

## **Laura:**

### Deficits in Glenohumeral Passive Range of Motion Increase Risk of Shoulder Injury in Professional Baseball Players: A Prospective Study

Kevin E. Wilk, PT, DPT, FAPTA; Leonard C. Macrina, MSPT, SCS, CSCS; Glenn S. Fleisig, PhD; Kyle T. Aune, MPH; Ron A. Porterfield, ATC; Paul Harker, ATC; Timothy J. Evans, MD; and James R. Andrews, MD

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Wilk, Macrina, and Fleisig, et al. have recently published a fourth study in a series of prospective cohort studies examining the relationship between shoulder passive range of motion and risk of injury in professional baseball players over the course of 8 competitive seasons. A total of 296 pitchers were evaluated each year starting in 2005 for passive range of motion in both dominant and non-dominant shoulders for flexion, internal rotation at 90 degrees, and external rotation at 90 degrees. The athletes were then followed through the conclusion of the 2012 Major League Baseball season and recorded injured when the player was placed the disabled list (DL) for any throwing shoulder injury.

The authors found that 46% of pitchers had insufficient external rotation and 23% were placed on the DL for a shoulder injury (compared to 12% of pitchers without insufficient external rotation). Players with insufficient external rotation were 2.2 times more likely to be placed on the DL for a shoulder injury and 4.0 times more likely to undergo shoulder surgery. External rotation was found to be more statistically significant than internal rotation and total rotational motion deficits, which is in contrast to previous studies that find positive relationships between internal rotation and total rotational motion to shoulder injuries.

There were several sources of possible confounding factors within this study design in comparison to the previous studies with this cohort. In the 2011 study of correlation between internal rotation/total rotational motion and shoulder injuries, the authors differentiated the factors of age, minor and major league, and years of professional experience. These subgroupings were absent in the current study. The authors also previously used direct medical assessment to define "injured" and did not use the number of days on the disabled list for data analysis due to "inherent inconsistencies seen with this classification"<sup>2</sup>. The current study recorded "injured" when a player is placed on the injury list and used how many days on the DL for analysis, regardless of questions of injury definitions and whether all days on the DL were truly injury days. In previous studies, the authors state that this could influence the results due to players not reporting injuries or being misdiagnosed.

The players who entered the study at the later seasons had a shorter time frame to capture injuries than the players entering the study at the start of the study. Possible outcomes could be missed if those players who entered the study later develop injuries after the study is concluded, but still in the same time frame as the initial players. In addition, a dose-response relationship cannot be demonstrated with this study due to lack of severity or extent of injury in the records.

When appraising evidence, clinicians need to remember that causality cannot be directly established within prospective cohort studies. Due to the longitudinal design and strong correlation measurement, this study can infer a positive relationship between external rotation deficit and shoulder injury. Players should be carefully evaluated with comparison to normative values for a similar population to determine injury risk and apply appropriate treatment interventions.

Previous articles published within same cohort:

1. Passive Range of Motion Characteristics in the Overhead Baseball Pitcher and Their Implications for Rehabilitation – Kevin E. Wilk, PT, DPT; Leonard C. Macrina, MSPT, SCS, CSCS; Christopher Arrigo, MS, PT. *Clinical Orthopaedics and Related Research* (2012). 470:1586-1594.
2. Correlation of Glenohumeral Internal Rotation Deficit and Total Rotational Motion to Shoulder Injuries in Professional Baseball Pitchers – Kevin E. Wilk, DPT, PT; Leonard C. Macrina, MSPT, SCS, CSCS; Glenn S. Fleisig, PhD; Ronald Porterfield, MS, ATC; Charles D. Simpson II, DPT, CSCS; Paul Harker, ATC; Nick Pararesta, ATC; and James R. Andrews, MD. *American Journal of Sports Medicine* (2011). 39:329
3. Deficits in Glenohumeral Passive Range of Motion Increase Risk of Elbow Injury in Professional Baseball Pitchers - Kevin E. Wilk, DPT, PT, FAPTA; Leonard C. Macrina, MSPT, SCS, CSCS; Glenn S. Fleisig, PhD; Kyle T. Aune, MPH; Ron A. Porterfield, ATC; Paul Harker, ATC; Timothy J. Evans, MS; and James R. Andrews, MD. *The American Journal of Sports Medicine* (2014). 42:2075

## **Oksana:**

Shoes in the 1912s are completely different to the engineered masterpieces of the 21<sup>st</sup> century: support, cushioning, light-weight, minimalist, barefoot shoes, etc. Running injuries have not changed of the past 40 years. There have been multiple studies that focus on the correlation of cushioning to running injuries. It was found that a softer shoe insole reduced injuries in military shoes. Another study looked at the influence of comfortable insoles. Military runners had a choice of 6 different insoles with respect to comfort and it was found that the test group had 53% less injuries. Comfort is important for all movement- related injuries to the lower extremities.

Running is influenced by extrinsic (mileage, training) and intrinsic factors (foot pronation, impact factors). There are multiple studies on the influence of vertical impact forces and foot pronation associated with running injuries and results were non conclusive.

When people run, they have a preferred movement pathway. The University of Calgary constructed a study of analyzing movement of a skeleton and its changes as a result of footwear interventions. They found that changes in insoles had a small impact on the changes in the actual path of movement of the calcaneus and the tibia. Changes in mechanics primarily happened in the range of movement not the in path of movement. For example, when running barefoot the initial ankle dorsiflexion is decreased; however, the actual movement path stays the same. The

questions is what does “preferred movement path” mean and how do you establish a research protocol that focuses on assessing specific movement patterns? Overall, more research is needed to focus on factors that affect a range of movement.

When selecting running shoes one should select a shoe based on one’s own comfort. This was found to be an important factor in reducing injury. Intrinsic factors such as pronation and impact forces have little evidence for predicting running injuries. More research is needed to define, verify and quantify the new paradigm of ‘preferred movement paths’. This may provide insight into better understand the mechanisms of running performance and running injuries.

*Reference:*

Running shoes and running injuries: mythbusting and a proposal for two new paradigms: 'preferred movement path' and 'comfort filter'. Nigg BM<sup>1</sup>, Baltich J<sup>1</sup>, Hoerzer S<sup>1</sup>, Enders H<sup>1</sup>.. Br J Sports Med. 2015 Oct.

**Nick:**

Gilbert KK, James CR, Apte G, Brown C, Sizer PS, Brimsee J, Smith MP. Effects of simulated neural mobilization on fluid movement in cadaveric peripheral nerve sections: implications for the treatment of neuropathic pain and dysfunction. *J Man Manip Ther.* 2015; 23:219-225.

In the literature review, the authors report that nerve compression commonly leads to intraneural edema. They note that while neural mobilizations have been shown to result in improved patient symptoms, the precise mechanisms for this are not fully understood. They hypothesize that dispersion of intraneural edema could be partly responsible for the effectiveness behind neural mobilizations, and note that few studies have examined the effects of neural mobilization on fluid dynamics in neural tissue.

The hypothesis that neural mobilizations may help to disperse intraneural fluid was tested in a controlled laboratory environment on cadaver tissue. 6 right/left pairs of excised sciatic nerves were used. A dye solution composed of human plasma and toluidine blue stock solution was injected into the proximal third of the all nerve tissues just beneath the epineurium. The fluid was allowed to disperse via the natural effect of gravity until it was observed that fluid movement had ceased. Following this, half of the sciatic nerve tissues (experimental group) underwent repetitive stretch/relax cycles via a materials tester set to 6% tissue strain. The mobilization period lasted 5 minutes, after which fluid dispersion was recorded for both the control and experimental group.

The researchers hypothesis was confirmed in that fluid dispersion was significantly greater in the experimental group (3.2 mm), whereas in the control group it remained unchanged (-0.1 mm).

This study was performed in a laboratory setting on cadaver tissue with the use of a materials tester in performing the neural mobilizations; in all of these components, the results must be interpreted cautiously when considering clinical carryover and applicability. Nevertheless, the

results suggest that the effectiveness of neural mobilizations *may* be due in part to helping disperse local intraneural edema, which has proven to be detrimental. Additionally, such fluid dispersion can possibly occur through the mere mechanical (vs. physiological) effects exerted on the tissue.

This study personally raised my awareness to the reality of intraneural edema, its negative effects, and the potential for neural mobilizations to help disperse such edema.

### **Alex:**

Camargo PR, Albuquerque-sendín F, Avila MA, Haik MN, Vieira A, Salvini TF. Effects of Stretching and Strengthening Exercises With and Without Manual Therapy on Scapular Kinematics, Function, and Pain in Individuals With Shoulder Impingement: A Randomized Controlled Trial. *J Orthop Sports Phys Ther.* 2015;;1-34.a

doi:10.2519/jospt.2015.5939

This article by Camargo *et al.* investigates the potential benefit of adding manual therapy techniques to a therapeutic exercise treatment approach of shoulder impingement syndrome (SIS). The study is a randomized controlled trial with 46 patients assigned to a therex + MT group and a therex only group. Both groups performed the same exercises, using the same parameters, however, resistance (thera bands) was adjusted individually. Therex consisted of stretches to the upper trapezius, pectoralis minor and posterior shoulder, as well as resisted training of shoulder external rotation, scapular protraction (serratus anterior) and shoulder extension (lower trapezius).

MT consisted of techniques addressing athro- and osteokinematic movement of GHJ, SCJ, ACJ, scapulothoracic joint and cervical spine, as well as STM, PNF, rhythmic stabilizations, strain-counterstrain and contract-relax techniques. The duration of the intervention was four weeks.

The primary outcome measure was scapular kinematics with arm elevation in the scapular and sagittal planes and the secondary outcome measures were mechanical sensitivity in the upper quadrant and the DASH.

Camargo *et al.* found no significant differences in the outcome measures at the end of the interventions, suggesting an added benefit of manual therapy techniques to therapeutic exercise in patients with SIS. The authors state that the large improvements in pain of function demonstrated by both groups in absence of significant changes in scapular kinematics suggest that improvements are independent of changes in scapular motion.

The authors listed some limitations of the study, including limited literature on reliability and MCID of scapular kinematics and the lack of assessment of muscle activation. While this study provides an in depth analysis of scapular motion and pressure pain thresholds, there are a few limitations that seem worth discussing, before jumping to conclusions.

The first question that came to mind when reading about participants and inclusion/exclusion criteria was what the underlying cause of the symptoms was and whether it was fair to group these participants together for comparison. The inclusion criteria leave room

for variability in regards to dysfunction and cause of SIS, especially in a versatile joint like the shoulder. There is no discussion or differentiation between mechanical or motor control dysfunction, or other potential contributing factors to scapulothoracic and GHJ function (such as thorax movement and mobility). Given the vast number of potential contributing factors in the region, specification of functional and physiological impairments would certainly help applying these results to patient care. While the authors do state that the manual intervention was tailored specifically to each patient based on their presentation and re-assessment during each visit, there is no documentation as to what techniques were performed specifically and whether there was a change in outcome depending on what the treatment consisted of. Furthermore, the inclusion criteria state that the subjects had to reach 150 degrees of elevation (as per visual observation), however, there is no differentiation in regards to onset of SIS symptoms at specific degrees of elevation. Additionally, we do not know how the onset of symptoms during elevation correlates to specific scapular dysfunction in these patients and whether there was a difference between patients who experienced symptoms in lower degrees of elevation with minimal scapulothoracic motion and those who experienced symptoms at higher degrees.

Another limitation to point out is the fact that scapulothoracic kinematics were only measured on the involved side, neglecting potential differences in contralateral movement that could suggest whether or not the kinematics are abnormal for the individual subject.

Given the limitations and generalization of patients with SIS, it is difficult to draw specific conclusions as to whether or not manual therapy techniques should be included in patient care. Treating a symptom rather than specific limitations may produce general improvements, however, failing to address underlying causes and modifying treatment approaches (whether it is therex, manual therapy, or something else) to specific limitations would be a disservice to our patients.

### **Sean:**

Second discussion board post. Article published in October edition of Manual Therapy.

A tailored exercise program versus general exercise for a subgroup of patients with low back pain and movement control impairment: A randomized controlled trial with one-year follow-up. (the first article in attachments)

Peter O'Sullivan has researched and developed methods for classifying patients with LBP. He states most patients with chronic LBP do not have a specific diagnosis and are labeled as non-specific low back pain (NSLBP). O'Sullivan classifies a subgroup of NSLBP as patients with movement control impairments (MCI). A series of 6 physical examination tests have been developed to classify patients with MCI. Patients with MCI are placed in categories as having a flexion, active extension, passive extension, lateral shift or multidirectional MCI. This study by Saner et al. examines the effects of an exercise program designed to specifically address the movement control impairments found during examination versus a general strengthening program for this subgroup of patients with NSLBP.

This article does not specifically explain the MCI tests or the general exercise program that was utilized; therefore, I have attached articles with descriptions of the MCI tests and the general exercise program that was implemented in this study.

I feel this study had a good sample size (106 participants) and number of therapists performing the treatments (28). As you will see, the results of this study indicate there was no significant difference between the groups at 6 months and 1 year follow-up. Both groups demonstrated a significant improvement in pain and disability.

Features I found to be significant

- 1) Exclusion criteria: patients excluded from this study include the following; 1) patients with LBP due to known or specific causes with recent surgery, 2) patients with spondylodesis, 3) those with comorbid health conditions that limit exercise training, 4) patients complaining of constant pain and/or pain below the knee, 5) patients with score of more than 130 on the OMPSQ, 6) more than 3 months of sick leave due to LBP.
- 2) Participants were relatively active in sports
- 3) Outcome Measures: Patient Specific Functional Scale to measure activity limitations and pain level measured with the Graded Chronic Pain Scale.
- 4) Mean number of recommended exercises for the Movement Control (MC) group = 3.9, General Exercise (GE) group = 5.0
- 5) Both groups started with a mean number of impaired movement control tests of 3.9. MC group improved to a mean of 1.8; GE improved to a mean of 2.8.

Discussion

The practice of analyzing specific movements and formulating treatments to address observed impairments is the basis of our expertise as physical therapists. Inherently we aim to develop specific treatment plans individualized for each patient and we expect the specificity of our plan to be superior over a “general plan” that one could prescribe to each patient. Therefore, I would have liked to have seen this study support that approach to better validate our expertise. I feel there are aspect we can critique that will help us continue to support and validate our approach to a specific treatment plan.

Questions for consideration and discussion:

- 1) Is it justified to interpret this study as having an undesirable outcome, or can we form positive conclusions from the results?
- 2) Were the outcome measures chosen appropriate for this study or would more desirable or significant results been achieved if different outcome measures were chosen? What outcome measures would you have used?
- 3) How significant is it to classify patient’s with LBP and how do you feel this classification system fits into your practice.
- 4) Can you think of a group or particular patient you have seen that may benefit from movement control impairment testing and subsequent treatment tailored to their impairments found?

Looking at the outcome measures it was noted that while the measures are functional and specific in nature, they were all in fact subjective measures. The Patient Specific Functional Scale is a good scale and asks patients to specifically list activities they are having trouble with and to rate their level of difficulty/ability with the tasks. It appears this study does not take into consideration the level of fear avoidance patients may have with these activities, nor do they tailor treatment to address the specific functional tasks the patients list. Given the fact that patients in the MC group required a less number of exercises and, objectively, they demonstrated a less number of MCI than the GE group at follow-ups, I would be interested to see if results would be different if there were emphasis on patient education and addressing specific functional activities during treatment as well. We don't really know objectively if the patients actually made attempts to perform the functional activities they listed.

The patient's perceived level of improvement is ultimately key for a positive outcome. However, it may be more applicable, in the case of this study, to use objective measures to assess the outcome of a treatment if the assessment is in fact an objective functional test and treatment is designed to improve those functional movements. If your goal is to improve a patient's ability to perform a particular task, then perhaps graded exposure to that task with the addition of tailored exercise addressing movement control impairments would be a high quality approach. One could also argue that if a patient demonstrates less movement control impairments, as seen in this study, then that may correlate with performing a particular task with better quality of movement and less risk for further injury. We just need to find a way to test this.