March 2016 Resident Article Reviews

Oksana

The Effects of an Injury Prevention Program on Landing Biomechanics Over Time. Lindsay J. DiStefano, PhD, ATC, Stephen W. Marshall,z PhD, Darin A. Padua,§ PhD, ATC, Karen Y. Peck,|| MEd, ATC, Anthony I. Beutler,{ MD, Sarah J. de la Motte,{ PhD, MPH, ATC, Barnett S. Frank,§ MA, ATC, Jessica C. Martinez,y PhD, ATC, and Kenneth L. Cameron,|| PhD, MPH, ATC. The American Journal of Sports Medicine, Vol. 44, No. 3_2016.

There have been multiple studies that focus on injury prevention programs that have been shown to improve biomechanical and neuromuscular characteristics. However, there is limited evidence available on the long-term effects of these benefits. The purpose of the study was to evaluate the effects of an injury prevention program compared to a standard warm-up over 2, 4, 6, and 8 months. This controlled laboratory study included 1104 freshman cadets (17-22 yo). All participants were healthy and able to physically perform all of required test. Warm-ups consisted of 10-12 min for 6 weeks. The SWU (standard warm-up) consisted of 10 standard exercises used commonly in the US Army. The DIME (Dynamic injury prevention program) placed an increased emphasis on balance exercise in addition to other exercises that were specifically designed to teach proper alignment. There were 6 movement assessments: before, after, post 2m, post 4m, post 6m and post 8m. Participants were instructed to jump forward from a 30cm box a distance half of their body weight, land in a target area, and immediately jump for their maximal vertical height.

It was found the DIME injury prevention program helped decreased ground reaction forces; however, there was no greater improvement in overall movement technique in both groups. There are many limiting factors in this study. Initially there wasn't a significant change in ground reaction forces. These cadets go through an intense 6-week training camp, which made the participants fatigued and therefore may have affected their VGRF. As well these cadets were also going through a physical education course that involves training new cadets through military tasks and landing. As well, another limitation in this study is that most prevention programs published last from 15-20min while this was only 10 min.

In conclusion, the VGRF and movement landing technique did not last for over 6 months. These landing techniques seem transient. Training may need to continue through booster sessions to help maintain their motor learning program. It will be interesting to see future studies on the importance of prevention/ maintenance programs. We have talked about booster sessions for knee OA patients. I believe offering fitness screens for athletes every couple months might make a change in injury rates? I think this would be an interesting study.

Sean

Superficial and Deep Scapulothoracic Muscle Electromyographic Activity During Elevation Exercises in the Scapular Plane: Controlled Laboratory Study

Choosing the appropriate exercise progression for patients with scapular dyskinesia can be challenging. It can be difficult to determine the best position or movement to target the most appropriate muscle groups to improve scapulothoracic rhythm. Studies have documented lower activation of the middle and lower trapezius and serratus anterior in patients with scapular

dyskinesia. Minimal evidence shows the activation pattern of the pec minor, levator scap and rhomboids during shoulder elevation.
This study looks at scapulothoracic superficial muscle activity (upper trap, middle trap, lower trap, serratus anterior), as well as deep muscle activity (pec minor, levator scap, rhomboid major) differences with various typs of rehabilitation exercises with an elevation component. The authors investigate how different exercises with elevation in the scapular plane may alter muscle activation.

Subjects:

21 participants ranging from 21-55 years old, mean age of 32, 11 male and 10 female. All subjects did not have current or a history of neck or shoulder pain.

Design:

EMG data on muscle groups listed above in the dominant UE during 3 different arm elevation tasks in the scapular plane: 1) elevation in the scapular plane; 2) towel wall slide; 3) elevation with an external rotation component with a Thera-Band. Data was collected again with additional load.

Results:

The article has a nice graph illustrating the results of the different exercises and the muscle groups involved.
During scaption, the upper trap as significantly more active than during the wall slide and elevation with ER and upper trap and serratus anterior activity increased significantly. If the exercise was performed without additional load, the middle and lower trap generated the most activity during elevation with Theraband ER compared to the other two exercises. With the addition of load from a dumbbell, scaption and elevation with ER showed significantly higher middle and lower trap activity.
For the deeper muscle groups, elevation with band ER without additional load showed significantly higher levator scap (LS) activity than the wall slide. No differences found in levator scap activity in the unloaded condition between scaption and the other two exercises. When load was added, scaption and elevation with ER showed higher LS activity than the wall slide. Elevation with ER with additional load did not significantly increase the activity of the levator scap, as did the other exercises with additional load. It's not a surprise that the wall slide demonstrated significantly higher pec minor activation.

Discussion:

This study provided valuable data applicable to clinical practice. Knowing muscle activation patterns for normal subjects could help us be more specific in our exercise prescriptions to achieve our intended goal. For instance, let's say you have a patient that you feel demonstrates dominance of the upper trap to achieve scapular upward rotation and your goal is to decrease upper trap activation and facilitate middle and lower trap activity. I have often attempted to use verbal and tactile cues with scaption in attempt to achieve this goal (scapular assist), with minimal success. I realize that with the data from this study, this approach may be counter-productive if I'm performing an exercise that would normally facilitate high upper trap activation.
Serratus anterior is an important muscle for scapulothoracic rhythm and often targeted with exercise. Take note in **Figure 4** of the high serratus anterior activation under load with all three exercises, and then look at the high pec minor activation with the wall slide. I have often prescribed weight bearing activity, such as quadruped and closed chain elevation to target serratus anterior; however, if I want to calm down the pec minor, it's good to know that I can achieve roughly the same level of serratus anterior activation with scaption and elevation with ER with additional load.

Laura

The training—injury prevention paradox: should athletes be training smarter and harder?
Tim Gabbett
Br J Sports Med 2016;50:273-280

Tim Gabbett has recently published a review article in the British Journal of Sports Medicine on the paradox of training load and injury risk of athletes. There are several well-known constructs related to training, performance, and injury. Hypothetically speaking, higher doses of training lead to better performance, but also correlate with a higher risk of injury. Lower doses of training lead to poorer performance, but reduce the risk of injury. However, it is agreed upon that under-training can also increase risk of injury due to under-preparation for the demands of competition or task. Here in lies the training vs. injury paradox and the search for the answer of the "ideal" training load to maximize performance potential while minimizing injury.

Gabbett begins his review by breaking down training dose into volume, intensity, and frequency and how we are to measure training load. Increases in all three components can result in increases in fitness, performance, and risk of injury and therefore, each component needs to be considered and adjusted for each athlete. The training load can then be measured and tracked by either external or internal capacities. The external load, such as distance ran, weight lifted, number of jumps completed, can elicit different internal loads, such as rate of perceived exertion and heart rate, again based on individual characteristics. These individual characteristics, such as chronological age, training age, injury history, and physical capacity, should be the axis in which all modifications are based around. We can measure the athlete's training load by external and/or internal loads and therefore adjust load accordingly depending on desired outcome.

Gabbett next proposes a different view on modifying training loads to each individual athlete to optimize performance and minimize injury risk. He introduces the concept of acute and chronic training loads. Acute training loads are associated with the most current time frame, most accept this as weekly status. He refers to the acute standing as their "state of fatigue". Chronic training loads are associated with the last 3-6 weeks, or "state of fitness". This ratio of acute:chronic status will predict the athlete's preparation for competition/task. An overall low acute state of fatigue and overall high chronic state of fitness is the most ideal, prepared state for an athlete with the lowest risk of injury. The "sweet spot", per se. On the other hand, an overall state of high acute fatigue and low chronic fitness significantly increases the risk for injury.

How does Gabbett explain how to achieve the balanced ratio of maximizing performance and minimizing injury? Gabbett references another important concept of looking at the *changes in load* as athletes go through training programs. Is it the current training load that increases the injury risk, or is it the rate of change of load from week to week that predisposes injury? Take an athlete who is at superb fitness level and is training at high volume and high intensity. He is steadily increasing his load little by little over a period of time. Compare this to another athlete who is subjected to a lower training load than his predecessor. However, he has taken some time off in previous weeks and this week he has decided to return to his former training load. This rapid increase in training load (acute "fatigue") has been found to have a much greater risk of injury with higher relative *change* in load rather than absolute amount of load. Gabbett explains that it is our job as practitioners to prevent this spike in training load and develop the athlete's resilience and training tolerance to the task ahead.

Regardless of practitioner type, this article is a great read on stepping back and looking at each athlete at overall fitness, current status, and physical demands of sport/competition. As physical therapists, the majority of us are introduced to these athletes at injury or high level of "fatigue". It is our job to take all previous concepts discussed as well as incorporate tissue healing and protection from further injury to guide our athletes back into play, prevent "spikes" in training loads, and optimize the balance between load and recovery. We can use these models to easily explain to our clients the reasoning behind overtraining and increased risk for injury to improve the buy-in for our specific training programs. By maximizing compliance with training programs and planning weekly absolute vs. relative loads based on individual characteristics, Gabbett reasons that we can create high chronic workloads and smarter training programs.

Nick

Walsh R, Kinsella S. **The effects of caudal mobilization with movement (MVW) and caudal self-mobilisation with movement (SMWM) in the relation to restricted internal rotation in the hip: A randomised control pilot study.** *Man Ther.* 2016; 22(1):9-15

The goal of the study of interest is manifested by its title: to examine the effects of inferiorly directed mobilization to hip, either by the clinician or by the patients themselves, on hip internal rotation range of motion. In the introduction the authors draw attention to the association of various pathologies, notably femoracetabular impingement (FAI), with limited hip flexion and internal rotation range of motion. It is postulated that improving such range of motion may help manage and or prevent local and distal pathology.

22 *healthy* male subjects with IR of 30 degrees or less in prone were randomized to either mobilization with movement, self mobilization with movement, or a control treatment. The mobilization with movement technique was performed with the patient in quadruped, the clinician behind the patient providing an inferiorly directed force via a belt around the clinician and the patients proximal hip. The patient then moved back and forth into relative hip adduction with the inferior mobilization sustained. The self mobilization with movement was essentially the same, only the mobilization force was through the use of a belt attached to an immovable surface. The control group performed the same exercise, only with no clinician or band directed mobilization to the hip. All groups performed 30 repetitions, with no specified holding times indicated.

Internal rotation range of motion was assessed seated with the hip flexed at 90 degrees and also in a standing position, what the authors note as, "functional internal rotation test."

In both the self and clinician directed mobilization groups, hip IR ROM in seated and in standing improved by approximately an average of 5 degrees, while there was no change in the control group. Only the improved internal rotation range of motion in standing for the clinician guided mobilization with movement was found to be statistically significant over the control group.

The results of this study appear modest but encouraging. 5 degrees may seem quite a small improvement, but was only performed once with measurements immediately pre-and post. It is possible that the effects of the self mobilization program over a two week period of time may have shown even greater ROM improvements. Additionally, it is possible that a 5 degree improvement in hip IR ROM may be of clinical value in certain patients. The results must certainly be taken cautiously as the test was performed on healthy subjects with no present or past history of hip injury or pain.

I appreciate the value of this study in giving me an additional tool which can be readily utilized in the clinic and given to the patient to perform at home, and has a modest degree of evidence supporting its utility if deemed appropriate by sound clinical reasoning.

Alex

Shannon Bravo Petersen, Chad Cook, Megan Donaldson, Amy Hassen, Alyson Ellis & Ken Learman (2015) The effect of manual therapy with augmentative exercises for neck pain: a randomised clinical trial, Journal of Manual & Manipulative Therapy, 23:5, 264-275

The purpose of this randomized clinical trial was to investigate possible differences between treating neck pain patients with manual therapy and either general range of motion exercises (ROM), or augmentative exercise program (AEP) specific to the patients' impairments and reflective of the manual intervention they received. The secondary objective was quantifying differences in the patient's perception of improvement.

Outcomes were measured using the NDI and NPRS and quantitative sensory testing (QST) consisting of pain and vibration thresholds, as well as the Global Rating of Change (GRoC) score. Patients received one treatment session and outcome measures were given before and immediately after the intervention, as well as 48 and 96 hours post-treatment. Between group differences for the functional outcome measures and QST yielded no significant differences, however, all patients demonstrated improvement after the intervention. The GRoC scores of the MT and AEP group were superior to the MT and ROM group, demonstrating a statistically significant difference. This suggests that the MT and AEP group perceived their intervention to be more helpful, possibly due to the specificity and individualization of the exercise program.

Despite not being able to demonstrate significant differences between the groups for the functional outcome measures, the results of this study are quite interesting from a clinical perspective. Firstly, the improvement of both groups following one intervention further supports the benefits of specific manual therapy in combination with therapeutic exercise. The manual interventions were tailored to each subject's limitations, demonstrating the importance of specificity in this aspect. Secondly, the perceived improvement by the AEP group indicates that even though there may not be a difference, between general ROM and AEP in regards to outcome measures, tailoring the therapeutic exercises and home exercise program to the individual may improve rapport and compliance with treatment.

There were some limitations to the study, namely a lack of a group receiving manual intervention without any exercise, as well as the short duration. It would be interesting to investigate whether there would be significant differences in outcomes between the groups with several treatment sessions over a larger time frame. However, considering the low level of disability of the subjects in this study and the fact that significant improvements were still made after one session demonstrates the value of a multimodal treatment approach.