FMS test.

It may be beneficial for clinicians to consider assessing for movement quality based on the subtests instead of the composite score. Different subtests assess for different movement qualities, such as range of motion, strength, or balance. Identifying movement qualities that are crucial to specific sports and using only the FMS subtests which assess those movement qualities may be more beneficial for sport types that did not have significant results with the composite score. Similarly, if a sport consists of upper extremity use, it may be more beneficial for clinicians to focus the examination on the movement quality of the upper extremity using subtests that specifically assess the upper extremity. We are not suggesting that injury prevention be hyperfocused to a singular joint, rather there is a need to examine the kinetic chain and how movement patterns at the ankle can affect the hip, and so on. We suggest that clinicians consider the individual subtest of the FMS as a better tool than the composite score of the FMS. For example, the hurdle step of the FMS is a multi-joint assessment that could be very helpful for a lower extremity activity like ballet or soccer, which the guiding review did not identify as having a clinically meaningful finding. Reviewing subtests individually would allow the clinician to identify movement patterns which most affect the patient, rather than performing a complete FMS test to get a composite score.

The composite score and presence of asymmetry are strong predictors of injury risk in senior compared to junior athletes, though again, this effect size was small in magnitude. Junior cohorts may benefit from a lower composite score threshold, as suggested by the consistent null findings in junior athletes. There have been many false positives in junior cohort studies, in relation to FMS composite scores and injury risk, so creating a new composite threshold for junior athletes may produce more significant findings and make the screening tool more useful in these cohorts. It is likely that the painful scores seen in junior athletes is related to poor neuromuscular control as they develop, rather than dysfunctional movements. Many of the FMS subtests use body weight and asymmetrical movements are a result of motor control deficits which may lead to increased injury risk. Since senior athletes are exposed to higher game speeds and increased force impacts, a stronger relationship between FMS composite scores and injury risk in this population may be expected. Injury mechanism and definition do not have a significant impact on the relationship between FMS testing and injury risk, and due to the sex bias in the literature, findings from this review indicate a stronger correlation with male athletes than female athletes.

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Rater Reliability of the Functional Movement Screen: An Evidence-to-Practice Review

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ABSTRACT

The purpose of this evidence-to-practice review is to summarize a systematic review on the inter- and intrarater reliability of the Functional Movement Screen (FMS). Reliability is crucial to the FMS, as clinicians may retest to view a patient's changes and improvements in movement patterns. This review and analysis looked at 7 studies which showed that both inter- and intrarater reliability were good. Studies were only included if the primary focus was on inter- and intrarater reliability. Clinicians had varying levels of familiarity with the FMS process. Athletic training students with less than one year to no experience were found to have poor reliability. The findings also supported that clinicians who treated the same patient would have similar results about 80% of the time. The same clinician completing several screenings with the different patient would have reliable results about 85% of the time. Interrater reliability is an important aspect to a clinician's ability to monitor progress or modifications that a patient may exhibit. Overall, the FMS has good inter- and intrarater reliability and can be a predictor of injury risk and mobility. For both inter- and intrarater reliability to improve, it is beneficial for clinicians to have clinical experience and practice using the test to aid in accurate scoring. Certification in FMS is a way to develop repetition training from a reliable source, but it is unclear from these studies if certification changes reliability. The FMS screening serves as a useful tool because it allows for unlimited testing, video recordings for patient education or additional clinician evaluation, and is reliable among clinicians. We suggest that components of the FMS be used clinically for injury prevention, such as pre-participation exams and return-to-play criteria for injuries if scored by a formally trained clinician with experience assessing patient functional movement.

Key Phrases
Preparticipation exams and screening, injury risk reduction, functional testing

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SUMMARY

CLINICAL PROBLEM AND QUESTION

The Functional Movement Screen (FMS) is a standardized movement screen for individuals using a score to predict risk of injury and mobility.[1-3] It uses a series of 7 tests including the deep squat, hurdle step, in-line lunge, shoulder mobility, active straight leg raise, trunk stability push-up, and rotatory stability.[1,3] Each test is scored 0-3 with a score of 3 meaning that there is no compensation, a score of 2 meaning there is compensation during the movement, a score of 1 meaning the movement is not fully completed as instructed, and a score of 0 meaning there is pain with the associated movement.[1] The use of the FMS as an clinical assessment tool to identify limitations and restrictions in athletic movement has previously come under scrutiny due to rater reliability.[2,4,5] Interrater reliability is the measure that assesses how different evaluators agree or disagree upon the grading, while intrarater reliability assesses how reliable grading is by the same evaluator at different points in time.[6] In theory, high rates of reliability for the FMS are necessary to be able to identify score differences over time or among a team of clinicians in physical medicine (athletic training and physical therapy). If the interrater reliability is not adequate, the use of multiple clinicians can misrepresent intervention

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outcome scores. If the intrarater reliability is not adequate, interventions over time may be misrepresented when the patient is re-tested. Due to the increased popularity of the movement screening in clinical practice,[7] there is a need to review the evidence specific to inter- and intrarater reliability of the FMS.

SUMMARY OF LITERATURE

The focus of the guiding systematic review[8] was to determine the inter- and intrarater reliability of the FMS in clinical practice. Articles that were selected included active populations (secondary school and collegiate athletes). The included studies had to use the original scoring system[1,7] and incorporated all 7 tests that make up the standard movement screen for the FMS, with or without the three clearing tasks.[3,7] The FMS clearing tasks (shoulder clearing, extension clearing, and flexion clearing) are pain provocation tests that take a joint through a full range of motion and meant to provide a clear stopping point when a medical referral is necessary. No studies involving injured athletes or that measured reliability as part of a larger study were included. The authors originally retrieved 110 articles and narrowed to 14 studies based off the purpose of the study. After author review, was narrowed to 7 studies that met specific inclusion criteria for the purpose of the study.

SUMMARY OF OUTCOMES

Of these 7 articles included, 6 studies evaluated interrater reliability and 6 studies evaluated intrarater reliability. All 7 of the studies went through rigorous risk bias using a Quality Appraisal of Reliability Studies (QAREL) checklist. The QAREL checklist further identified the quality of the studies included in the final grouping. After article selection and quality appraisal, the results from all included studies were meta-analyzed to identify FMS reliability. The sample size of clinicians in the included articles was also assessed (range=1-38), with 5 of the 7 articles reporting 1-5 clinicians. The studies also included a mixture of assessment procedures that used real-time assessments and video recordings.

FINDINGS AND CLINICAL IMPLICATIONS

The meta-analysis identified that the FMS has good inter- and intrarater reliability.[8] The intraclass coefficient (ICC), or the measure of how a score closely matches up to another score, value for interrater reliability was 0.843. A value closer to 1 indicates similarity between different tests for a single rater. The 95% confidence interval for the interrater reliability ICC value was 0.797 to 0.882. The ICC value for intrarater reliability was 0.869 with a 95% confidence interval between 0.854 to 0.885.

There was a moderate level of quality evidence showing good interrater reliability. There was only one study[9] that found it to be fair or poor, but did not lower the overall average. From the one fair/poor study,[9] the authors identified poor reliability in clinicians that were limited in their FMS experience, which ranged from self-taught to less than 1 year of experience. However, the study did not mention if the clinicians had been formally certified in FMS. The guiding systematic review findings[8] indicated formal training paired with experience as the best way to achieve accurate results. It is unclear if certification is necessary, based on these studies, other than that a certification course provides the formal training and educational resources.[3] The other aspect analyzed was clinical experience with the studies including healthcare providers and students from various fields including physical therapy,[9-13] athletic training,[9,14,15] strength & conditioning[9,15] with certified and non-certified FMS testers of various experiences (0-4 years). Based off the data from the guiding systematic review, when the rater had greater experience with FMS scoring the interrater reliability subsequently increased.[9,11]

Intrarater reliability received similar results to interrater, which identified a moderate level of quality evidence for good reliability on the FMS. There was one study that was deemed fair, but the clinicians were athletic training students with no previous FMS experience.[14] Based on the findings, it was determined that experience played a significant role in the intrarater reliability for many of the same reasons as interrater reliability. Several reiterations with the same patient would also be a major benefit for the clinician, as observing how different movements are completed could indicate which muscles are activated. Inter- and intrarater reliability were assessed with real time and video recorded scoring. Both scoring methods were deemed good. The finding suggests that scoring could be completed several times and by several clinicians if needed, or videos could be sent to a certified FMS tester for screening confirmation if additional input was warranted. Formal certification can be expensive with current Level 1 FMS training costing $400.[3] Certification is a reasonable option for situations where analysis is needed, and the clinician will be primarily involved in correction strategies. However, sending videos to a more experienced FMS tester could also be an option for newly trained clinicians and athletic training students to obtain experience while receiving feedback on their scoring assessment. Video review may also be a viable option for FMS scorers who do not receive many repetitions of the test but still have a desire to implement the outcome measure.

CLINICAL BOTTOM LINE

One domain of athletic training practice is injury and illness prevention and wellness promotion.[16] Through this domain, athletic trainers should seek to minimize the risk of injury, which has often been linked to mechanisms such as pre-participation exams, screening practices, and maintaining a safe environment for activities.[17] One specific screening mechanism, the FMS, has been used as an established method to evaluate movement quality and subsequent insufficiencies.[1,11] However, there is conflicting evidence whether the FMS tests can predict specific or overall injury risk using the scoring criteria.[4,5,18] The issue is that the test is scored by a rater for movement quality at specific joints and through the kinetic chain on a graded scale which does not account for sport specific movements.[7] Additionally, previous research has noted that there are conflated reports of injury prediction modeling leading to questions specific to its ability to screen for injury.[2] In the guiding systematic review, the FMS test has shown good interrater and intrarater reliability which provides support to clinicians for long term outcome measures and evaluation.[8] However, despite the data supporting the reliability, the external resources often call into question if the FMS test has the predictive capabilities or screening sensitivity necessary for that of directing prevention resources towards a targeted population.[19]

More specifically, the FMS has also been used as a tool to monitor and evaluate rehabilitation progress. As the FMS seems not to have the screening or preventative nature necessary for sports medicine, we suggest that raters incorporate the FMS as a baseline screening not for injury prevention planning but as a model for return-to-activity basis. The data supports the use of video recording for FMS testing,[8] as well as during injury rehabilitation as a means to reduce the psychosocial impact of fear avoidance movements.[20] We suggest that athletic trainers wishing to implement the FMS as a screening tool do so for all patients, regardless of injury, and video record their movements. After doing so, if the patient sustains an injury, the clinician could use the video recording of the FMS as a baseline for movement quality pre-injury and a goal setting technique for the rehabilitation phases.

However, the issue still with the FMS is the subjective nature of the objective scoring.[7] While, as an outcome measure, the FMS provides a specific and measurable goal for the patient to achieve following their injury. The FMS score alone leaves a lot to be desired, since there are many factors that lead to a specific score; thus, clinician interpretation is crucial. Factors such as range of motion across multiple joints and muscle recruitment are all integrated to create one numerical score, as well as observation from a singular vantage point through dynamic movement is of concern.[15] The main takeaway of the FMS is to identify if there is an issue; however the unique biomechanical movements of specific athletes cannot be viewed in a score. The score also must be supplemented by commentary by a trained clinician who interprets the scoring to identify associated weaknesses and steps to strengthen primary muscle movers. The FMS does not guarantee the clinician will always notice the weakness either. For example, a clinician watching a deep squat might score a 2 for an athlete that has excessive forward lean as a compensatory movement. While this score would be correct, if another clinician received that score without any notes, it would be difficult to know where the incorrect movement occurred. A qualified individual scoring the FMS would be able to take that score and implement changes to ankle dorsiflexion to eliminate the compensatory movement, retest, and determine if further changes were necessary. Since the FMS has strong inter and intrarater reliability suggesting that it has a place in clinical practice, we suggest that athletic trainers wishing to incorporate it see the score as one piece of the data and that notes or qualitative explanations of the movement insufficiencies be explained in detail for clarity on the scoring, intervention planning, and later reevaluation of the test.

The guiding systematic review suggested that for both inter- and intrarater reliability to improve, clinicians must have opportunities to use the FMS test with repetitions and directed feedback in their scoring.[8] The use of feedback and deliberate practice requires time, which athletic training has continued to identify as a limitation in implementing evidence-based practice.[21] However, we believe that the use of video to record the patient throughout the testing movements would allow multiple clinicians to score the patient outside of real time. The proposal would be best integrated during pre-season or a pre-participation exam. A clinician among the healthcare team, whether that be within the same college/university or hospital outreach team, or even a cohort of students within an athletic training program, could evaluate and score the videos from multiple angles (frontal and sagittal planes of the body) with specific feedback on the movement quality noted. Not only would this allow for a future clinician to get the needed practice with the current patient population, but it also removes the burden from a singular formally trained clinician with experience assessing patient functional movement.

Overall, the data supports that there is reliability with the scoring within and between raters. However, clinicians have begun to adopt the FMS as the singular screening tool to predict injury, which is not supported by the literature. We must be creative in our pursuits of using objective outcome measures, such as the FMS, not as a number based criteria for injury prevention planning or ruling out risk, but as a means to have baseline data among the team of raters in case of an injury occurring for future return-to-activity therapeutic interventions.

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Southwest Athletic Trainers' Association Free Communications Abstract Presentations

The following abstracts were accepted and presented at the 67th Southwest Athletic Trainers' Association (SWATA) Symposium, 2021.

Athletic Trainers' Perceived Readiness to Recognize Mental Health Symptoms in Student Athletes

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Context: Athletic trainers (AT) may report a lack of confidence in decision-making as they transition to professional practice. There is limited research on how prepared ATs feel managing mental health conditions in athletes. **Objective:** The purpose of this study was to explore the perceived readiness and confidence of master's AT students, transitioning to professional practice, to recognize mental health symptoms and provide appropriate referral strategies. **Design:** Quantitative, descriptive study. **Setting:** Texas master's AT programs. **Patients or Other Participants:** Non-probability consecutive sampling method. The target population was 2nd-year master's AT students in Texas who were eligible to graduate and sit for the BOC. A total of 33 students attempted the electronic survey; 17 met the inclusion criteria and completed the entire survey for a response rate of 61%. **Interventions:** Program directors of AT programs received a recruitment letter asking them to distribute the participant recruitment letter and survey link to their 2nd-year master's AT students. Students completed the survey via SurveyMonkey™. The adapted survey included a set of three vignettes with two associated multiple choice response questions for each vignette, and a binary scale with an additional "Not sure" option for assessing athletic trainer responsibility. A 5-point Likert scale was created to assess perceived readiness and confidence. Subject matter experts were used to establish face and content validity. **Main Outcome Measures:** Perceived readiness and confidence were the main outcome measures assessed. Identification of the correct mental health symptom and best referral option for each vignette was also assessed. Data analysis was conducted using SPSS Statistics v. 27.0. All data were analyzed using descriptive statistics and appropriate measures of central tendency and dispersion. **Results:** Normality testing was run for the variable, *age*, using the Shapiro-Wilk test ($p < .001$). The median survey participant age was 23.00 years (*IQR*= 2; *Min/Max* = 22, 28) and the majority of students were female ($n = 15$; 88.2%). When asked if ATs were responsible for implementing psychological interventions, 52.9 % ($n =9$) students incorrectly chose *yes* and 41.2% ($n = 7$) reported *not sure*. Athletic training students reported preparedness to recognize signs and symptoms of mental health conditions in athletes ($n =11$; 64.7%), but not as prepared to provide referral strategies. They also *agreed* or *strongly agreed* they had the confidence to identify an athlete in need of a mental health referral ($n = 10$; 58.8%), but lacked confidence to manage the referral. **Conclusions**: AT students perceived readiness and confidence to recognize signs and symptoms of mental health conditions in athletes, but felt unprepared to provide appropriate referrals. The lack of preparedness and confidence may illustrate a need for further instruction in AT education programs.

Hiring Practices Among NCAA Division I Head Athletic Trainers

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Context: Limited empirical evidence exists on how athletic trainers (ATs) are hired by NCAA institutions. Current legislation protects many demographics from discrimination during hiring, but these laws may not be enforced by institutions. **Objective:** The purpose of this study was to describe potential factors that might influence the hiring practices of NCAA Division I Head Athletic Trainers. **Design:** Cross-sectional design. **Setting:** Electronic survey distributed to certified athletic trainers. **Participants:** A web-based survey (Qualtrics) that was distributed to by email to 329 NCAA Division I Head Athletic Trainers. A total of 114 ATs completed the survey (response and completion rate=34.7%). **Interventions:** NCAA Division I Head Athletic Trainers were emailed an invitation to participate in an electronic survey. The survey included a prompt for hiring an assistant athletic trainer for an NCAA Division I athletics program, questions on demographic data, impact of candidate demographic factors on hiring practices, and impact of candidate skills and education on hiring practices. After the collection window had closed, we calculated central tendencies for participant responses. **Main Outcome Measures:** Traits and characteristics of applicants preferred by NCAA Division I Head Athletic Trainers. **Results:** Most ATs reported they would be most likely to hire a candidate with three to five years of experience (90.3%). Most ATs also reported that they would be most likely to hire a candidate with primarily collegiate athletics experience (91.2%). Regarding education, most ATs were most likely to hire a candidate with a post-professional master's degree in athletic training (95.6%). For demographic factors, most ATs responded in the mid-range of agreement about the impact these factors had on hiring practices. More athletic trainers stated a willingness to hire a candidate of a different race (50%), different religion (45.6%) and different sex (48.2%). Responses regarding sexual orientation were near the mid-range for both same and different sexual orientation. When asked about the most attractive credentials for candidates, ATs ranked Corrective Exercise Specialist, Graston Technique Certified, and Performance Enhancement Specialist highest. **Conclusions:** Most head athletic trainers agreed that three to five years of professional experience, previous experience with collegiate athletics, and a master's degree in athletic training were the attributes most likely to influence a candidate being hired. However, many ATs responded toward the mid-range of agreement when asked about demographic factors when considering candidates. This may indicate an unwillingness to respond favorably or unfavorably on the topic. Future research should focus on assessing hiring practices in a manner that requires a favorable or unfavorable response. Athletic trainers involved in the hiring practice at their institutions must work to ensure that they are hiring the best candidate irrespective of demographic factors that have no bearing on technical standards of the position.

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Attitudes Among Collegiate Volleyball and Women's Soccer Players Prior to the COVID-19 Altered 2020-21 Season

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Context: In response to the global spread of SARS-CoV-2, the National Collegiate Athletic Association cancelled all 2020 winter and spring championships that had not been completed. Additionally, the majority of 2020 fall spring championships were rescheduled to take place in the spring semester of 2021. **Objective**: The purpose of this study was to describe the attitudes, moods, and motivations of collegiate women's soccer and women's volleyball players toward the alteration to the 2020-2021 season. **Design**: Cross-sectional design. **Setting**: Web-based survey. **Participants**: A total of 46 female collegiate soccer and volleyball players participated in this study (Age = 17.8 years ± 1.3; Women's Soccer = 24; Women's Volleyball = 22). **Interventions**: Participants were sent an electronic survey that collected demographic information, assessed attitudes and motivations regarding the altered season, and asked items found on the PHQ-9 and GAD-7 to assess depression and anxiety related feelings. Data was downloaded and analyzed using commercially available statistics software. **Main Outcome Measures**: Emotions experienced following the alteration to the 2020-2021 competitive season, depression related symptoms, and anxiety related symptoms. **Results**: The vast majority of participants stated that they were disappointed and sad when they received news that the 2020-2021 season would be altered (Disappointed = 80.4%). In contrast, the least commonly experienced emotion was happiness (Happy = 19.6%). On the PHQ-9, the majority of participants reported symptoms consistent with either moderate or severe depression (Moderate Depression = 15, Severe Depression = 13). 82.6% (N=38) of participants reported experiencing symptoms consistent with at least moderate depression. On the GAD-7, all participants reported symptoms consistent with at least mild anxiety (N = 46). The majority of participants reported symptoms consistent with mild or moderate anxiety (Mild Anxiety = 16, Moderate Anxiety = 14). **Conclusions**: The majority of surveyed collegiate women's soccer and volleyball players reported feeling disappointed or sad upon receiving news that the 2020-2021 competitive season would be altered. Less than 20% of respondents reported feeling happy about this news. The majority of participants reported feeling symptoms consistent with depression and anxiety shortly after receiving the news that their seasons would be altered. As athletic trainers, coaches, and administrators prepare to move forward, it is important to consider the possible implications and effects the alteration of the 2020-2021 competitive season will have on the mental health of student-athletes. Consideration of these factors may allow for intervention should student-athletes continue to experience these negative mood states.

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Effect of Tissue Flossing on Grip Strength in Collegiate Baseball Players

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Context: Tissue flossing bands are a relatively new therapeutic modality that has increased in popularity in recent years. While there is evidence to suggest that tissue flossing bands can decrease pain and increase perceived range of motion, there has been little research conducted to determine the effects of tissue flossing on muscular strength and performance. Thus, the aim of this study was to assess the effects of a single tissue flossing treatment on grip strength among healthy collegiate baseball players. **Methods:** Twenty apparently healthy collegiate baseball players (21.4 ± 1.54 years, 181.9 ± 3.56 cm, 84.5 ± 8.56 kg) were recruited and consented to participate in this study. The tissue flossing treatment was performed from the wrist to the elbow on the participant's throwing arm. Grip strength was then measured three times using a hand grip dynamometer both before and after treatment. The patient's non-throwing hand was tested before and after a one minute rest period to serve as a control. Data analysis was performed using a paired samples t-test to determine statistical significance of differences in maximum grip strength before and after intervention for both the treatment and control arms, and a one sample t-test was performed to determine the statistical significance of differences in maximum grip strength between groups. All statistical analyses were performed using SPSS Statistics Software (IBM, Armonk, NY). The level of significance was set at $p < 0.05$. **Results:** Following one round of tissue flossing treatment, the participants experienced a 4.3% decrease in grip strength (111.69 ± 16.95 to 106.89 ± 16.19, $p = 0.001$). However, participants did not experience a significant decrease in grip strength compared to the control arm (4.90 ± 11.12 to 1.93 ± 12.93, $p = 0.143$). None of the participants reported any adverse effects as a result of the tissue flossing band treatment other than mild soreness and redness of the skin that resolved within 10-15 minutes. **Conclusions:** These findings demonstrated that in healthy young baseball players, tissue flossing bands did not significantly decrease grip strength when compared to a healthy control. Thus, it would be reasonable to perform a tissue flossing band treatment prior to performing physical activity that involved gripping. Clinicians must use discretion when choosing a treatment option if a patient will be performing physical activity afterwards.

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Athletic Trainers' Perceived and Actual Knowledge of Cold Related Modalities

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Context: To date, there does not appear to be a study published that has examined the perceived and actual knowledge of cold related modalities that athletic trainers process. **Objective**: The purpose of this study was to determine the perceived and actual knowledge of cold related modalities among athletic trainers. **Design**: Cross sectional study. **Setting**: Electronic, web-based survey sent to credentialed athletic trainers. **Patients or Other Participants**: 191 certified athletic trainers completed the study (age = 42 ± 12 years, years of certified experience = 19 ± 11 years). **Interventions**: Participants were sent an electronic survey via email that assessed frequency of usage, perceived knowledge, and actual knowledge of cold related modalities. Data was downloaded and analyzed using a commercially available statistics package (SPSS Version 26, IBM, Armonk, NY). Measures of central tendency (means, standard deviations, frequencies) were calculated for all survey items. A Pearson correlation was calculated for the perceived and actual knowledge items to assess for a knowledge gap between what one believes they know and what they actually know. Significance was set at $P < .05$ a priori. **Main Outcome Measures**: Usage of cold related modalities, perceived knowledge of cold related modalities, actual knowledge of cold related modalities. **Results**: The majority of athletic trainers reported using cold related modalities to treat acute, chronic, and post-operative pain. Regarding perceived knowledge, most respondents indicated some level of confidence in their knowledge of cold related modalities. Average scores on actual knowledge were 6.07 ± out of 10 questions. No significant relationship was found between perceived and actual knowledge ($r = 0.127$, $P = 0.081$). **Conclusions**: While the majority of athletic trainers reported confidence in their knowledge of cold related modalities, their demonstration of actual knowledge was not commensurate. However, individuals who recently participated in post-professional continuing education related to cold related modalities demonstrated better actual knowledge of the topic than those who did not. This suggests that clinicians may benefit from continuing education interventions to improve knowledge of the definition, modes of action, indications, and contraindications of cold related modalities.

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Nonsurgical management of unilateral, nondisplaced lateral malleolus fracture in 17-year-old outside linebacker

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Background: Ankle fractures, specifically unilateral fractures, are among the most common injuries encountered by orthopedic surgeons. Ankle fractures have an incidence of 187 out of 100,000 individuals. Current treatment options for ankle fractures are dependent on stability of the ankle mortise, determined through number of fracture sites and ligamentous integrity. The management of the fracture scan either be surgical or nonsurgical, the majority being surgical. In this case report, a 17-year-oldmaleoutside linebacker sustained a left lateral ankle injury during a regular season football game. As he attempted to make a tackle, his left foot got caught in the turf, he fell backwards, and heard a pop. He continued to play in the game, but the pain progressively got worse. Upon halftime evaluation, the injury was deemed a lateral ankle sprain and the student-athlete (SA) was taped for external support. The SA could no longer ambulate. The SA was given crutches post-game and returned to the athletic training room the next day for further evaluation. The tuning fork test, squeeze test, and bump test were all positive, but only 2 out of 5 criteria for Ottawa Ankle Rules were met. **Differential Diagnosis:** Differential diagnoses include lateral ankle sprain, lateral malleolus fracture, and subluxation of peroneal muscle. **Treatment:** The SA was given a walking boot and referred to a physician for imaging. Radiographic images showed a minimally displaced, left lateral malleolus fracture. The SA was referred back to the athletic training room to complete a rehabilitation program. After 7 weeks of rehabilitation working on regaining range of motion, strength, proprioception, and neuromuscular control, the SA was cleared for participation and was able to play in the last football game of the season. **Uniqueness:** Most lateral ankle fractures are treated surgically, but because there was no displacement or ligamentous disruption in this case, the fracture was treated nonsurgically. **Conclusion:** Minimally displaced lateral ankle fractures that are treated nonsurgically have excellent outcomes. A thorough examination and evaluation is vital in overall ankle management. The best rehabilitation program depends on a lot of factors, but the stability and mobility of the ankle should be considered along with the pain levels with weight bearing, time elapsed from injury, bone quality, and risk factors for healing. While radiographic imaging is the gold standard when fractures are suspected, examination findings by an athletic trainer can play an important role in identification and triage.

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Treatment and Management of Complex Knee Injury: A Case Report

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Background: The "unhappy triad" injury includes tears of the anterior cruciate ligament, medial collateral ligament, and medial meniscus. There is limited research on the prevalence and outcome of this injury. The unique surgical repair consisting of lateral extra-articular tenodesis (LET) was utilized to reinforce the anterior cruciate ligament repair (ACLR) and to prevent rerupture. Due to this extensive surgery, the patient struggled to regain full range of motion and quadriceps activation. This case is a Level 2 case study that explores the different interventions used to address the aforementioned objective deficits and return him safely to play. **Patient:** The patient is an 18-year-old male soccer player that presents to physical therapy and the athletic training room for postoperative rehabilitation after ACLR, LET, MCL repair, and medial meniscus repair. The initial injury was non-contact and occurred while playing soccer; He reports planting his left leg and feeling his knee shift. He denies feeling or hearing a pop. Swelling in the knee was present and he was unable to continue playing. Upon examination, the knee was not tender to palpation, loss of range of motion was not significant, and Valgus and Varus stress tests were negative; Lachman's was positive. **Differential Diagnosis:** The differential diagnosis of this injury was ACL tear with MCL and medial meniscus involvement; and ACL tear with concomitant chondral injury. The physician's assessment, including MRI imaging, revealed a torn ACL with MCL sprain and medial meniscus tear. **Treatment:** Surgical repair was performed 2.5 weeks after the initial injury and consisted of bone-patellar tendon-bone ACL reconstruction with lateral extra-articular tenodesis, MCL and medial meniscus repairs. The patient began physical therapy 2 days post-op with treatment consisting of manual techniques to target range of motion and blood flow restriction to promote quadriceps strength and hypertrophy. Due to weight-bearing precautions, the Alter-G machine was utilized to aid in gait training. According to an ACLR study, the knee should have full range of motion at week 6. The patient still lacked 43 degrees at week 6. **Outcomes:** There are no specific guidelines for return to play after an ACLR, LET, MCL repair, and medial meniscus repair, therefore, a unique treatment plan was created by the treating physical therapist and athletic trainer to meet the patient's needs. The patient achieved full extension and continues to lack 5 degrees of flexion at 7 months. **Conclusions:** The complexity of the surgical repair and the patient's response to the interventions created challenges. Recommendations for clinical practice include implementing early interventions of blood flow restriction to inhibit muscle atrophy, Alter-G to initiate early gait training and more manual techniques to improve range of motion. **Clinical Bottom Line:** This case stresses the importance of involving the entire medical team (physician, athletic trainer, physical therapist) in the care of the patient as well as the ability to find ways to be creative with rehabilitation when there are protocols inhibiting traditional interventions.

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Evaluation and Treatment of the Water-polo player with Anterior Glenohumeral Instability

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Background: Glenohumeral (GH) instability is a common shoulder condition with a range of characteristics from laxity within the GH joint to complete dislocation of the humerus. The GH joint is held in place by static and dynamic stabilizers that need to be functioning appropriately to center the humerus in the glenoid fossa. Acquired shoulder instability is defined as chronic stress of the humerus in an externally rotated and abducted position on the shoulder joint from repetitive overhead (OH) sports causing anterior instability of the shoulder. Diagnosing shoulder instability is reliant on the patient's history and physical examination findings during testing. Using a combination of anterior apprehension, relocation, sulcus sign, and load and shift tests are recommended in the clinical examination to effectively diagnose GH instability. Current evidence treating non-operative shoulder instability starts with restoring ROM with the use of mobilization techniques, followed by strengthening exercises targeting the serratus anterior (SA), rhomboids, deltoids, and rotator cuff to improve overall stability. The purpose of this case is to show that manual therapy followed by specific therapeutic exercise is effective in treating acquired anterior shoulder instability in an adolescent water polo player. **Patient:** The subject is a seventeen-year-old female water polo player who has been suffering from left shoulder pain for two months. Her pain is intermittent throughout the day but worsens with swimming and the late cocking phase of her throw. She has no specific mechanism of injury (MOI). She rated her pain a dull and achy 5/10 at rest and a sharp 9/10 pain while throwing during practice. Her pain starts on the anterior aspect of the shoulder at rest and moves to the superior/posterior aspect during movement. She complains about neck stiffness with any movement along with shoulder pain. She reported no radiating symptoms down her back or arm. She reported no popping or clicking within the shoulder. She was unable to sleep on the left side and is frequently woken up due to the pain. Her goal for treatment is to learn how to manage her pain if the pain comes back after being treated. She also wants to be able to practice and participate in games pain-free. **Treatment:** Treatment consisted of manual intervention and therapeutic exercise throughout four sessions. Manual techniques performed included: soft tissue stripping of the pectoralis (pec) minor, lattisimus dorsi (lats), upper trapezius (traps), and subscapularis (subscap), inferior and posterior mobilization GH mobilizations, thoracic gapping and manipulations. The goals of manual therapy was to improve the patient's ROM and postural deficits. The posterior mobilizations were used to increase flexion and internal rotation while the inferior mobilizations were utilized to increase abduction and flexion at 0-60 degrees. Therapeutic exercises targeting thoracic mobility, internal and external rotation. While strengthening and stability exercises were aimed towards the rotator cuff, deltoid, serratus anterior, and rhomboids. **Outcomes:** By the end of all four sessions every deficit was addressed. She has been able to fully participate in practices and games completely without pain. Her functionality score progressed from a 49% to a 96.3% in two weeks. All the patient's goals were completed showing increased strength and stability within the GH joint. **Conclusion** During the four-session rehabilitation program, this case showed that acquired anterior GH instability can be treated with the previous techniques to increase stability within the dynamic stabilizers of the GH joint. Clinical bottom line: The results shown in this case of a water-polo player with acquired anterior GH instability showed that manual therapy and

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specific exercise can efficiently treat acquired instability with only four visits.

Diagnosis and Intervention of Posterior Shoulder Impingement in a Non-Throwing Athlete

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Background: Posterior impingement, also commonly called internal impingement, is identified by a repetitive compression of the posterosuperior aspect of the glenoid by the greater tuberosity of the humeral head when the arm is in an abducted and externally rotated position. There are multiple possible causes of this impingement. One of the most frequent contributors is scapular dyskinesis, where the scapula does not track properly with overhead movement due to weakness. Other contributors include kinetic chain instabilities found in the spine, core, and lower extremity, as well as glenohumeral instability causing a shift in the humeral head. Posterior impingement is commonly seen in upper extremity athletes during the late cocking and early acceleration phase of throwing, however this level two case report looks at the dysfunction in the less commonly occurring sport of volleyball. **Patient**: The patient is a fifteen-year-old female volleyball athlete that came to the athletic training facility complaining of left posterior shoulder pain. She has been playing the sport for 2 years, and claims the pain started around two years ago. At the time of evaluation the patient was in the off-season and was preparing to play in the upcoming season. The patient reported moderate pain at rest which increased to major pain while performing overhead movement. Her most recent season saw the greatest increase in pain, and the athlete attributed it to an increase in hitting and serving. The patient reported frequent popping in the shoulder, but no pain accompanied it. With passive movement, the patient had pain at end range in external and internal rotation, and actively had pain with flexion and abduction twenty degrees before end range. Patient presented as well was a lack of scapular upward rotation during shoulder movement, and the patient reported no pain with flexion when assisted with scapular upward rotation. A load and shift test presented with a grade 2 on the involved side. The posterior impingement test was performed and found to be positive. This led to a diagnosis of posterior shoulder impingement, caused by scapular dyskinesis and glenohumeral instability. **Treatment**: Treatment was focused on improving glenohumeral stability and activating the upward rotators of the scapula to improve the dyskinesis. Initially, manual therapy was used to mobilize the scapula into upward rotation and decrease tension in the latissimus dorsi and upper trapezius. Therapeutic exercise consisted of strengthening of the upward rotators, focusing on functional positions and overhead activities to mimic athletic play. Glenohumeral stability was improved through closed kinetic chain exercises for the shoulder. With the patient being a volleyball athlete, a larger importance was placed on overhead stability with the elbow in near full extension when compared to the typical throwing athlete with posterior impingement. **Outcomes**: The patient progressed well, with manual and exercise therapy interventions improving the patient back to pain free active daily living. Rehabilitation is still ongoing to return to a competitive level, however sport specific activity has been performed by the athlete pain free for short amounts of time. **Conclusions**: Overall the patient's progression was in line with current research, however modifications to rehabilitation needed to be made to fit the athlete's sport. Research for posterior impingement is centered on throwing athletes, and does not take into account the different demands of volleyball. While the patient herself did not have an atypical presentation, her sport called for an atypical approach when forming a rehabilitation plan based on current research. This approach placed a greater emphasis on stabilization in overhead activities, especially in situations where power is needed to generate the force for serving and hitting.

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Cervical Kyphosis in a Collegiate Baseball Player

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Background: A 21-year-old collegiate baseball player reported to the athletic training staff complaining of pain along the superior angle of the scapula, decreased shoulder range of motion, and transient numbness and tingling in the 4th and 5th digits of his right hand. Physical evaluation revealed substantial spasm and rigidity of the upper trapezius and scapular stabilizer musculature, along with myofascial adhesions in the rhomboids and levator scapulae, in addition to weakness with shoulder abduction and external rotation. All thoracic outlet syndrome testing yielded no positive tests. Thorough patient history revealed a history of shoulder arthroscopy the previous summer to address minor fraying of the rotator cuff after which the patient reported participating in minimal therapeutic exercise. At this time, the patient was advised to begin icing following every practice, along over the counter NSAIDs as directed. The patient was also instructed to begin therapeutic exercise on a daily basis with the athletic training staff. **Differential Diagnosis:** Scapular dyskinesis, scar tissue following improper rehabilitation of shoulder arthroscopy, general deconditioning of the shoulder musculature. **Treatment:** *Day 1,* patient began therapeutic exercises with the athletic training staff aimed at addressing scapular stabilizer weakness and decreased shoulder range of motion. During exercise, patient reported increased pain along the superior angle of the scapula when performing shoulder abduction with dumbbells. This exercise was discontinued at this time while the remainder of the therapeutic exercise program was continued. *Day 2,* patient reported that his shoulder and the surrounding musculature felt fatigued, but did not feel sore. Following re-evaluation, it was determined that the fatigue was a normal response to therapeutic exercise following deconditioning and exercise was continued. *Day 5,* patient began seeing the team chiropractor during regular weekly clinics. Evaluation from the team chiropractor confirmed both weakness and tightness of the shoulder musculature. At this time the patient was informed that they would be referred to the team physician if their symptoms worsened or did not significantly improve two weeks after the initial evaluation. *Day 9,* patient reported worsening symptoms during practice. Patient was then removed from team activities and scheduled to see the team physician. *Day 10,* upon evaluation, the team physician concurred with the evaluation of poor scapular stabilizer strength while also diagnosing the patient with poor postural stabilization of the cervical spine. Following the updated diagnosis, the patient's therapeutic exercise plan was revised to address the new found weakness. *Day 14,* during treatment at the team chiropractor's office cervical spine x-rays were obtained that revealed cervical kyphosis. With this new finding, patient began undergoing dry needling and cupping treatments in an attempt to address tight anterior musculature while continuing to address weakness. *Day 21,* patient continued current treatment plan, and presented with an increase in strength and range of motion. Throughout the remainder of the season, the patient continued treatment and rehabilitation plan and was able to participate in practices and competitions with minimal symptoms. **Uniqueness:** While cervical kyphosis is not a unique diagnosis in and of itself, the continued participation in competitive intercollegiate activity is noteworthy. Furthermore, patients suffering from cervical kyphosis often require surgical intervention to be able to maintain quality of life. In this case, the patient was able to continue with activities of daily living through the utilization of conservative measures. **Conclusions:** When treating a patient with an uncommon condition in their population, it is paramount that the clinician exhaust all resources to find proper treatment to address all associated pathologies. Should a clinician be treating a condition they are unfamiliar with, evaluation and re-evaluation of outcomes is crucial for an optimal prognosis.

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