It's Time for Intraprofessional Practice

Kenneth E Games, PhD, LAT, ATC
Indiana State University, Terre Haute, IN

Key Phrases
Collaborative practice, BOC standards of practice, change

Correspondence
Dr. Kenneth Games, Indiana State University, 567 N. 5th Street, Terre Haute, IN 47809.
E-mail: kenneth.games@indstate.edu
Twitter: @GamesKenneth

Full Citation
Games KE. It's Time for Intraprofessional Practice. *Clin Pract Athl Train.* 2018;1(2): 1-3.
https://doi.org/10.31622/2018/0002.1

Submitted: October 27, 2018 **Accepted**: October 30, 2018

EDITORIAL

By now we have all heard about interprofessional and collaborative practice (IPCP), also called interprofessional practice (IPP) or interprofessional education (IPE). What about *intraprofessional* practice? When was the last time that you effectively practiced in a team-based setting with other athletic trainers? I am not just talking about sharing patients. I am talking about deliberately and intentionally co-facilitating patient care using each individual athletic trainer's strengths to create a "super provider" capable of delivering the best patient care possible to the populations we treat. Are you pausing…thinking this seems impossible? It is already being done in other healthcare professions. Nursing has been engaging in intraprofessional practice for years and currently has multiple iterations of best practice guidelines for intraprofessional collaborative practice.[1] Through a framework to create a collaborative workplace, nursing has effectively created a system that maximizes health and wellness for nursing and delivers the best possible outcomes for patients.[1] I see a future where we, as athletic trainers, fundamentally shift our practice models to create environments of intraprofessional collaboration, and that future is closer than you think!

I know what you may be thinking…"This will never work" or "Athletic training is different" or even "It may work in some settings, but not all." If these are your initial reactions, you aren't alone. This radical shift requires new ways of thinking and framing our work in ways we have rarely done in the past. Intraprofessional practice can work in any setting. To demonstrate this, imagine with me as I describe an alternative reality than that which currently exists in most secondary school settings.
Imagine a world where athletic trainers from "rival" high schools provided care to patients at both schools collaboratively based on each athletic trainer's specialty areas. The athletic trainer from high school A is a specialist in orthopedics, while the athletic trainer from high school B is a specialist in neurotrauma, and both residency trained in their respective areas. A patient from high school A comes into the athletic training facility reporting the signs and symptoms of a concussion. After appropriate evaluation and diagnosis of a concussion, the athletic trainer from high school A determines that intraprofessional referral is necessary and refers the patient to the athletic trainer at high school B for treatment and rehabilitation from the concussion. Both athletic trainers keep the patient at the center of the care team and keep their egos out of the health, safety, and wellness of patients. They seamlessly exchange documentation in accordance with Federal regulations and together, return the patient to activity with better short, medium, and life-long outcomes. This could be as simple as practitioner to practitioner consultation, as traditional as the patient receiving care at the rival high school, or as advanced as telemedicine to reduce the burden on the patient and provider.

Try to hold off on that instinct…"Well, that's not MY team!" Remember that the BOC Standards of

 ISSN Online 2577-8188

Professional Practice indicate that the athletic trainer "takes no action that leads to or may lead to improper influence of the outcome or score of an athletic contest or event" (Code of Professional Responsibility, Professional Responsibility 3.10).[2] The Standards also state that the athletic trainer "practices in collaboration and cooperation with others involved in a patient's care when warranted; respecting the expertise and medico-legal responsibility of all parties" (Code of Professional Responsibility, Professional Responsibility 3.3).[2] Just consider…this is possible now!

Are there some structural barriers we must overcome? Yes. Are their going to be unexpected setbacks? Absolutely. But we must start to shift our mindset to be ready to take advantage of opportunities for change when they come. Too often, and by too often I mean almost always, the biggest barrier to substantial change and progress in anything (including athletic training) is ourselves. We can no longer believe that we are healthcare providers within the sport and physical activity industry. We are healthcare providers in the healthcare industry providing services to the sport and physical activity industry. This foundational shift in mindset is the first step in opening up a world where intraprofessional collaborative practice becomes the norm, not the exception.

The benefits of intraprofessional practice may include the benefits we see with team-based care across healthcare such as improved communication and partnerships among providers and patients;[3,4] better response processes in addressing the determinants of health;[4] improved coordination of care;[3] high levels of satisfaction on healthcare delivery;[3,5] and the effective use of resources.[6] There could even be more benefits of effective intraprofessional practice in athletic training than we can imagine, due to our unique role in the healthcare industry, but we must take the first step in this change.

I'm asking each and every athletic trainer to take a moment and imagine a future of intraprofessional practice in their individual setting. What opportunities do you see? What challenges can you expect? What beliefs that you have about athletic training and your role in healthcare are limiting you AND your patients? What will you do to overcome those limiting beliefs? The responsibility is on us. To change the industry we serve, we must change our practice, and before we change our practice, we must shift our mindset. Let's shift our mindset and start imagining and have conversations about intraprofessional practice in athletic training today.

REFERENCES:

1. Registered Nurses' Association of Ontario (RNAO). Intra-professional collaborative practice among nurses: Second edition. Registered Nurses' Association of Ontario. Toronto, Ontario. 2016.
2. Board of Certification (BOC). BOC standards of professional practice: Version 3.1. Board of Certification, Inc. 2017.
3. Kates N, Ackerman S, eds. Shared mental healthcare in Canada: A compendium of current projects. Ottawa: Canadian Psychiatric Association; and Mississauga: College of Family Physicians of Canada Collaborative Working Group on Shared Mental Health. 2002.
4. Nolte J. Enhancing interdisciplinary collaboration in primary healthcare in Canada. Ottawa: Enhancing Interdisciplinary Collaboration in Primary Health Initiative. 2005.
5. Marriott A, Marble J. Sharing the learning: The health transition fund synthesis series: Primary healthcare. Ottawa: Health Canada. 2002.
6. Task Force Two. A physician human resource strategy for Canada: Innovation service

ISSN Online 2577-8188

models in Canada database. Ottawa: Government of Canada. 2005.

ISSN Online 2577-8188

Exercise Dependence and Shin Pain in a Division I Cross-Country Runner: A Case Study

Allyssa K. Memmini, MS, ATC
University of Michigan, Ann Arbor, MI

ABSTRACT

The following case investigates insidious onset of shin pain in a Division I female cross-country runner. Though her initial evaluation revealed early onset medial tibial stress syndrome, the sequence of events that occurred immediately afterwards is what makes this case unique. As the student-athlete underwent lower extremity rehabilitation to increase her mileage, she reported that her pain had plateaued. The initial x-ray revealed a periosteal reaction of the posterior left tibia. After adhering to the treatment plan for four weeks, the student-athlete continued to report significant bouts of pain as demonstrated by the Visual Analog Scale. A follow-up x-ray revealed a transverse fracture through the proximal tibia. It was discovered through teammates that she was exercising at the university's recreation center for up to three extra hours per day, despite set limitations by the athletic trainers, team physician, and coaches. Her roommate also confided in the coaching staff that there were instances of the student-athlete deliberately skipping meals, and even conducted bouts of binging and purging. The student-athlete was immediately removed from team activities and referred to the team physician, who reviewed her case and relevant medical history. Further, she was referred to additional behavioral counseling for disordered eating, obsessive compulsive tendencies, and her idealization of weight and excessive exercise. Although true exercise addiction is rare, the comorbidity rate in patients with disordered eating is clinically relevant. The Exercise Addiction Inventory is a simple and reliable questionnaire for healthcare providers to utilize during pre-participation examinations as a way of identifying athletes who may have a related medical history, and greater risk of developing comorbidities.

Key Phrases
Emotional wellness and mental health, comorbidities, college and university patient population

Correspondence
Allyssa K. Memmini, University of Michigan, 401 Washtenaw Ave. Ann Arbor, Michigan 48109
E-mail: amemmini@umich.edu

Full Citation
Memmini AK. Exercise dependence and shin pain in a division I cross country runner: a case study. *Clin Pract Athl Train.*2018;1(2):4-8.
https://doi.org/10.31622/2018/0002.2

Submitted: August 6, 2018 **Accepted**: October 4, 2018

INTRODUCTION

A Division I female cross-country runner with a previous history of depression, anorexia, and bulimia nervosa presented with increasing left proximal shin pain at the beginning of winter training. Initial evaluation revealed early-onset medial tibial stress syndrome, which was treated conservatively for two weeks with instrument assisted soft tissue mobilization, as well as intrinsic foot, gluteus medius and calf strengthening. Despite defined parameters for cross-training, in addition to daily rehabilitation and treatment, her reporting of pain remained relatively high compared to her baseline levels at the onset of medical care. As cross-country is often defined as an aesthetic sport, this student-athlete experienced episodes of body dysmorphia, depression, disordered eating habits, and even unhealthy patterns of excessive exercise. At this time, the student-athlete was referred to our team physician, nutritionist, and behavioral psychology department for further evaluation.

Patient Information

Patient: The student-athlete is a female cross-country runner (age=20years; height: 1.91m; mass: 56.9kg). She had a previous history of bilateral tibial and metatarsal stress fractures that began as a freshman in high school and occurred intermittently until her senior year of college. She was consistently meeting with a psychiatrist through the institution for episodes of anorexia nervosa and bulimia, which initially began upon arrival to campus. The student-athlete's parents were well-known ultramarathoners – sometimes running up to 80-

 ISSN Online 2577-8188

100 miles a weekend which may have added additional pressure for her success. In terms of family dynamic, she would often report a distanced relationship between herself and her father, and a heightened desire to please her parents. Although she has an extensive medical history specifically related to the female athlete triad, her parents would often minimize her injuries, such as blaming the reoccurrence of injuries on inconsistent wear of compression socks or inadequate turnover rate in her training shoes.

Differential Diagnosis and Evaluation

The student-athlete presented with left shin pain of insidious onset. She denied night pain, including difficulty falling or staying asleep, and denied antalgic gait pain during the first few steps after awakening. When asked to point where the pain resides, she was able to locate the muscle belly of the tibialis anterior. She reported that it did not replicate the same pain that she experienced previously during her numerous stress injuries. In general, she reported the most discomfort while ascending and descending staircases when her ankle was positioned in full plantarflexion. She reported no difficulty completing activities of daily living, but reported that she could only run one mile before the symptoms became bothersome. The differential diagnoses list included: chronic exertional compartment syndrome, tibialis anterior contusion, tibial stress reaction or fracture, fibular stress reaction or fracture, and medial tibial stress syndrome. With continuation of rehabilitation and controlled training parameters, her reporting of pain remained moderately high. After an additional two weeks of rehabilitation, initial x-rays confirmed a left proximal periosteal tibial stress reaction, and she was again limited in weight-bearing training. Approximately four weeks post-imaging, a follow-up x-ray revealed a complete transverse fracture through her left proximal tibia.

Body Structure and Function

Upon examination, she was tender to palpation along the muscle belly of the tibialis anterior and its insertion of the muscle onto the tibia, but did not present with edema surrounding the muscle belly, or effusion within the tibiofemoral joint. There were no other signs of trauma. A tuning fork was placed at her tibial tuberosity and along her distal tibial shaft to determine any areas of stress-related injury. She denied pain at all of the locations that the tuning fork was placed. The patient reported pain was a 4/10 measured with the Visual Analog Scale. When compared bilaterally, she demonstrated full active and passive ankle and knee ranges of motion and were all within normal limits. Manual muscle tests demonstrated weakness of the left tibialis anterior (4/5), gastrocnemius (4/5), medial hamstring (4/5) and gluteus medius (4/5). During functional testing, she was able to complete calf raises without discomfort, but noted localized pain with double leg hopping (forward/backward and side-side).

Activity and Participation

Due to her medical history, the mileage assigned for this specific student-athlete was scaled back to 30-35 miles/week, in comparison to the rest of the team, which typically completed around 60 miles. As a high school runner, she was very successful at regional and state track and field championships. When she initially arrived at the university, she presented with a significantly smaller frame than when she was first recruited, thus leading the coaching staff to believe she was suffering from some form of disordered eating or possible overtraining. She was referred to mental health counseling the following week and continued to work with counselors until her junior year of college.

Environmental and Personal Factors

She had a previous mental health history that included depression, anorexia nervosa, bulimia and most recently, suicidal ideation. The student-athlete's parents were well-known for competing

ISSN Online 2577-8188

in ultramarathons, and appeared unconcerned about the number of stress-related injuries that she had accumulated over time.

INTERVENTIONS

The physician and athletic trainers outlined a structured cross-training plan to maximally reduce the amount of force through her shins while maintaining her overall fitness. The student-athlete's adherence to the treatment plan was demonstrated by completing rehabilitation at least three times during the week. Despite consistent treatment sessions with the athletic trainers, her symptoms continued to worsen with specified training intervals. When the team physician asked her to clarify her symptom reporting, she reported lower pain thresholds compared to what she reported to her athletic trainers and coaching staff. She was to solely complete one workout per day for a maximum of 30 minutes on the bicycle, or 60 minutes in a pool setting. Her training progression would begin with aqua jogging or supervised bike workouts, and then eventually to elliptical and anti-gravity treadmill training until she became asymptomatic for at least eight weeks.

OUTCOMES

Body Structure and Function: Prior to her follow-up x-ray, she described having a "drop foot" sensation while walking to class. Subsequent evaluation demonstrated knee joint effusion and edema at the proximolateral tibia. A neurological screen of the lower quarter was completed and proved to be negative. Despite rehabilitation to strengthen her gastrocnemius and tibialis anterior, she still lacked full strength in comparison to the contralateral side (4/5 manual muscle testing).

Activity and Participation

Based on her numerous referrals, and previous physical and mental health history, the athlete ultimately decided that it was in her best interest to dismiss herself from all team activities. She was immediately removed from activity and referred to our team physician, who then referred her to mental health counseling and nutrition staff. In order to ensure that she had full potential to return to a healthy lifestyle, she had access to the same medical treatment that was available to her while actively participating on the team. Although she was no longer physically on the team, she remained active with the student-athlete community through an internship developed by the nutritional department. She volunteered her time by preparing post-practice meals, and setting up hydration stations throughout various facilities. She remained roommates with her previous teammates until her graduation the following spring.

Environmental and Personal Factors

Over the following weeks, the healthcare team was notified of the student-athlete completing numerous additional unsupervised cross-training sessions lasting between two to three hours at the university recreational center. Furthermore, the student-athlete's roommate confided in the coach that she observed her skipping multiple meals throughout the week, and was behaving similarly to previous episodes of binging and purging. Even though there were several interventions between the student-athlete, coaches, and medical staff about the importance of compliance to the physician's recommendations, she continued to complete additional workouts in secrecy.

DISCUSSION:

The literature reports an inconsistent prevalence of individuals suffering from exercise dependence (EXD), ranging from 0.3% to 77%, yet the co-occurrence rate with persons diagnosed with anorexia nervosa is three times higher than other diagnoses of disordered eating.[1-4] EXD is often described as a manifestation of uncontrollable exercise, increased tolerance, and associated anxiety/ depression with withdrawal of activity.[2-4] A

ISSN Online 2577-8188

component of EXD related to this patient specifically is continuance – the perpetuation of exercise despite comprehension of the potential to increase the physical deficits and interpersonal strains.[4] Populations commonly affected by EXD include young women, high-performance athletes, and high achievers with associated body dysmorphia.[4-6] Although this patient presented with several red flags in relation to the female athlete triad, the effects of a possible underlying diagnosis of EXD and additional bio-psychosocial disorders on her initial shin pain make this case unique.

A prominent strength in this case was the close-knit relationship between the athletic trainers, team physician, and coaching staff. By maintaining thorough communication, the entire staff was able to provide the student-athlete the help that she crucially needed. Another strength was the willingness of her teammates to discuss her irregular eating and exercise patterns with the staff. Since it was difficult to know when the patient was truthful in her responses, the advocacy of her teammates assisted in an efficient transition to referral. On the other hand, a significant limitation included minimal communication with the sports medicine staff and the mental health counseling center on campus. Since the center is located outside of the athletic department, it was difficult for the athletic trainers to communicate their concerns and any crucial updates directly to the counselors. Another limitation includes the inability to control the student-athlete's activity outside of the athletic training room and track facilities. Because she was able to walk, bike, and run anywhere on campus, she had greater capability to complete additional workouts, in contrast to someone who plays soccer or lacrosse and needs extensive equipment or teammates for activity. Lastly, there were no patient-reported outcomes tracked throughout this patient case beyond subjective pain. However, the background and psychosocial factors that influenced this case are still evident, and can help other athletic trainers understand how family and social factors influence difficult patient cases.

CLINICAL BOTTOM LINE:

Typical red flags in cases related to the female athlete triad include accelerated weight loss within a short period of time, dark and sunken orbitals, brittle nails, dissociation from team activities both on and off campus, and co-morbidities such as depression, anxiety, and obsessive-compulsive disorder. Although the diagnosis of EXD is rare, there are a number of screening tools available for clinicians to utilize for the referral process should concerning histories present themselves. The Exercise Addiction Inventory is a simple survey with significant reliability when paired with other disordered eating questionnaires.[7] Since the sports medicine staff did not utilize this scale with their current student-athletes, it is something to consider for future pre-participation screening, especially for student-athletes with relevant medical history. In general, athletic trainers should be well-educated about the long-term health risks of relative energy deficiency in sport, and employ supplemental resources when working with high-risk teams such as cross-country, volleyball, and be aware of the effects related to aesthetic sports such as gymnastics, cheerleading, and swimming on athletes' mental health and overall well-being.

ACKNOWLEDGEMENTS:

The author would like to thank all the members of the care team for their contributions, guidance, and clinical recommendations in providing care for this student-athlete.

REFERENCES:

1. Starcevic V, Khazaal Y. Relationships between behavioural addictions and psychiatric disorders: What is known and what is yet to be learned? Front Psychiatry. 2017;8:53. https://doi.org/10.3389/fpsyt.2017.0005

2. Weinstein A, Maayan G, Weinstein Y. A study on the relationship between compulsive exercise, depression and anxiety. J Behavl Addict. 2015;4(4):315-318. https://doi.org/10.1556/2006.4.2015.034
3. Egorov AY, Szabo A. The exercise paradox: An interactional model for a clearer conceptualization of exercise addiction. J Behavl Addict. 2013;2(4):199-208. https://doi.org/10.1556/JBA.2.2013.4.2
4. Freimuth M, Moniz S, Kim SR. Clarifying exercise addiction: Differential diagnosis, co-occurring disorders, and phases of addiction. Int J Environ Res Public Health. 2011;8(10):4069-4081. https://doi.org/10.3390/ijerph8104069
5. Scully D, Kremer J, Meade MM, Graham R, Dudgeon K. Physical exercise and psychological well being: A critical review. Br J Sports Med. 1998;32(2):111-120.
6. Harris N, Gee D, D'Acquisto D, Ogan D, Pritchett K. Eating disorder risk, exercise dependence, and body weight dissatisfaction among female nutrition and exercise science university majors. J Behavl Addict. 2015;4(3):206-209. https://doi.org/10.1556/2006.4.2015.029
7. Griffiths M, Szabo A, Terry A. The exercise addiction inventory: A quick and easy screening tool for health practitioners. Br J Sports Med. 2005;39(6):e30. https://doi.org/10.1136/bjsm.2004.017020

ISSN Online 2577-8188

Acute Management of an Abductor Digiti Minimi Strain in a Collegiate Baseball Player: A Patient-Centered Case Study

S. Andrew Cage, MEd, LAT, ATC[1,2], Diana M. Gallegos, MS, LAT, ATC[1], Brandon J. Warner, MEd, LAT, ATC[2,3]

[1]The University of Texas at Tyler, Tyler, TX; 2The University of North Carolina Greensboro, Greensboro, NC , [3]Grand Canyon University, Phoenix, AZ

ABSTRACT

The purpose of this disablement model case study was to describe the case of a collegiate baseball player suffering from an isolated abductor digiti minimi strain. Despite an initial decrease in function, the treating sports medicine staff was able to provide the necessary care to allow the patient to participate in the final games of his career. While the anatomy and function of abductor digiti minimi are well described in the literature, there is no documentation of isolated abductor digiti minimi injuries. In this case, the patient injured the medial aspect of his hand when hitting a baseball. The patient experienced immediate pain along with the sensation of "tightening" throughout the hypothenar eminence. The following day the patient reported difficulty with sleeping and daily activities due to pain. Although fracture tests were negative, the patient exhibited significant weakness and pain with fifth finger abduction and flexion leading to physician referral. The team physician noted pain with active ulnar deviation in addition to previous symptoms. At this time, the patient was diagnosed with an abductor digiti minimi strain. The patient stated that he was in his final season of competition and wished to continue participating with his team. The patient consented to a treatment plan involving local injection of lidocaine and bupivacaine along with compression via Kinesiology Tape®. Using these methods, the patient was able to participate in the final two games of his career. Following the cessation of baseball activities, the patient noted that he had no recurrent symptoms or complications from his injury. When prescribing treatment for patients in a competitive setting, it is paramount that clinicians take into account patient centered values. If there is no risk of significant, long term injury, clinicians should attempt to provide patients with the means to participate in activities if they should desire.

Key Phrases
Abductor digiti minimi, college and university patient population, functional testing

Correspondence
S. Andrew Cage, The University of Texas Tyler, 11325 Preakness Dr., Flint, TX 75762.
E-mail: sacage@uncg.edu

Full Citation
Cage SA, Gallegos DM, Warner BJ. Acute Management of an Abductor Digiti Minimi Strain in a Collegiate Baseball Player: A Case Study. *Clin Pract Athl Train.* 2018;1(2):9-13. https://doi.org/10.31622/2018/0002.3.

Submitted: August 16, 2018 **Accepted:** October 1, 2018

INTRODUCTION

The abductor digiti minimi is a small muscle that makes up a portion of the hypothenar eminence. Originating from the pisiform, pisohamate ligament, and flexor retinaculum, the abductor inserts on the proximal phalanx of the fifth digit as well as the sesamoid bone when present. Primarily, this muscle is responsible for the abduction of the fifth digit.[1] The muscle receives its neurological innervation from the deep branch of the ulnar nerve and vascular supply from the ulnar artery.[2] Apart from its role in fifth digit abduction, no other functions have been described for the abductor digiti minimi.

The abductor digiti minimi has been implicated in approximately a quarter of the cases of Dupuytren's contracture of the hand.[3] In some cases, this compression of the ulnar nerve can be caused by the presence of an accessory abductor digiti minimi muscle.[4] In spite of the abductor digiti minimi's involvement in ulnar nerve pathologies, there is no peer reviewed literature describing an isolated injury to the abductor digiti minimi.[3,4] Furthermore, without a body of literature, it is difficult to create an evidence based approach to treating these injuries and the subsequent dysfunctions that occur. Thus, it is the purpose of this case study to describe an isolated abductor digiti minimi in a collegiate baseball player. This case will describe the mechanism of injury, diagnosis, treatment, patient reported disablements, and outcomes.

Patient Information

The patient described in this case is a right 22-year-old collegiate baseball player who fielded the shortstop position. When playing, the patient would throw right-handed and bat left-handed. The patient had a previous history of surgical excision of the hook of the hamate in his right hand from the previous year, but was otherwise healthy and fully functional. After hitting a baseball during competition, the patient reported immediate pain along the medial aspect of his right hand. Initial evaluation revealed moderate pain, but full strength and range of motion with all wrist and digit motions. For the remainder of the game, the patient was able to participate at full capacity, but was instructed to report to the athletic training staff the following day.

Differential Diagnosis and Evaluation

The following day, the patient reported to the athletic training clinic complaining of increased pain. The patient stated that the pain had disrupted his sleep, made it difficult to turn the steering wheel of his car while driving to the clinic, and was significantly worse than the previous day. The patient's hand was diffusely tender to palpation along the medial aspect of the hypothenar eminence. While all fracture tests were negative, the patient presented with enough pain and weakness with fifth digit abduction and grip strength that physician referral was warranted. At this time, the differential diagnosis included: TFCC injury, Wrist Sprain, Wrist Strain, Subluxing Extensor Carpi Ulnaris.

Two days after the initial injury during the team physician's evaluation, it was also noted that the patient was experiencing pain with ulnar deviation. However, the most explicit pain and weakness was elicited with resisted fifth digit abduction. Following a comprehensive exam, the patient was diagnosed with an abductor digiti minimi strain. It was at this time that the patient expressed his concern regarding his ability to participate in the upcoming tournament. His concern were compounded by the fact that he was in his last year of eligibility, and the upcoming tournament represented his last opportunity to participate in collegiate baseball.

With the patient's desires and values in mind, treatment options were discussed, and the patient was educated on the potential outcomes of all of them. Given that other conservative treatment options would have resulted in a significant delay in returning to competition, the decision was ultimately made to perform local injections of lidocaine and bupivacaine at the insertion of the abductor digiti minimi prior to the upcoming competitions in addition to being taped to provide as much compression as possible without inhibiting function (**Figure 1**). Kinesiology Tape® was chosen to allow the patient the most range of motion possible at the wrist while also providing compression. A first strip of tape was cut and then applied over the medial aspect of the hypothenar eminence with 50 % tension. A second strip of tape was split half way, with the anchor covering the ulnar styloid. Once the anchor was affixed, the split ends of the tape were then wrapped around the wrist medial to lateral in an effort to provide as much compression as possible without occluding neurovascular structures.

Body Structure and Function

Given that the injury was muscular in nature, the primary diagnostic tools utilized were strength and range of motion tests. At the initial time of injury, the patient presented with full range of motion and adequate wrist and digit strength with only mild pain. However, by the following day, the patient's strength with fifth digit abduction had decreased to a 4/5. The patient was still able to perform ulnar deviation with full

Figure 1: Compression tape for digiti mini strain.

strength, but noted increased pain from the previous day. Additionally, the patient could no longer perform the motion without experiencing significant pain.

Activity and Participation

In order to determine if the patient would be able to participate in the upcoming games, functional testing was performed consisting of hitting and throwing drills prior to the initiation of interventions. With the decrease in strength and increase in pain, the patient began to experience difficulty gripping his bat and throwing with both accuracy and velocity. If the patient decreased his velocity he could throw more accurately, but he expressed concern that this may affect his ability to remain competitive at his position. The patient stated that he believed that he would be able to improve both the accuracy and velocity of his throws if his pain levels were decreased.

Environmental and Personal Factors

Outside of baseball related activities, the patient stated that the pain he was experiencing in his hand was affecting his daily activities. Specifically, the patient stated that the intensity of pain inhibited his ability to obtain quality sleep and drive his motor vehicle. Other activities that the patient's hand pain affected included being able to type on his computer. The patient reported having to change his typing form in order to mitigate the intensity of pain he was experiencing. This change in form resulted in the patient's homework assignment taking significantly longer than it would have otherwise. Given the inconveniences created for the patient's in his collegiate activities and in his daily life, he wished for his injury to be healed as quickly as possible

INTERVENTIONS

Three days post injury, the patient was seen in the athletic training room prior to his first postseason competition. The patient's skin was prepped using an alcohol prep pad, and a mixture of lidocaine and bupivacaine was injected near the proximal aspect of the hypothenar eminence. Two strips of Kinesiology Tape® were then used to provide as much compression as possible without impeding wrist or hand motion. While this technique had not necessarily been described in the current literature, the clinician used knowledge of the structures being taped and the principles behind compression tape to approximate the best tape job possible for the goals in mind. Follow up evaluation revealed that the patient did not experience any further pain at rest, or with motion, and demonstrated full strength with fifth digit abduction and grip strength. The patient was then taken to the field to ensure that he would be able to grip and swing a bat, and grip and throw a baseball. After demonstrating the ability to swing a bat without pain, the patient then hit off of a tee to provide resistance to his swing. Once the patient had passed this sport-specific testing, the patient was cleared to participate in the day's competition.

OUTCOMES

Body Structure and Function

The patient was able to regain fifth finger abduction, wrist ulnar deviation, and grip strength after the application of lidocaine and bupivacaine injections in combination with compression taping at the proximal aspect of the hypothenar eminence. Along with the recovered strength, the patient noted that there was little to no pain for roughly three hours post injection. However, after the three hour time frame had elapsed, his pain gradually increased again. When asked, the patient said this period of relatively pain-free activity was enough to allow him to comfortably and effectively participate in his competitions at full function.

Activity and Participation

Through the use of the proposed treatment plan, the patient was able to participate in the final two contests of his career. While participating, the patient was able to perform at a high level and maintain the standard of performance he had throughout the season. The patient noted that if any of the competitions had gone longer than their regulation length, he may have had increased difficulty in completing in them, but had no severe issues completing a standard game.

Aside from baseball, both sleeping and activities of daily living that required gripping or fifth digit abduction continued to bother him. If the injury had taken place during the regular season, the patient may have required considerations from his instructors regarding completion of course work that required a large amount of typing or writing. Fortunately, the academic year had concluded by this point in the season, and the patient was not required to perform extensive writing or typing that might have exacerbated the symptoms of his injury. Within a week of completing his final season, the patient reported significant decreases in pain following relative rest combined with regular icing and NSAID usage, and was pain free by the two-week mark.

Environmental and Personal Factors

Given the patient's expressed desire to participate in the final competitions of his playing career, he remained stringently adherent to all appointments and measures taken to allow him to participate. While the patient reported a slight increase in pain from baseline following each of the two competitions, he stated that is was well within tolerable limits if it meant he was allowed to continue to play. Furthermore, the patient was not allergic to lidocaine, bupivacaine, or the adhesive from the Kinesiology Tape®. As such, the patient suffered from no adverse effects from the chosen treatment course.

DISCUSSION

This case describes the diagnosis and management of a patient suffering from an isolated abductor digiti minimi strain. While the abductor digiti minimi's involvement in other pathologies has been described, there is no documentation detailing strains to the muscle and the treatment thereof.[3,4] Fortunately, this case resulted in a positive outcome for the patient which allowed him to achieve his goals. However, the short timeframe did not allow for a measurement of progression of the injury while continuing participation in baseball. Had this injury occurred at a different phase of the season, the clinician would have been able to attempt other conservative treatments and chart the progression of the patient's outcomes in order to determine the best possible course of treatment in future instances. This means that the case presented may not be generalizable for clinicians seeking to care for a patient with a similar injury over a longer course of time. Further research is required to determine the best practices for managing an acutely strained abductor digiti minimi in a patient who requires above average dexterity to complete their daily activities.

Overall, the choice of intervention (i.e. local anesthetic injection and compression taping) was chosen due to the short timeframe in which the patient had to recover from his injury. Had the patient had prospects of playing past the current season, there may have been other considerations when determining the course of treatment. Additionally, if the patient had been required to continue typing for his academic work there may have been a need for other interventions, including discussions with instructors of alternate methods for the patient to complete his assignments. Ultimately, the patient's symptoms were able to resolve with cessation of activity, and no adverse outcomes were reported.

CLINICAL BOTTOM LINE

Within the scope of clinical practice, it is entirely possible for clinicians to encounter injuries and conditions that are not well described in the literature. In these instances, clinicians must rely on their expertise along with patient-reported measures and values. When relying on these facets of clinical care, evaluation and re-evaluation of the clinician's treatment and rehabilitation plan are crucial to achieving optimal patient outcomes. When prescribing a course of treatment for patients in a competitive setting, it is paramount that clinicians take into account patient-centered values. While the goal of clinicians should be to provide patient-centered care, they must also incorporate patient education as much as possible. By providing a patient with as much information as possible regarding potential outcomes of a chosen treatment program, the clinician can hopefully mitigate at least some of the potential conflicts of interest that may occur in such a scenario. If there is no risk of significant, long-term injury, clinicians should attempt to provide patients with the means to participate in activities if they should desire.

REFERENCES:

1. Schmidt UL. *Surgical Anatomy of the Hand*. 1st ed. New York, NY: Thieme Medical Publishers, Inc; 2003.
2. Usyal AC, Alagoz MS, Tuccar E, Sensoz O, Tekdemir I. The vascular anatomy of the abductor digiti minimi and the flexor digitorum brevis muscles. *J Hand Surg Am*. 2005;30(1):172-176. https://doi.org/10.1016/j.jhsa.2004.06.001
3. Meathrel KE, Thoma A. Abductor digiti minimi involvement in Dupuytren's contracture of the small finger. *J Hand Surg Am*. 2004;29(3):510-513. https://doi.org/10.1016/j.jhsa.2004.01.016
4. Al-Qattan MM. Ulnar nerve compression at the wrist by the accessory abductor digiti minimi muscle: wrist trauma as a precipitating factor. *J Hand Surg*. 2004;9(1):79-82. https://doi.org/10.1142/S0218810404001899

Guidelines to Useful Integration of Patient-Rated Outcome Measures into Clinical Practice

Skye Livermore-Brasher, MPA, AT[1]; Russell Baker, PhD, DAT, MS, AT[1]; Alan Nasypany, Ed.D., M.Ed., AT[1]; and Scott Cheatham, Ph.D., DPT, LPT, ATC[2]

[1]The University of Idaho, Moscow, ID; [2]California State University Dominguez Hills, Carson, CA

Key Phrases
Patient-reported outcomes, patient education, policy and procedure development

Correspondence
Skye Livermore-Brasher, University of Idaho, 407 Lumpkin St., Fort Benning, GA 301905.
E-mail: skyelivermore123@hotmail.com

Full Citation
Livermore-Brasher S, Baker R, Nasypany A, Cheatham S. Guidelines to Useful Integration of Patient-Rated Outcome Measures into Clinical Practice. *Clin Pract Athl Train.* 2018;1(2):14-30.
https://doi.org/10.31622/2018/0002.4

Submitted: July 24, 2018 **Accepted**: October 17, 2018

COMMENTARY

Outcome measures gauge intervention effectiveness in an evidence-based, patient-centered practice. Patient-rated outcomes (PROs) are tools to measure the perceived effectiveness of a clinician's practice, while serving as instruments to improve clinician-patient communication and health-related quality of life (HRQoL).[1,2,3] While clinicians may recognize the importance of PRO usage in practice, adoption into practice can be perceived to be burdensome. In one study, only 26% of the sample of athletic trainers used PRO measures regularly in practice.[4] The assortment, variation, and abundance of available measures can be defeating to a clinician who is a novice at utilizing PROs. Clinicians may lack knowledge regarding PRO usage and interpretation, and may struggle with developing the habit of using the instruments in practice. Furthermore, they may lack an understanding of how to interpret PROs for their unique patient populations. The purpose of this paper is to introduce and discuss valid PROs that can be used easily across most athletic training patient populations, and to present a model to begin implementing the use of these PROs in practice.

PATIENT-CENTERED CARE

Outcome measures are an essential part of whole-person care, "comprehensive care that considers and addresses all aspects of disability, from the impairment of body structures and functions to activity limitations and participation restrictions."[4] Outcome measure collection is a crucial aspect of patient-centered care for several reasons. First, for individual patients, using outcome measures provides means for patient-clinician communication about HRQoL factors beyond primary complaint, such as social and economic well-being.[1] Clinicians may become aware of information about symptoms not discussed during the history, symptoms whose severity was downplayed, or symptoms which are difficult to discuss.[3] Secondly, outcome measure collection can be used to investigate the effectiveness and efficacy of clinical care by individual healthcare practitioners, clinics, programs, or hospitals, and particular treatments and interventions.[1] Finally, outcome measure collection improves quality,[1] evaluating and making changes in clinical care,[1] and determining the effects of translational research into practice.[5]

While athletic training clinicians are already adept at gathering clinician-oriented outcome measures such as range of motion and manual muscle testing, researchers and educators urge clinicians to begin collecting PRO measures.[4] Generic patient-rated outcome measures address a broad range of health concepts, focus on HRQoL, and cover a wide variety of health domains.[6] Patient-rated outcomes can also be specific measures, such as region-specific (ankle, shoulder), disease specific (migraines, asthma), or

 ISSN Online 2577-8188

dimension-specific (pain, fear avoidance) instruments.[6] Patient-rated outcomes provide the patient perspective and a valuable indication of the effects of the patient's condition on HRQoL.[4] Benefits to PRO use include providing information central to patient-oriented evidence that matters (POEM), advancing the athletic training profession, and enabling evidence-based athletic training practice.[6] Patients' perceptions of improvement or perceived degree of change may exert an important influence on reports of satisfaction of care.[7] Clinicians may use data generated by PRO measures along with clinician-rated measures such as range of motion and strength tests as part of an overall clinical outcomes management plan to assess their clinical care and improve their athletic training practice.[2,6,8] These benefits support the immediate adoption of PROs into clinical use.

The general population of athletic trainers, however, has thus far failed to adopt PROs in practice. Valier et al. reported that 74% (n=311) of athletic trainers who completed a survey about PRO use in practice (n=421) indicated they did not use PRO measures.[4] This finding is similar to trends in other rehabilitation professions. Nicholas et al. reported that 52% of clinicians failed to record standardized outcome measures at discharge during a 12-month mandatory reporting period.[9] Barriers identified in the implementation and use of PROs include confusing to the patient, time-consuming for the clinician, and lack of clinician knowledge.[9] The large variety and different classifications of PROs is one reason why PRO use is burdensome to clinicians in routine practice.[6]

EVALUATING THE UTILITY OF A PATIENT-RATED OUTCOME MEASURE

Two elements of a PRO to consider before implementing a specific measure in practice are essential elements and clinical utility.[8] Essential elements involve psychometric measures of the soundness of the instrument and its development.[8] Psychometrics and clinimetrics are the methodologies used to develop and evaluate instruments such as PROs (Table 1).[10] These methodologies are evaluated for a PRO for a wide range of conditions, because the instrument may respond differently in varying populations with varying severity. Two important types of validity are content validity, the extent items in the instrument assess the same content, and construct validity, how well the instrument measures a theoretical construct.[9] Reliability is a measure of consistency under repetition of constant conditions.[11-13] Responsiveness is a measure of how well the instrument measures change over time.[12,13] Clinical utility involves the acceptability, feasibility, and appropriateness of using the PRO in clinical practice.[8] The clinician must determine if the instrument is useful, time- and cost-effective, and acceptable to both himself and the patient.[8] Clinicians use the minimal clinically important difference (MCID) to measure change. The MCID is a threshold value for change that a patient considers worthwhile and meaningful.[14] For example, the MCID for the numeric pain rating scale (NRS) is generally considered to be 2 points on a scale from 0 (no pain) to 10 (worst imaginable pain). Once a PRO has been selected that meets both the essential elements and the clinical utility, the implementation into practice becomes easier.

GENERIC PATIENT-RATED OUTCOME MEASURES

When clinicians decide to incorporate PROs into practice, setbacks may arise in difficulty choosing which measures to use. The sheer number of available instruments may leave the clinician feeling overwhelmed before beginning. A good starting place for the novice PRO user is generic measures because they are designed to be appropriate to a wide range of patients.[18] Generic patient-rated outcome measures are defined as "scales intended to measure a broad range of health status facets."[6] Benefits to generic PROs include applicability to a wide range of patients, ability to compare across groups, and the establishment of normative values within practice.[6] Generic PROs provide the athletic trainer information about both individual patient

 ISSN Online 2577-8188

Table 1. Psychometric Measures in Patient-Rated Outcome Scales

Psychometric Measure	Definition	
Validity	The soundness or correctness of an instrument in measuring what it is designed to measure[8,10,11,15-18] Does it measure what it is supposed to measure?	Must be established for each target population[8] Correlation Coefficient Values:[19] -1.0: Perfectly negative correlation -0.8: Strongly negative correlation -0.5: Moderately negative correlation -0.2: Weakly negative correlation 0.0: No association +0.2: Weakly positive correlation +0.5: Moderately positive correlation +0.8: Strongly positive correlation +1.0: Perfectly positive correlation
Content Validity	The extent to which the items on a measure assess the same content, or how well the content material was sampled[8,10, 18,20,21] Do experts/patients think it measures what it is intended to measure? Has it been tested on a large enough sample population?	May be evaluated by expert panel and/or patients[8,10]
Criterion Validity	The extent to which a statistically significant relationship exists between the measure and a criterion[15,18] Does it correspond with a "gold standard" measure?	Gold standards are difficult to find for PROs because there is wide variation[8,10] Often evaluated in comparison with other PROs or clinical data[22]
Construct Validity	The extent to which a measure evaluates the theoretical construct or trait[8,10,17,18,20] If it is intended to measure a particular construct (e.g. pain, function), is that what it measures?	Must be established for each population[8]
Reliability	The measure of consistency of date when measurements are taken more than once under the same conditions[8,15, 17,18,20] If nothing has changed in the patient's condition, is the score the same from one point to another?	Establishes that changes observed are due to intervention and not problems with the instrument[18] Reliability Ranges:[23] 0.00-0.10: Virtually no reliability 0.11-0.40: Slight reliability 0.41-0.60: Fair reliability 0.61-0.80: Moderate reliability 0.81-1.0: Substantial reliability
Test-Retest Reliability	The reliability of a patient's response when the instrument is administered multiple times[24] If a patient's health status does not change, will the answers remain the same?	Reflects patient's condition rather than instrument error[8,18,24]

Table 1. Psychometric Measures in Patient-Rated Outcome Scales (Continued)

Internal Consistency	The reliability of the items within the scale[8,18,24] Do all items in the instrument measure the same health domain?	Homogeneity of the questions related to a specific health domain[8]
Responsiveness	The instrument's ability to detect change over time[7,15,16,20, 21,25] Does it measure change? If no change occurs, does it remain static?	Instrument must detect changes over time that matter to patients[18] Can be measured statistically or clinically[8]
Standard Error of Measurement (SEM)	The variation in score due to error rather than true observed change[8, 11,14] How much change is due to error?	Point values associated with scale[8]
Minimal Detectable Change (MDC)	The smallest change that can be measured above that which would occur due to error[8,11,20,26,27] How much change is due to genuine change?	Point values associated with scale[8]
Minimal Clinically Important Change (MCID)	A threshold value representing change that is considered meaningful and worthwhile by the patient[8,14,20,24,28,29] What amount of change is meaningful to the patient?	Point values associated with scale[8] Important because clinical measures of improvement are not necessarily meaningful to patients, or may not correspond to patients' perception of improvement or deterioration[14]

care and overall practice trends.[8] Disadvantages include information without sufficient detail to assess specific patient condition, lack of relevancy to some conditions, and less sensitivity to change from an intervention than specific scales.[6] Commonly used generic PROs are the Short-form Health Survey, Sickness Impact Profile, Child Health Questionnaire, and Pediatrics Outcomes Data Collection Instrument.[6]

Several PROs are applicable in the athletic training setting. The numeric pain rating scale (NRS) is commonly collected during history intake in practice, and can be used as a PRO.[30] The global rating of change (GRoC) is another easy-to-implement scale that can be adopted into practice.[22,31] Further, two generic scales may be useful in athletic training because they were designed for physically active populations experiencing musculoskeletal injuries: the Patient-Specific Functional Scale (PSFS)[32] and the Disablement in the Physically Active scale (DPAS).[24] These generic PRO measures may be used individually or in conjunction to increase the clinician's understanding of the patient's functional status, disablement, and HRQoL.

FOUR GENERIC PATIENT-RATED OUTCOME MEASURES TO CONSIDER IN PRACTICE:

Numeric Pain Rating Scale (Table 2)

Pain is one of the primary reasons patients seek medical attention.[15,30] Each patient presents with a different pain experience that is complete and multidimensional,[15] and the clinician cannot compare the meaning of one person's pain to another.[33] The NRS can be used to compare the intensity of pain from one time point to another. The NRS is an 11-point scale with no pain as its lower anchor (0) and worst pain imaginable as its upper anchor (10).[15,17,30,33-43] The numeric values lack word assignment, allowing each patient to assign importance at each level based on life experience and interpretation.[33] The clinician can establish a time frame when asking the patient to rate pain, such as best, worst, current, at onset, on average, during the last 24 hours, on average during the past 2 days, etc.[15,30,33] A reduction of score by any patient indicates improvement.[33] In athletic training practice, the NRS may be used to evaluate immediate changes in the patient's pain from before to after intervention as well as over the duration of care for a particular injury or illness.

Global Rating of Change Scale (Table 3, Appendix 1[22])

Health-related quality of life (HRQoL) may be difficult to measure as a multifaceted construct. The GRoC is a quick and simple scale used to measure self-perceived change in HQoL.[31] Unlike other outcome measures which are designed to evaluate a specific dimension of health such as

Table 2: Psychometrics for Numeric Pain Rating Scale (NPRS).

PURPOSE	Measure perceived intensity of pain[15,30,36,37]
GENERAL DESCRIPTION	11-point interval scale ranging from no pain to worst pain imaginable[15,17,30,36,38]
METHOD OF COLLECTION	Verbal[38]
TEST-RETEST RELIABILITY (Intraclass correlation coefficient 2,1)	Fair reliability: 0.59[44] Moderate reliability: 0.63 for last 24 hours, 0.70 for 2-day average [35] 0.63, CI95%:0.28-0.86[45] 0.74[17] Substantial reliability: 0.92[25]
VALIDITY (Spearman's R)	0.74, p<0.001: High validity[34] (Strong positive correlation)
SEM	1.07 (90%CI)[17] 0.86 (95%CI)[25] 1.5 (95% CI: 1.3-1.6) 24 hours; 1.3 (95% CI: 1.1-1.4) 2 day[35] 1.7 (unchanged condition), 1.8 (minimum change in condition)[44] 1.453 Back and buttock, 1.58 Thigh and leg [46]
MDC	2.5[17] 2.4[25] 3.5 (31%) 24 hours; 3.0 (27.3%) 2 day[35] 4.1[44] 3.69 Thigh and leg, 3.39 Back and buttock[46]
Minimum Clinically Important Difference	
Low Back Pain	4.0[25] 2.0[41] 1.0[47]
Shoulder Pain	1.1[17] 2.2[39]
Patellofemoral Pain	1.2[40]
Acute Pain	1.3[37] 1.4[38]
Fibromyalsia Pain	2.1[43]
Cervical Radiculopathy	2.2[44]
Average MCID (from these studies) is 1.5	
MCID for clinical use (based on these studies): 2.0	

Table 3: Psychometrics for Global Rating of Change (GROC) Scale

PURPOSE	Measure overall health status based on what is important to the patient[22,31]
GENERAL DESCRIPTION	Recall-based questionnaire of well-being based on progress since initial treatment encounter[22,48] 15-point scale ranging from "a very great deal worse" (-7) to "a very great deal better" (+7)[22,48] *May also use 11-point scale (-5 to +5)[22]
ANTICIPATED TEST LENGTH	Seconds
NUMBER OF ITEMS	One item[22,31,48]
METHOD OF COLLECTION	Verbal,[22] paper,[22] electronic
TEST-RETEST RELIABILITY (Intraclass correlation coefficient 2,1)	Substantial reliability: 0.90, CI95%:0.84-0.93 for 11-point scale[16]
VALIDITY (Spearman's correlation)	0.72, p<.05 for 15-point scale[16] 0.87 for 7-point scale[50] (Strong positive correlation)
SEM	None reported
MDC	.45 on 11-point scale[22]
Minimum Clinically Important Difference **MCID for clinical use: 2**[22]	

pain or function, the GRoC allows patients to provide a global rating of their overall health status by choosing what is most important to them.[22] The GRoC consists of a single question requesting the patients to assess their change on a designated scale from a previous time point to the current time point.[13,14,48,49] Various numeric scales (i.e., 7-, 11-, and 15-point scales) have been used in research.[31] Based on clinometric properties, there isn't a difference in responsiveness among the different point scales; however, the 11-point scale may be easiest to use in clinical practice because it aligns with the 11-point NRS and has similar values (e.g. MDC and MCID) to the NRS.[22] There are indications that recall bias, i.e. inability to recall the initial status after a period, affects the accuracy of the GRoC.[13,14,48,49] The GRoC can be meaningful in the athletic training setting when used in conjunction with other generic and regional PROs

Patient-Specific Functional Scale (Table 4, Appendix 2[32])

Stratford et al.[32] developed the PSFS in 1995 to provide a resolution to the following problems they observed in the implementation of PROs in orthopedic practice. First, clinicians' caseloads were too varied to support the use of any one, two, or multiple questionnaires.[33] Secondly, traditional health status measures lacked adeptness at providing valid assessment for patients functioning at a high level of independence.[32] Finally, available measures of improvement did not necessarily emphasize the patient's concept of improvement over that of clinician perceived improvement.[32] The PSFS is a self-reported, patient-specific measure designed to assess functional change primarily for patients suffering from musculoskeletal disorders.[20]

The format of the PSFS is simple and easy to administer. Patients identify 3-5 important activities that they are unable to perform or with which they are having difficulty due to their injury.[32] Each activity is rated from 0-10 regarding the current level of difficulty, with the lower anchor (0) indicating that the patient is "unable to perform activity" and the upper anchor (10) indicating an ability "to perform activity at pre-injury level."[32] The PSFS is administered before intervention occurs to maximize focus on functional activity instead of impairment.[51] Post-intervention, the PSFS may be re-administered, and the identified activities may be used throughout the treatment duration to assess change.[33] However, the patient may nominate new activities that arise when completing the PSFS during follow-up visits.[32] The structure of the PSFS renders it extremely adaptable to the patient's

Table 4: Psychometrics for Patient Specific Functional Scale (PSFS).

PURPOSE	Determine functional activities most important to an individual patient with associated rating of difficulty[20,52-55]
GENERAL DESCRIPTION	11-point interval scale rating patient-specified functional activities from 0 (unable to perform activity) to 10 (can perform fully)[32,52-54]
ANTICIPATED TEST LENGTH	2-6 minutes[51,55]
NUMBER OF ITEMS	Patient-dependent (3-5 activities chosen by the patient) [20,32,55]
METHOD OF COLLECTION	Written[32,55]
TEST-RETEST RELIABILITY (Intraclass correlation coefficient 2,1)	Slight reliability: 0.17 (average)[44] Fair reliability: 0.59, CI95%:0.23-0.81[46] Moderate reliability: 0.71, CI95%:0.51-0.84[53] 0.73, CI:0.49-0.86 (Individual Activity 1), 0.75 CI:0.56-0.87 (Individual Activity 2)[56] Substantial reliability: 0.82, CI95%:0.54-0.93[45] 0.84, CI95%:0.78-0.88[51] 0.86, CI:0.74-0.93 (Individual Activity 3)[56] 0.87, CI95%:0.72-0.94[57] 0.91, $p<0.05$[25] 0.92, CI95%(lower limit):0.78 (average), 0.91, CI95%(lower limit):0.77 (Individual Activities)[58] 0.97[32]
VALIDITY (Pearson's R)	0.77, CI95%:0.61-0.89, $p<0.002$[51] (Strong positive correlation)
SEM	0.5[25] 0.41[32] 1.5[45] 1.03[46] 1.3, CI90% (individual activity); 0.62, CI90% (average score)[51] 0.35[57]
MDC	1.4[25] 3.3, CI90% (average)[44] 2.1[45] 3.4[46] 2.5 (individual activity); 1.5 (average score)[51] 2.9, CI95%:1.7-4.2[53] 0.97[57] 2.0 (individual activity)[58]
Minimum Clinically Important Difference (all reported on average score)	
Low Back Pain	2.3[25]
Cervical Radiculopathy	2.2[44] 2.0 (Sensitivity 0.95, CI95%:0.77-0.92, Specificity 1.0, CI95%:0.82-1.0)[45]
Spinal Stenosis	1.3[46]
Upper Extremity	1.2 (Sensitivity 0.88, Specificity 0.79)[53]
Shoulder Complaint	1.29[57]
Musculoskeletal Injuries	1.3, 2.3, 2.7 (small, medium, large change)[59]
Average MCID (for average score based on these studies) is 2.1 **MCID for clinical use (based on Stratford's original report): 2.0 average score; 3.0 for single activity score**[32,55]	

 ISSN Online 2577-8188

needs and priorities, further enhancing its applicability in athletic training practice. To be effective in improving patient care, PSFS scores from follow-up visits are compared to those on the initial administration of the scale.

Disablement in the Physically Active Scale (Table 5, Appendix 3[24])

The Disablement in the Physically Active (DPA) scale was developed by athletic training researchers and is "derived from a disablement framework that includes measures of impairment, functional limitations, and disability."[24] The scale is multidimensional, incorporating measures that evaluate impairments, functional limitations, and disability.[24] The DPA scale has enhanced value because it includes psychosocial measures.[24] The DPA scale is an excellent tool to begin use of outcome measurement in clinical practice because it was developed specifically for and by athletic trainers. The format of the scale involves 16 questions.[24] Questions are rated on a scale of 1-5, where 1 indicates that the patient does not have this problem and 5 indicates that the patient is severely affected by this problem.[24] Scores for each question are added, then 16 is subtracted; thus the total score can range from 0-64 where 0 indicates no dysfunction and 64 indicates severe dysfunction.[24]

PRACTICAL USE OF PATIENT-RATED OUTCOME MEASURES

Hankemeier et al.[61] investigated the use of PROs in athletic training practice, finding that most respondents were unfamiliar with various PRO measures and rarely implemented them in practice. Their results were consistent with those of Valier et al,[4] who reported that 26% of the athletic trainers responding incorporated PRO measures in patient care. Hankemeier et al.[61] proposed increased knowledge, behavioral change, organizational support, and professional responsibility to increase the use of PROs in athletic training practice. A central factor in the adoption of PROs in clinical practice is the intention to do so; the willingness and effort clinicians plan to exert.[62] One method to increase knowledge about PROs is the publication of

Table 5. Psychometrics for Disablement in the Physically Active (DPA) Scale.

PURPOSE	Generic measure of health used in the evaluation of physically active individuals with musculoskeletal injuries measuring impairment, functional limitations, disability, and quality of life[24,26,60]
GENERAL DESCRIPTION	6-item instrument with each response based on a 5-point Likert scale from 1 (no problem) to 5 (severe). Once scored, 16 points are subtracted from total score. Score ranges from 0 to 64, with higher scores representing lower levels of HRQoL status[24,26,60]
METHOD OF COLLECTION	Written[24,26,27, 60]
TEST-RETEST RELIABILITY (Intraclass correlation coefficient 2,1)	Moderate reliability: 0.79[26] Substantial reliability: 0.94, CI95%:0.89-0.97[24]
VALIDITY (Pearson correlation)	-0.75, $p<0.001$ (acute injuries)[24] -0.71, $p<0.002$ (persistent injuries)[24] (Strong negative correlation)
SEM	4.5[26]
MDC	12.48[26]
Minimum Clinically Important Difference	
Acute Injuries	9[24]
Persistent injuries	6[24]
MCID for clinical use based on Vela & Denegar, 2010: 6 for persistent injuries, 9 for acute injuries[24]	

easyto-use and read guidelines regarding specific PRO measures. These publications may reduce clinicians' burden in researching measures to use. Clinicians may be more likely to adopt the use of PROs in practice if they perceive a professional obligation to do so.[62] Employer requirements, as well as National Athletic Trainers' Association position statements, may help increase PRO collection in practice.[61] Step-by-step guidelines to ease the adoption of PROs into use is necessary to support behavior change as well as knowledge.

One practical guideline for adopting PROs into practice is to use measures that most likely reflect the effects of the athletic training intervention.[63] The NRS, a measurement of pain intensity, is routinely collected during history and can easily be transformed into an outcome measure by asking for NRS scores after intervention and across subsequent patient encounters. The PSFS scale to assess function can be adopted into the history portion of evaluation, then re-administered after intervention and subsequent encounters. The clinician can use NRS and PSFS scores together to form a multifaceted understanding of the patient's pain and function. After intervention, the GRoC is administered to gain understanding of the patient's experienced change. Although all three of these measures can be printed to add to the patient's file, they do not require pen and paper and are therefore easily administered during on-field evaluations, as well as in a clinic-based setting. The DPAS does require pen and paper, and can be administered while the clinician is preparing for the evaluation, then administered at regular intervals during the patient's rehabilitation progression. Overall, the administrative burden in using these PROs is low. (See Table 6 for advantages and disadvantages of each PRO listed.)

The following steps may be taken to adopt these PROs into clinical use:

1. When possible, incorporate PROs into electronic health record (EHR) platforms to save time and improve direct care. [2,67] Some scales have not been validated for electronic use and scores may vary between paper and electronic versions, so clinicians who chose to incorporate PROs into electronic format must switch between formats for a given patient.
2. Use patient portals, tablets, or clinician terminals to collect PROs such as the DPAS before a visit or before beginning evaluation,[2,67] or have pen and paper versions available at check in. Alternatively, DPAS forms may be kept with evaluation form, SOAP notes, or near regularly used evaluation tools (e.g. goniometers).
3. Use the most actionable, relevant PROs with fewer than 30 questions.[67] Together, the NRS (current, best, worst, average), PSFS (3-5 specific activities), DPAS (16 questions), and GRoC (1 question) include no more than 26 questions, most of which can be collected during the routine history.
4. Incorporate NRS scores (best, worst, average, current) and PSFS scores into standard evaluation and rehabilitation documents (e.g. flow sheets).
5. Make the PROs relevant to the patient by reviewing the patient's responses in real time and asking follow up questions as part of the evaluation. [2,67]
6. Create a sheet with MCIDs for all four PROs or print out accompanying tables.
7. Evaluate patient flow through the athletic training clinic for each clinician to identify key personnel involved in and appropriate timing for the administration of PROs.[2,3] When all staff members are committed to the collection of PROs, they can work together to determine the best point of collection, analysis, and integration into patient encounters.[3]

PRACTICE IMPLICATIONS

The consensus in the literature indicates each of these PRO measures may be used in conjunction with other generic measures as well as specific measures related to the patient's injury. Both the DPAS and the PSFS are developed specifically for the patient population treated by athletic trainers and are therefore most applicable.

As novice PRO users adopt these measures into their practice, individual patient care will likely improve as they become more competent and comfortable with their use. Clinicians may improve their practice using the information gleaned in regular PRO measurement. Once the athletic trainer becomes adept at the use of these generic measures, more specific measures may be integrated as appropriate.

Table 6: Advantages and Disadvantages of Specific Generic PROs.

	ADVANTAGES	**DISADVANTAGES**
NRS	Commonly used[15,17,33] Simple to score[15,34,37] Quick[38] Easy to administer and record[15,30,34,36-38] Individuals who are older or less literate, or have sustained trauma or lack intact motor skills, can easily complete the scale[35,36,38]	Only measures one dimension (intensity) of a multifaceted, complex, and contextual symptom[15,30] Has less ability to detect change than self-reported functional measures[35]
GRoC	Quick[22] Applicable to wide ranges of patient populations[22] Easy to understand[22] Strong clinical relevance[22] Adaptable[22,31] Measures deterioration as well as improvement[22]	Relies on patient's estimates of previous health status[22,31,48] Patients may demonstrate recall bias (basing previous health status on current status)[22,31,48] Scores may fluctuate with repeated measure[48] Only correlated to functional measures up to 3 weeks[48]
PSFS	Patient specific[20,32, 51,55,64] Fast and Efficient[20,51,55] Easy to use[20,32,65] Able to assess important change over time[32] Formalizes questions asked during routine evaluation[32,66] Aids clinicians in planning treatments and evaluating progress[51,55,64] Applicable to a variety of clinical presentations and demographic populations[58]	Difficult to compare between patients[20,53,54,58] Little range available on the scale for patient to describe decreased ability when condition deteriorates[51]
DPAS	Specifically designed for use among the physically active[24, 27,26,60] Includes 4 important dimensions of HRQoL (impairment, functional limitations, disability, quality of life)[24]	Scale is new (developed in 2010)[24] Lacks clinimetric support[24,26,27,60]

 ISSN Online 2577-8188

REFERENCES

1. Deyo RA. Using outcomes to improve quality of research and quality of care. *J Am Board Fam Pract.* 1998;11(6):465–473. https://https://doi.org/.org/10.3122/jabfm.11.6.465
2. Slover JD, Karia RJ, Hauer C, Gelber Z, Band PA, Graham J. Feasibility of integrating standardized patient-reported outcomes in orthopedic care. *Am J Manag Care.* 2015;21(8):e494–500.
3. Rotenstein LS, Agarwal A, O'Neil K, et al. Implementing patient-reported outcome surveys as part of routine care: Lessons from an academic radiation oncology department. *J Am Med Inform Assoc.* 2017;24(5):964–968. https://https://doi.org/.org/10.1093/jamia/ocx009
4. Valier ARS, Jennings AL, Parsons JT, Vela LI. Benefits of and barriers to using patient-rated outcome measures in athletic training. *J Athl Train.* 2014;49(5):674–683. https://https://doi.org/.org/10.4085/100191
5. Koshy E, Koshy V, Waterman H. *Action Research in Healthcare.* Thousand Oaks, CA: Sage Publications Ltd; 2011.
6. McLeod TCV, Snyder AR, Parsons JT, Bay RC, Michener LA, Sauers EL. Using disablement models and clinical outcomes assessment to enable evidence-based athletic training practice, part II: clinical outcomes assessment. *J Athl Train.* 2008;43(4):437. https://https://doi.org/.org/10.4085/1062-6050-43.4.437
7. Beattie PF, Nelson RM, Heintzelman M. The relationship between patient satisfaction with physical therapy care and global rating of change reported by patients receiving worker's compensation. *Physiother Theory Pract.* 2011;27(4):310–318. https://https://doi.org/.org/10.3109/09593985.2010.490575
8. Valier AR, Lam KC. Beyond the basics of clinical outcomes assessment: selecting appropriate patient-rated outcomes instruments for patient care. *Athl Train Educ J.* 2015;10(1):91–100. https://https://doi.org/.org/10.4085/100191
9. Nicholas P, Hefford C, Tumilty S. The use of the Patient-Specific Functional Scale to measure rehabilitative progress in a physiotherapy setting. *J Man Manip Ther.* 2012;20(3):147–152. https://https://doi.org/.org/10.1179/2042618612Y.0000000006
10. Dekker J, Dallmeijer AJ, Lankhorst GJ, et al. Clinimetrics in rehabilitation medicine: current issues in developing and applying measurement instruments 1. 2005. https://doi.org/10.1080/16501970510035179
11. Arnold, BL, Gansneder BM, Perrin DH. *Research Methods in Athletic Training.* Philadelphia: F.A. Davis Company; 2005.
12. Rubio DM, Berg-Weger M, Tebb SS, Lee ES, Rauch S. Objectifying content validity: Conducting a content validity study in social work research. *Soc Work Res.* 2003;27(2):94–104. https://doi.org/.org/10.1093/swr/27.2.94
13. Vincent WJ, Weir JP. *Statistics in Kinesiology.* Champaign, IL: Human Kinetics; 2012.
14. Copay AG, Subach BR, Glassman SD, Polly DW, Schuler TC. Understanding the minimum clinically important difference: A review of concepts and methods. *Spine J.* 2007;7(5):541–546. https://doi.org/:10.1016/j.spinee.2007.01.008
15. Kahl C, Cleland JA. Visual analogue scale, numeric pain rating scale and the McGill Pain Questionnaire: An overview of psychometric properties. *Phys Ther Rev.* 2005;10(2):123-128 https://doi.org/.org/10.1179/108331905X55776
16. Costa LOP, Maher CG, Latimer J, et al. Clinimetric testing of three self-report outcome measures for low back pain patients

in Brazil: Which one is the best? *Spine*. 2008;33(22):2459–2463. https://doi.org/.org/10.1097/BRS.0b013e3181849dbe

17. Mintken PE, Glynn P, Cleland JA. Psychometric properties of the shortened disabilities of the Arm, Shoulder, and Hand Questionnaire (QuickDASH) and Numeric Pain Rating Scale in patients with shoulder pain. *J Shoulder Elbow Surg*. 2009;18(6):920–926. https://doi.org/:10.1016/j.jse.2008.12.015
18. Fitzpatrick R, Davey C, Buxton MJ, Jones DR. Evaluating patient-based outcome measures for use in clinical trials. *Health Technol Assess*. 1998;2(14):1-74
19. Zou KH, Tuncali K, Silverman SG. Correlation and simple linear regression. *Radiology*. 2003;227(3):617–628. https://doi.org/.org/10.1148/radiol.2273011499
20. Horn KK, Jennings S, Richardson G, Van Vliet D, Hefford C, Abbott JH. The patient-specific functional scale: Psychometrics, clinimetrics, and application as a clinical outcome measure. *J Orthop Sports Phys Ther*. 2012;42(1):30–D17. https://doi.org/:10.2519/jospt.2012.3727
21. Fletcher KE, French CT, Irwin RS, Corapi KM, Norman GR. A prospective global measure, the Punum Ladder, provides more valid assessments of quality of life than a retrospective transition measure. *J Clin Epidemiol*. 2010;63(10):1123–1131. https://doi.org/.org/10.1016/j.jclinepi.2009.09.015
22. Kamper SJ, Maher CG, Mackay G. Global rating of change scales: A review of strengths and weaknesses and considerations for design. *J Man Manip Ther*. 2009;17(3):163–170. https://doi.org/10.1179/jmt.2009.17.3.163
23. Shrout PE. Measurement reliability and agreement in psychiatry. *Stat Methods Med Res*. 1998;7(3):301–317. https://doi.org/10.1177/096228029800700306
24. Vela LI, Denegar CR. The disablement in the physically active scale, part ii: the psychometric properties of an outcomes scale for musculoskeletal injuries. *J Athl Train*. 2010;45(6):630-641. https://doi.org/10.4085/1062-6050-45.6.630
25. Maughan EF, Lewis JS. Outcome measures in chronic low back pain. *Eur Spine J*. 2010;19(9):1484–1494. https://doi.org/10.1007/s00586-010-1353-6
26. Hoch JM, Druvenga B, Ferguson BA, Houston MN, Hoch MC. Patient-reported outcomes in male and female collegiate soccer players during an athletic season. *J Athl Train*. 2015;50(9):930-936. https://doi.org/10.4085/1062-6050-50.5.03
27. Houston MN, Van Lunen BL, Hoch MC. Health-related quality of life in individuals with chronic ankle instability. *J Athl Train*. 2014;49(6):758–763. https://doi.org/10.4085/1062-6050-49.3.54
28. Jaeschke R, Singer J, Guyatt GH. Measurement of health status: Ascertaining the minimal clinically important difference. *Control Clin Trials*. 1989;10(4):407–415.
29. Cleland JA, Childs JD, Whitman JM. Psychometric properties of the Neck Disability Index and Numeric Pain Rating Scale in patients with mechanical neck pain. *Arch Phys Med Rehabil*. 2008;89(1):69–74. https://doi.org/10.1016/j.apmr.2007.08.126
30. Williamson A, Hoggart B. Pain: A review of three commonly used pain rating scales. *J Clin Nurs*. 2005;14(7):798–804. https://doi.org/:10.1111/j.1365-2702.2005.01121.x
31. Kamper S. Global rating of change scales. *Aust J Physiother*. 2009;55(4):289.

https://doi.org/10.1016/S0004-9514(09)70015-7

32. Stratford P, Gill C, Westaway M, Binkley J. Assessing disability and change on individual patients: A report of a patient specific measure. *Physiother Can*. 1995;47(4):258–263. https://doi.org/10.3138/ptc.47.4.258
33. Farrar JT, Pritchett YL, Robinson M, Prakash A, Chappell A. The clinical importance of changes in the 0 to 10 numeric rating scale for worst, least, and average pain intensity: Analyses of data from clinical trials of duloxetine in pain disorders. *J Pain*. 2010;11(2):109–118. https://doi.org/10.1016/j.jpain.2009.06.007
34. Lara-Muñoz C, de Leon SP, Feinstein AR, Puente A, Wells CK. Comparison of three rating scales for measuring subjective phenomena in clinical research: i. Use of experimentally controlled auditory stimuli** Part II of this article will be published in the# 2, 2004 Issue. *Arch Med Res*. 2004;35(1):43–48. https://doi.org/10.1016/j.arcmed.2003.07.007
35. Spadoni GF, Stratford PW, Solomon PE, Wishart LR. The evaluation of change in pain intensity: A comparison of the P4 and single-item numeric pain rating scales. *J Orthop Sports Phys Ther*. 2004;34(4):187–193.
36. Bahreini M, Jalili M, Moradi-Lakeh M. A comparison of three self-report pain scales in adults with acute pain. *J Emerg Med*. 2015;48(1):10–18. https://doi.org/10.1016/j.jemermed.2014.07.039
37. Bijur PE, Latimer CT, Gallagher EJ. Validation of a verbally administered numerical rating scale of acute pain for use in the emergency department. *Acad Emerg Med*. 2003;10(4):390–392. https://doi.org/10.1111/j.1553-2712.2003.tb01355.x
38. Holdgate A, Asha S, Craig J, Thompson J. Comparison of a verbal numeric rating scale with the visual analogue scale for the measurement of acute pain. *Emerg Med*. 2003;15(5-6):441–446. https://doi.org/10.1046/j.1442-2026.2003.00499.x
39. Michener LA, Snyder AR, Leggin BG. Responsiveness of the numeric pain rating scale in patients with shoulder pain and the effect of surgical status. *J Sport Rehabil*. 2011;20(1):115. https://doi.org/10.1123/jsr.20.1.115
40. Piva SR, Gil AB, Moore CG, Fitzgerald GK. Responsiveness of the activities of daily living scale of the knee outcome survey and numeric pain rating scale in patients with patellofemoral pain. *J Rehabil Med*. 2009;41(3):129–135. https://doi.org/10.2340/16501977-0295
41. Vela LI, Haladay DE, Denegar C. Clinical assessment of low-back-pain treatment outcomes in athletes. *J Sport Rehabil*. 2011;20(1):74–88. https://doi.org/10.1123/jsr.20.1.74
42. Kendrick DB, Strout TD. The minimum clinically significant difference in patient-assigned numeric scores for pain. *Am J Emerg Med*. 2005;23(7):828–832. https://doi.org/10.1016/j.ajem.2005.07.009
43. Mease PJ, Spaeth M, Clauw DJ, et al. Estimation of minimum clinically important difference for pain in fibromyalgia. *Arthritis Care Res*. 2011;63(6):821–826. https://doi.org/10.1002/acr.20449
44. Young IA, Cleland JA, Michener LA, Brown C. Reliability, construct validity, and responsiveness of the neck disability index, patient-specific functional scale, and numeric pain rating scale in patients with cervical radiculopathy. *Am J Phys Med Rehabil*. 2010;89(10):831–839. https://doi.org/10.1097/PHM.0b013e3181ec98e6
45. Cleland JA, Fritz JM, Whitman JM, Palmer JA. The reliability and construct validity of the Neck Disability Index and patient specific

functional scale in patients with cervical radiculopathy. *Spine*. 2006;31(5):598–602. https://doi.org/10.1097/01.brs.0000201241.90914.22
46. Cleland JA, Whitman JM, Houser JL, Wainner RS, Childs JD. Psychometric properties of selected tests in patients with lumbar spinal stenosis. *Spine J*. 2012;12(10):921–931. https://doi.org/10.1016/j.spinee.2012.05.004
47. Lauridsen HH, Hartvigsen J, Manniche C, Korsholm L, Grunnet-Nilsson N. Responsiveness and minimal clinically important difference for pain and disability instruments in low back pain patients. *BMC Musculoskelet Disord*. 2006;7(1):1. https://doi.org/10.1186/1471-2474-7-82
48. Garrison C, Cook C. Clinimetrics corner: the global rating of change score (groc) poorly correlates with functional measures and is not temporally stable. *J Man Manip Ther*. 2012;20(4):178–181. https://doi.org/10.1179/1066981712Z.00000000022
49. Schmitt J, Abbott JH. Global ratings of change do not accurately reflect functional change over time in clinical practice. *J Orthop Sports Phys Ther*. 2015;45(2):106–111. https://doi.org/10.2519/jospt.2015.5247
50. Farrar JT, Young Jr JP, LaMoreaux L, Werth JL, Poole RM. Clinical importance of changes in chronic pain intensity measured on an 11-point numerical pain rating scale. *Pain*. 2001;94(2):149–158. https://doi.org/10.1016/S0304-3959(01)00349-9
51. Chatman AB, Hyams SP, Neel JM, et al. The patient-specific functional scale: measurement properties in patients with knee dysfunction. *Phys Ther*. 1997;77(8):820–829. https://doi.org/10/1093.ptj/77.8.820
52. Stratford PW, Kennedy DM, Wainwright AV. Assessing the patient-specific functional scale's ability to detect early recovery following total knee arthroplasty. *Phys Ther*. 2014;94(6):838–844. https://doi.org/10.2522/ptj.20130399
53. Hefford C, Abbott JH, Arnold R, Baxter GD. The patient-specific functional scale: validity, reliability, and responsiveness in patients with upper extremity musculoskeletal problems. J Orthop Sports Phys Ther. 2012;42(2):56–65. https://doi.org/10.2519/jospt.2012.3953
54. Jolles BM, Buchbinder R, Beaton DE. A study compared nine patient-specific indices for musculoskeletal disorders. J Clin Epidemiol. 2005;58(8):791–801. https://doi.org/10.1016/j.jclinepi.2005.01.012
55. Sterling M. Patient specific functional scale. *Aust J Physiother*. 2007;53(1):65–66.
56. Berghmans DD, Lenssen AF, van Rhijn LW, de Bie RA. Patient specific function scale: its reliability and responsiveness in patients undergoing a total knee arthroplasty. *J Orthop Sports Phys Ther*. 2015;(Early Access):1–22. https://doi.org/10.2519/jospt.2015.5825
57. Koehorst ML, van Trijffel E, Lindeboom R. Evaluative measurement properties of the patient-specific functional scale for primary shoulder complaints in physical therapy practice. *J Orthop Sports Phys Ther*. 2014;44(8):595–603. https://doi.org/10.2519/jospt.2014.5133
58. Westaway MD, Stratford PW, Binkley JM. The patient-specific functional scale: Validation of its use in persons with neck dysfunction. *J Orthop Sports Phys Ther*. 1998;27(5):331–338. https://doi.org/10.2519/jospt.1998.27.5.331
59. Abbott JH, Schmitt JS. The Patient-Specific Functional Scale was valid for group-level change comparisons and between-group discrimination. *J Clin Epidemiol*. 2014;67(6):681–688. https://doi.org/10.1016/j.jclinepi.2013.11.002

60. Houston MN, Hoch JM, Gabriner ML, Kirby JL, Hoch MC. Clinical and laboratory measures associated with health-related quality of life in individuals with chronic ankle instability. *Phys Ther Sport*. 2015;16(2):169–175. https://doi.org/10.1016/j.ptsp.2014.10.006
61. Hankemeier DA, Popp JK, Walker SE. Familiarity with and use of clinical prediction rules and patient-rated outcome measures. *Athl Train Sports Health Care*. 2017. https://doi.org/10.3928/19425864-20170112-02
62. Ajzen I. The theory of planned behavior. *Organ Behav Hum Decis Process*. 1991;50(2):179–211. https://doi.org/10.1016/0749-5978(91)90020-T
63. Ware Jr JE, Brook RH, Davies AR, Lohr KN. Choosing measures of health status for individuals in general populations. *Am J Public Health*. 1981;71(6):620–625. https://doi.org/10.2105/AJPH.71.6.620
64. Novak CB, Anastakis DJ, Beaton DE, Mackinnon SE, Katz J. Validity of the Patient Specific Functional Scale in patients following upper extremity nerve injury. *Hand*. 2013;8(2):132–138. https://doi.org/10.1007/s11552-013-9506-9
65. Gross DP, Battié MC, Asante AK. The Patient-Specific Functional Scale: Validity in workers' compensation claimants. *Arch Phys Med Rehabil*. 2008;89(7):1294–1299. https://doi.org/10.1016/j.apmr.2007.11.040
66. Hefford C, Lodge S, Elliot K, Abbott JH. Measuring patient-specific outcomes in musculoskeletal clinical practice: A pilot study. *NZ J Physiother*. 2008;36(2):42.
67. Wagle N. Capturing the patient voice: implementing patient-reported outcome measures. *N Engl J Med Catal*. November 2016. https://catalyst.nejm.org/implementing-proms-patient-reported-outcome-measures/

Appendix 1. Global Rating of Change (GROC)

Patient Name/Number: ____

Date: ________________________

Global Rating of Change Scale (GROC)

Please rate the overall condition of your shoulder from the time that you began treatment until now (check only one):

A very great deal worse (-7)	About the same (0)	A very great deal better (7)
A great deal worse (-6)		A great deal better (6)
Quite a bit worse (-5)		Quite a bit better (5)
Moderately worse (-4)		Moderately better (4)
Somewhat worse (-3)		Somewhat better (3)
A little bit worse (-2)		A little bit better (2)
A tiny bit worse (-1)		A tiny bit better (1)

Jaeschke R, Singer J, Guyatt GH. Measurement of health status. Ascertaining the minimal clinically important difference. Control Clin Trials 1989: 407-415.

Appendix 2. Patient-Specific Functional Scale (PSFS)

The Patient-Specific Functional Scale
This useful questionnaire can be used to quantify activity limitation and measure functional outcome for patients with any orthopaedic condition.

Clinician to read and fill in below: Complete at the end of the history and prior to physical examination.

Initial Assessment:
I am going to ask you to identify up to three important activities that you are unable to do or are having difficulty with as a result of your__problem. Today, are there any activities that you are unable to do or having difficulty with because of your_problem? (Clinician: show scale to patient and have the patient rate each activity).

Follow-up Assessments:
When I assessed you on (state previous assessment date), you told me that you had difficulty with (read all activities from list at a time). Today, do you still have difficulty with: (read and have patient score each item in the list)?
Patient-specific activity scoring scheme (Point to one number):

0 1 2 3 4 5 6 7 8 9 10

Unable to perform activity

(Date and Score)

Able to perform activity at the same level as before injury or problem

Activity	**Initial**					
1.						
2.						
3.						
4.						
5.						
Additional						
Additional						

Total score = sum of the activity scores/number of activities Minimum detectable change (90%CI) for average score = 2 points Minimum detectable change (90%CI) for single activity score = 3 points
PSFS developed by: Stratford, P., Gill, C., Westaway, M., & Binkley, J. (1995). Assessing disability and change on individual patients: a report of a patient specific measure. Physiotherapy Canada, 47, 258-263.

Appendix 3. Disablement in the Physically Active Scale (DPA) Scale

Disablement in the Physically Active Scale©

Instructions: Please answer **each statement** with one response by shading the circle that most closely describes your problem(s) within the past **24 hours.** Each problem has possible descriptors under each. Not all descriptors may apply to you but are given as common examples.

KEY

1 - no problem
2 - I have the problem(s), but it does not affect me
3 - The problem(s) slightly affects me
4 - The problem(s) moderately affects me
5 - The problem(s) severely affects me

	No problem 1	Does not affect 2	Slight 3	Moderate 4	Severe 5
Pain – *"Do I have* ***pain****?"*	O	O	O	O	O
Motion – *"Do I have impaired* ***motion****?"* **Ex.** decreased range/ease of motion, flexibility, and/or increased stiffness	O	O	O	O	O
Muscular Functioning – *"Do I have impaired* ***muscle function****?"* **Ex.** decreased strength, power, endurance, and/or increased fatigue	O	O	O	O	O
Stability – *"Do I have impaired* ***stability****?"* **Ex**. the injured area feels loose, gives out, or gives way	O	O	O	O	O
Changing Directions – *"Do I have difficulty with* ***changing directions*** *in activity?"* **Ex.** twisting, turning, starting/stopping, cutting, pivoting	O	O	O	O	O
Daily Actions – *"Do I have difficulty with* ***daily actions*** *that I would normally do?"* **Ex**. walking, squatting, getting up, lifting, carrying, bending over, reaching, and going up/down stairs	O	O	O	O	O
Maintaining Positions – *"Do I have difficulty* ***maintaining the same position*** *for a long period of time?"* **Ex.** standing, sitting, keeping the arm overhead, or sleeping	O	O	O	O	O
Skill Performance – *"Do I have difficulties with* ***performing skills*** *that are required for physical activity?"*					
1.) **Ex**. running, jumping, kicking, throwing, & catching	O	O	O	O	O
2.) **Ex.** coordination, agility, precision & balance	O	O	O	O	O
Overall Fitness – *"Do I have difficulty maintaining my* ***fitness*** *level?"* **Ex**. conditioning, weight lifting & cardiovascular endurance	O	O	O	O	O
Participation in Activities – *"Do I have difficulty with* ***participating in activities****?"*					
1.) **Ex**. participating in leisure activities, hobbies, and games	O	O	O	O	O
2.) **Ex.** participating in my sport(s) of preference	O	O	O	O	O
Well Being – *"Do I have difficulties with the following…?"*					
1.) Increased uncertainty, stress, pressure, and/or anxiety	O	O	O	O	O
2.) Altered relationships with team, friends, and/or colleagues	O	O	O	O	O
3.) Decreased overall energy	O	O	O	O	O
4.) Changes in my mood and/or increased frustration	O	O	O	O	O

Using Tai Chi as a Therapeutic Intervention to Expand Complementary and Integrative Health in Clinical Practice

Connor A. Burton, LAT, ATC
Indiana State University, Terre Haute, IN

Key Phrases
Therapeutic exercise, emotional wellness, mental health, tai chi

Correspondence
Connor Burton, Indiana State University, 567 N. 5th Street, Terre Haute, IN 47809.
E-mail: cburton24@sycamores.indstate.edu
Twitter: @cburt105

Full Citation
Burton CA. Using tai chi as a therapeutic intervention to expand complementary and integrative health in clinical practice. *Clin Pract Athl Train.* 2018;1(2):32-36. https://doi.org/10.31622/2018/0002.5

Submitted: September 1, 2018 **Accepted**: October 23, 2018

COMMENTARY

The National Institutes of Health (NIH) define complementary and integrative health (CIH) as "those health care practices not currently considered an integral part of conventional medicine."[1] When an intervention is used in addition to conventional care, it is deemed as complementary medicine. Integrative medicine are those interventions that are used in place of conventional care.[1] Across the general public, the utilization of CIH in Western society is growing. A 2012 study of nearly 89,000 Americans indicated that 33.2% were utilizing CIH.[2] Within this study, various reasons for utilizing CIH included health/wellness improvement, treatment for symptoms related to disease, or to improve side effects from modern medicine.[2] Some Western health care providers have brought CIH into their practice, whether it be direct incorporation or referral to another qualified provider. Some of these interventions include chiropractic services, massage therapy, relaxation techniques, yoga and tai chi.[1] Although CIH continues to grow in in modern health care does not follow a similar trend. In order to provide patients with optimal care and satisfactory outcomes, it is crucial to consider all potential interventions when developing a patient-centered plan of care. Acting as the first point of care for the majority of our patient populations, athletic trainers can talk with patients about these unique interventions. In so doing, we play an integral role in starting a movement of holistic health care which provides patients which more options to meet their goals and needs.

What is Tai Chi and how is it implemented into practice?

There is a strong body of literature supporting the use of tai chi as an intervention for the mental health of young, physically active individuals.[3-5] Tai chi is a form of martial art and mind-body exercise which originated in China.[5] This technique is commonly described as combining slow-paced, precise, and constant functional movements with controlled breathing.[3-5] Tai chi can be implemented into clinical practice through one-on-one patient care with goals of addressing specific conditions. Due to the uniqueness of athletic training as a health care profession, tai chi can also be implemented into clinical practice in group intervention sessions. Two examples of this implementation could be facilitation of proper breathing during movement for endurance athletes or promotion of positive mental health. The literature supports the use of tai chi for both orthopedic (balance, agility, postural control, lower extremity strength,[3] cardiovascular and respiratory function,[7] and pain reduction[5]) and mental health (anxiety,[4,5] depression,[4,5] self-esteem,[5] and mood.[5]). Across the literature, improvement of outcomes were found regardless of the duration (15 to 60 minute sessions), frequency of sessions (once per week to daily) and length of patient enrollment in the program (3 to 12 week intervention).

As noted, tai chi can serve as an intervention to address causative factors related to mental health, as well as functional limitations. As a clinician, it is important to understand how a technique can be an effective option in patient care. Moreover, when aiming to provide patient centered care, it is equally important to educate the patient regarding how each available technique can be an effective component of the patient plan of care. For tai chi, the emphasis of the intervention is placed on incorporating relaxation and deep breathing into functional movements.[3-5] A visual aid of what a tai chi intervention could look like is detailed in Table 1. This table details notes for the clinician developing and implementing the intervention (left column) in addition to patient education and queues for appropriate integration of breathing with functional movement (right column).

Indications and Considerations for Implementing Tai Chi

Similar to each therapeutic intervention a clinician uses in clinical practice, it is important to understand the indications, contraindications, and considerations for a technique prior to implementing the technique into a plan of care. Like general physical activity there is an adherent risk of injury which must be acknowledged when performing tai chi. Individuals who have health conditions which require consultation with a

Table 1: Phase progression of diaphragmatic breathing with basic and advanced movements.

Phase	Concepts for Clinician	Examples of Cueing
Diaphragmatic Breathing	Hand placement above/below umbilicus Patient should begin diaphragmatic breathing. Time spent practicing dependent on dysfunction Correct any shoulder elevation and rib expansion during breathing Progress patient appropriately supine → sitting → standing	"Please find a position that is comfortable for you." (standing, seated, or supine) "Please place one hand on your stomach and one hand on your stomach below your belly button." "Breathe in through your nose so that you feel your stomach expand under your hand. Breathe out through your nose so that you feel your stomach shrink under your hands."
Functional Movement with Breathing	Patient continues diaphragmatic with basic movements (Single leg squat, arm elevation) Maintain proper breathing from phase one with movement. Ensure abdomen is moving with inhalations Progress patient to advanced functional movement when breathing is controlled and routine	"Starting in a standing position with feet shoulder width apart, breathe in as you raise your arms straight out in front of you." "Breathe out as you squat down and lower your arms to your side at the same time." "Breathe in as you rise up out of the squat and raise your hands straight in front of you." "Continue to focus on breathing through your belly and not raising your shoulders up or expanding your chest when breathing."
Advanced Functional Movement	Introduce occupational/sport specific movement with breathing Adjust movement speed and intensity according to patient progress and occupational/sport demands (Lifting an object repetitively, throwing a pitch, rebounding with contact)	"Breathe in as you properly squat down to pick up this weighted object and breathe out as you pick the object up." "Breathe in as you enter your wind-up phase and breathe out as you progress through your early cocking and follow-through phases of throwing."

physician prior to partaking in physical activity (e.g. heart condition, severe osteoporosis) should take precaution. Additionally, individuals with an orthopedic injury that requires modifications to activities of daily living or physical activity should take precaution and consult with their health care provider.

To obtain the greatest results, the difficulty of the tai chi exercises should be tailored to the patient's experience level with the intervention and fitness.[6] Tai chi can be utilized for any patient who is physically active. For patients who only complete walking and activities of daily living, a clinician can develop a program which revolves around foundational movements, such as mini squats with synchronous arm swings or controlled lunges. For patients who partake in a high level of physical activity, a clinician can develop a program which progresses through foundational movements into advanced movements which resemble free flowing dance movements, or tailor the program to introduce breathing with occupational/sport specific activities. In the realm of athletic training, patients may present with breathing dysfunction caused by a variety of factors such as compensatory movements in the kinetic chain, diaphragmatic dysfunction, thoracic sprain or strain, rib dysfunction, heightened levels of anxiety or stress, or faulty breathing mechanics. Inherently, breathing dysfunction can result in a negative impact on health-related quality of life for patients.

Applying A Patient-Centered Lens To Care

An important part of effectively providing patient-centered care is understanding more about the patient than just the condition. This understanding must dive deeper than a physical wellness understanding of the individual. There are seven dimensions which are key to understanding the holistic wellbeing of a patient. These dimensions include: social, emotional, spiritual, environmental, occupational, intellectual, and physical.[8] When providing care to a patient presenting with a form of breathing dysfunction, that can be defined as a breathing disorder in which respiration patterns change due to chronic factors resulting in dyspnea and other symptoms,[9] a holistic approach must be employed to identify the contributing factor(s). Examples of how a condition can impact the seven dimensions of wellness can be found in Table 2. This is not intended to be an exhaustive list of

Table 2. Implications of Impairment on the Seven Dimensions of Wellness.

Dimension	Implications
Social	External pressure to continue occupational/sport duties; change or loss of social identity
Emotional	Internal pressure to continue occupational/sport duties; internal loss of social identity; stress and/or anxiety associated with pain during physical activity/breathing
Spiritual	Dependent on the patient's spiritual beliefs tai chi can support, conflict, or be indifferent towards patient's spiritual health
Environmental	Increased number of provider visits can increase the impact of on environmental factors (pollution, healthcare system, economic, etc.)
Occupational	Pressure to continue meeting the organizational expectations of occupation/sport activity during and after injury
Intellectual	Patient education and cultural understanding of impairment is vital for treatment and success of interventions
Physical	Patient may experience pain with activities of daily living, pain with occupational/sport specific functions, or decreased level of function

holistic factors to consider, but is designed to help a clinician understand the frame of mind necessary to apply well-rounded patient care and extent of impairment on these domains. A patient who presents with thoracic, musculoskeletal pain with breathing during exercise and increased levels of stress and anxiety during physical activity many be a patient case worth considering the use of tai chi as a therapeutic intervention. When considering social and emotional wellness, a patient could be experiencing internal or external pressure to perform at a high level. Of the examples provided in Table 2, some of these factors can result in heightened anxiety and stress, which may result in physiologic changes like increased heart rate and respirations. These changes can alter the intricate function of the respiratory system.

CONCLUSION

As a CIH technique, tai chi can be incorporated into a patient's plan of care in conjunction with other interventions. As the current literature indicates,[3-5] patient outcomes related to mental health and physical impairment significantly improve regardless of the programming parameters for tai chi intervention. Due to the fact that guidelines are not specific, a clinician should work with the patient to set a plan of care which best suits the patient's availability, needs, and preferences. As a clinician it is viable to provide patients with options when establishing a plan of care which aims to address the goals the patient seeks to accomplish while receiving care. In order to best address patient needs and goals, a clinician must not only understand the clinical relevance of all considered interventions, but also recognize the impact a condition and intervention will have on the seven dimensions of patient wellness.

REFERENCES

1. National Center for Complementary and Integrative Health. U.S. Department of Health and Human Services – National Institutes of Health. https://nccih.nih.gov/research/camonpubmed/background.htm. Updated Sept 24, 2017. Access Date: June 6, 2018.

2. Clarke TC, Black LI, Stussman BJ, et al. Trends in the use of complementary health approaches among adults: United States, 2002-2012. *Natl Health Stat Report.* 2015;79:1-15.

3. Bu B, Haijun H, Yong L, et al. Effects of martial arts on health status: A systematic review. *J Evid-Based Med.* 2010;3:205-219. https://doi.org/10.1111/j.1756-5391.2010.01107.x

4. Sharma M, Haider T. Tai Chi as an Alternative and Complimentary Therapy for Anxiety: A Systematic Review. *J Evid-Based Complimentary & Altern Med.* 2015;20(2):143-153. https://doi.org/10.1177/2156587214561327

5. Wang F, Othelia Lee EK, Wu T, et al. The effects of tai chi on depression, anxiety, and psychological well-being: A systematic review and meta-analysis. *Intl J Bev Med.* 2014; 21:605-617. https://doi.org/10.1007/s12529-013-9351-9

6. Xiong KY, He H, Ni GX. Effect of skill level on cardiorespiratory and metabolic responses during Tai Chi training. *Eur J Sport Sci.* 2013;13(4):386-391. https://doi.org/10.1080/17461391.2011.635706

7. Polkey MI, Qiu ZH, Zhou L, et al. Tai chi and pulmonary rehabilitation compared for treatment-naïve patients with COPD: A randomized controlled trial. *Chest.* 2018;153(5):1116-24.

https://doi.org/10.1016/j.chest.2018.01.053

8. Lyon, K. The Seven dimensions of wellness. American Medical Student Association. https://www.amsa.org/the-seven-dimensions-of-wellness/. Updated July 8, 2015. Access Date: August 25, 2018.

9. Boulding R, Stacey R, Niven R, Fowler SJ. Dysfunctional breathing: A review of the literature and proposal for classification. *Eur Respir Rev.* 2016;25:287-94. https://doi.org/10.1183/16000617.0088-2015 .

Assessing Lower Extremity Injury Risk in a Mid-Atlantic Drum Corps Using the Weight Bearing Lunge Test

Nicolás C Merritt, DAT, SCAT, ATC, NS[1] and Cameron J Powden PhD, LAT, ATC[2]
[1]Furman University, Greenville, SC; [2]Indiana State University, Terre Haute, IN

ABSTRACT

With athletic training's expansion into non-traditional settings, it is important to assess if screening tools can provide value in range of settings. Currently, there is a dearth of information regarding specific models for injury risk assessment in drum corps patients. The Weight Bearing Lunge Test (WBLT) has been used to evaluate those at risk for suffering a lower extremity injury (LEI) in a traditional athletic population. This practice-based research is an attempt to apply current evidence of injury risk assessment use in the traditional settings to performing arts. The purpose of our investigation was to determine the effect of WBLT motion on LEI in Drum Corps. All participating Drum Corps members were measured using the WBLT during the preseason screening process. Injury record keeping was completed through electronic medical records (EMR) and all LEI were recorded over two consecutive, 85-day seasons. The average of the maximal distance in centimeters of the great toe from the wall indicated the WBLT Average (WBLTAv). WBLT Asymmetry (WBLTAsy) was the absolute difference between limbs. T-tests were used to determine if there was a significant difference between those who sustained a LEI (Injured) and those who did not (Uninjured) for WBLTAv and WBLTAsy. For dependent measures associated with significant group differences, receiver operator characteristic curves (ROC) were performed to examine injury risk using area under the curve (AUC). Lastly, cut-off scores that produced the maximal values of sensitivity and specificity were identified. Alpha level was set *a priori* at $p<0.05$. Drum Corps patients with lower WBLTAv (<11.47cm) or higher WBLTAsy (>0.75cm) measures were more likely to sustain a LEI during a competitive drum corps season. These data demonstrates that the WBLT could be viable as a screening tool in the marching arts and provides initial cut-off values.

Key Phrases
Injury risk reduction, injury surveillance, performing arts

Correspondence
Dr. Nico Merritt, Furman University, Timmons Arena, 3300 Poinsett Highway, Greenville, SC 29613.
E-mail: Nico.Merritt@furman.edu
Twitter: @bostonandbeyond

Full Citation
Merritt NC, Powden CJ. Assessing Lower Extremity Injury Risk in a Mid-Atlantic Drum Corps Using the Weight Bearing Lunge Test. *Clin Pract Athl Train.* 2018;1(2):37-41.
https://doi.org/10.31622/2018/0002.6

Submitted: September 13, 2018 **Accepted**: October 15, 2018

INTRODUCTION

A modern drum and bugle corps is a musical marching ensemble consisting of brass instruments, percussion instruments, synthesizers, and color guard. Drum and bugle corps are considered marching music's major league. These groups practice for over 10 hours a day, on their feet, and have high incidence of lower extremity injury (LEI). LEI is more common to occur in marching ensembles than injury to the upper extremity.[1] The most common injuries are medial tibial stress syndrome, achilles tendonitis, and ankle sprain. The commonality of these injuries in combination with their impact on heath and participation signifies the need to develop LEI preventative practices in this population to enhance patient safety.[1]

The first step to injury prevention is identifying those individuals that may be most at risk. In order to accomplish this, clinicians need efficient and effective screening tools. Screening tools usually examine range of motion, balance, strength, and/or other modifiable risk factors as potential injury risk predictors. There are many tools that may be effective in assessing injury risk in populations with high incidence of LEI.[2-6] Ankle dorsiflexion range of motion (DROM) is a simple measure that has a lot of supportive research in relation to LEI risk.[2-6] DROM has been used with basketball, volleyball, gymnastics, and other various sports and activities.[7] The weight bearing lunge test (WBLT), specifically, is a common quantification technique that measures DROM in a weight bearing position. Research has demonstrated that the WBLT can be used to quantify DROM and predict LEI.[7] Additionally, the WBLT has been associated with measures of dynamic movement[8] and balance[9] which have also been associated with injury risk in physically active populations.[10]

DFROM has been shown to have utility to predict individuals at risk of LEI in sports populations. This method, however, has not been conducted with the Drum Corps population. Therefore, the purpose of this study is to determine the effect of DROM on LEI risk within a Mid Atlantic Drum Corps by assessing DROM using the WBLT.

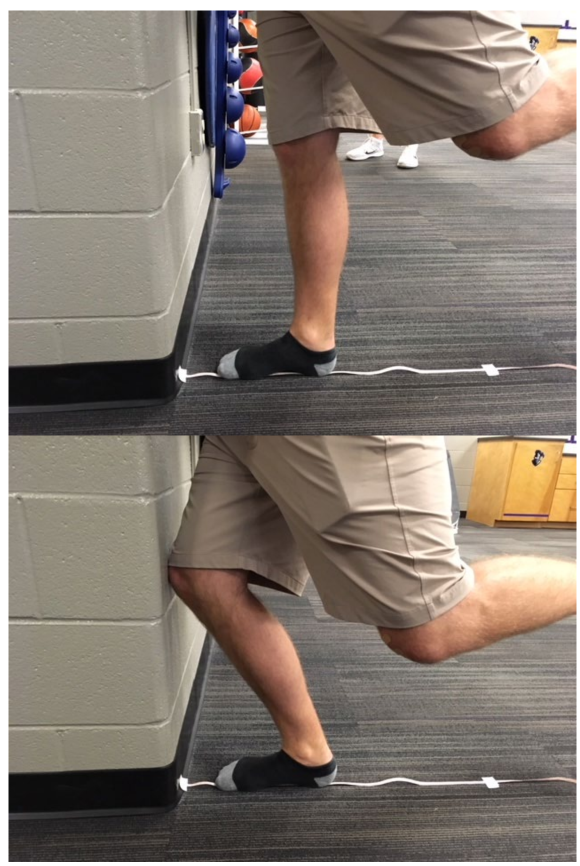
PATIENTS:

Two hundred thirty-eight patients from a Drum Corps International group from the Mid-Atlantic region that competes seasonally (Male=173, Female=65, Age=19.49± 1.05yrs) were screened as part of the pre-participation exam prior to the 2016 and 2017 seasons. Patients with current lower extremity injury at the time of data collection did not participate and were not included in the study. Patients who were included in this study were then monitored throughout the competitive season for lower extremity injury (LEI).

INTERVENTION:

The WBLT was used to measure weight bearing dorsiflexion ROM bilaterally in all patients. Assessment of the WBLT measurement in a systematic review suggested strong evidence that the inter-clinician reliability (ICC=0.80-0.99, MDC 4.6° or 1.6cm) and the intra-clinician reliability (ICC=0.65-0.99, MDC 4.7° or 1.9cm) were good.[11] The WBLT was performed using the knee-to-wall principle (Figure 1).[10,11] Patients were in a standing position facing a wall with the test foot parallel to and on top of a measuring tape. The measuring tape was secured to the floor with athletic tape or an equivalent. The second toe, heel, and knee of the test foot were perpendicular to the wall during the testing session. While maintaining a single leg stance, patients were instructed to perform a lunge towards the wall by flexing the knee while keeping the heel of the test foot firmly fixed to the testing surface and without letting the knee sway medially or laterally. The opposite limb of the test foot was allowed to be suspended in knee flexion and non-weight bearing while the test foot went through the proper motion. Patients were able to place their hands on the wall for balance if desired. The test foot was progressed away from the wall in one centimeter (cm) increments and repeated until the knee or heel of the test limb lost contact with the wall and/or floor respectively. The foot placement was then adjusted in smaller increments in order to have the foot the farthest point away from the wall while maintaining knee and heel contact and maximum lunge distance was recorded. The final successful trial was recorded for statistical analysis. WBLT measurements were completed by four individuals, two athletic trainers with 1-2

Figure 1. Weight Bearing Lunge Test (WBLT).



 ISSN Online 2577-8188

years of experience and two athletic training students.

OUTCOME MEASURES:

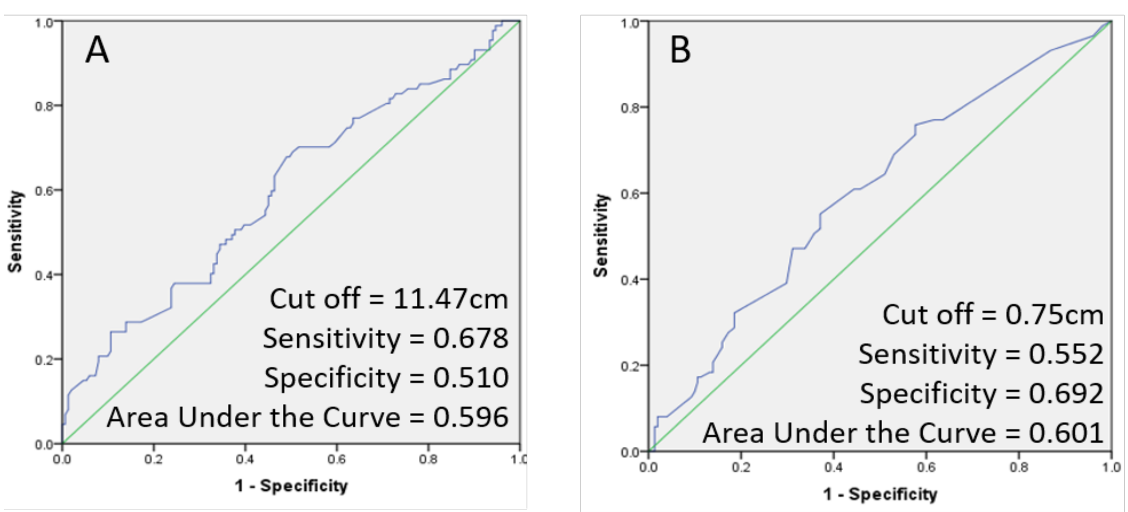
Injury electronic medical records were stored in a password protected, HIPAA compliant, online spreadsheet (G suite™ by Google©) and was used to keep track of the number of lower extremity injuries sustained over the two 85 day seasons. Each patient injury was recorded into the online spreadsheet; patients sustaining multiple injuries were included in the analysis for their first LEI only. The definition of a lower extremity injury was an injury that caused removal from activity and loss of practice time for a total of four or more cumulative hours (one practice block).

Analyses were completed using a statistical software program (IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 23.0 Armonk, NY: IBM Corp). Means and standard deviations of WBLT, average, and asymmetry measures were calculated for injured and non-injured patients. The average of the maximal distance in centimeters of the great toe from the wall indicated the WBLT Average (WBLTAv). WBLT Asymmetry (WBLTAsy) was the absolute difference between limbs. T-tests were used to determine if there was a significant difference between those who sustained a LEI (Injured) and those who did not (Uninjured) for WBLTAv and WBLTAsy. For dependent measures associated with significant group differences, receiver operator characteristic curves (ROC) were performed to examine injury risk using area under the curve (AUC). Lastly, cut-off scores that produced the maximal values of sensitivity and specificity were identified. Alpha level was set a priori at $p<0.05$.

RESULTS:

LEI occurred in 87 of 238 patients during the 2016 and 2017 drum corps regular seasons (Table 1). The normalized WBLTAv and WBLTAsy for injured and uninjured patients are presented in Table 2. The injured WBLTAv was significantly less compared to the uninjured ($p=0.005$). The injured WBLTAsy was significantly greater compared to the uninjured ($p=0.015$). The AUC from the ROC analysis (Figure 2) for WBLTAv and WBLTAsy was 0.596 and 0.601 respectively. A WBLTAv cutoff score of 11.47cm was associated with a sensitivity of 0.678 and a specificity of 0.510. A WBLTAsy cutoff score of 0.75cm was associated sensitivity of 0.552 and a specificity of 0.629. This data demonstrates that if a drum corps individual has a WBLTAv measure less than 11.47cm, they are 40% more likely to sustain an LEI; if a drum corps individual has a WBLTAsy measure greater than 0.75cm, then they are 49% more likely to sustain an LEI (Figure 2).

Figure 2. Receiver Operator Curve: A) WBLT Average and B) WBLT Asymetry.



DISCUSSION:

The purpose of this study was to determine if a relationship exists between DROM and LEI risk in the drum corps population. Slightly over one-third of the patients sustained an LEI during the 170 days of participation. This study demonstrate that individuals with greater measures of average weight bearing DROM (WBLTAv > 11.47cm) are less likely to become injured and individuals with a greater asymmetry of weight bearing DROM (WBLTAsy > 0.75cm) between limbs are more likely to become injured. These findings are the stepping stone to say that weight bearing DROM may be a predictor of injury in the drum corps population.

The results of this practice-based research identified WBLTAv (p=0.005) and WBLTAsy (p=0.015) differences between those that sustained a LEI and those that did not. To further analyze the utility of the WBLT, cutoff scores were calculated. While our findings indicated relatively low predictive accuracy overall, as signified by moderate AUC values (0.596 and 0.601), each measure fared well at either ruling in or out injury. This was indicated by WBLTAv sensitivity and WBLTAsy specificity values of almost 0.70. In terms of positive and negative likelihood ratios, this indicates that a drum corps member who have less than a 11.47cm WBLTAv are about 40% more likely to sustain a LEI than a member over that value (LR+ = 1.38). Additionally, if a member has greater than 0.75cm WBLTAsy, then they are 49% more likely to sustain a LEI than an individual with less asymmetry.

Overall, the results of this study indicate that the WBLT is a feasible screening method that does demonstrate useful data for a clinician to determine a drum corps member's LEI risk. These findings are similar to previous literature on LEI risk in traditional athletic populations.[2-6] Furthermore, due to DROM's nature as a modifiable risk factor, injury prevention programs could be implemented to reduce an individual's risk of LEI. We propose that this method of screening can be completed prior to the season, and could allow clinicians to identify at risk individuals and ultimately decrease the overall frequency of LEI for the season once these individuals have modified their weight bearing DROM through prevention programs. At this time however, there is a need to evaluate the best practices for increasing DROM in a prophylactic manner.

We experienced a number of obstacles during the implementation of the WBLT, however, we determined how to overcome these obstacles in the future. The implementation of the WBLT screening with multiple individuals in a short time span could have resulted in possible error. The WBLT takes approximately thirty seconds to one minute to perform with one patient. Therefore, it is suggested for future studies to either increase the number of trained individuals administering the screening, or increase the amount of time available to complete the screening with the drum corps Members. An athletic training student was trained and completed practice sessions, but since the WBLT was a new procedure for the athletic training student, this inexperience may have compromised the ability to record accurate measurements. In order to reduce error, it is recommended that individuals who are properly trained and who have previous experience should administer the screening. The number of participants participating in the study may have been too low to provide accurate data for analysis. Additional participants may be needed in future studies. This can be accomplished by introducing multiple drum corps groups to the screening and conducting data on all the groups combined, not just one corps for two seasons. Additionally, the definition of LEI included any injury distal to the hip. Although DROM can be associated with injuries proximal to the ankle, it is not the only correlating factor. These factors may have produced inaccurate measurements causing a misrepresentation of the studied population. Additional research in this area could explore other modifiable risk factors such as knee and hip posture/range of motion, as well as factors such as sex and instrument type, as these could play a contributing role to injury risk within Drum Corps.

CLINICAL IMPLICATIONS:

Little research has been conducted regarding injury prevalence and injury risk factors within the performing arts athlete population, specifically drum corps. Our study provides an initial look into potential risk factors for LEI. Clinicians could utilize this data and the WBLT within the drum corps population to screen for LEI risk and identify individuals with higher risk of LEI. Cutoff scores of greater than 0.75cm WBLTAsy and less than 10.40cm WBLTAv should be used to identify drum corps members that may be at greater risk of sustaining a LEI. With this information, healthcare providers can identify at-risk individuals and prescribe preventative measures in order to mitigate the potential injury during the drum corps season. In conclusion, our research study provides a starting point for prevention research in this unique population. However, additional research studies are needed regarding risk factors that predispose performing arts athletes to injury. Such studies can indicate how to best provide prevention strategies for the performing arts athletes in order to increase health related quality of life.

REFERENCES

1. Moffit DM, Russ AC, Mansell JL. Marching band camp injury rates at the collegiate level. Med Probl Perform Art. 2015;30(2):96. https://doi.org/10.21091/mppa.2015.2016
2. Tabrizi P, McIntyre W, Quesnel M, Howard A. Limited dorsiflexion predisposes to injuries of the ankle in children. *J Bone Joint Surg Brit*. 2000;82(8):1103-1106. https://doi.org/10.1302/0301-620X.82B8.0821103
3. Pope R, Herbert R, Kirwan J. Effects of ankle dorsiflexion range and pre-exercise calf muscle stretching on injury risk in Army recruits. *Aust J Physiother*. 1998;44(3):165-172. https://doi.org/10.1016/S0004-9514(14)60376-7
4. Willems TM, Witvrouw E, Delbaere K, Mahieu N, De Bourdeaudhuij I, De Clercq D. Intrinsic risk factors for inversion ankle sprains in male subjects: a prospective study. *Am J Sports Med*. 2005;33(3):415-423. https://doi.org/10.1177/0363546504268137
5. . Willems TM, Witvrouw E, Delbaere K, Philippaerts R, De Bourdeaudhuij I, De Clercq D. Intrinsic risk factors for inversion ankle sprains in females–a prospective study. *Scand J Med Sci Sports*. 2005;15(5):336-345. https://doi.org/10.1111/j.1600-0838.2004.00428.x
6. Malliaras P, Cook JL, Kent P. Reduced ankle dorsiflexion range may increase the risk of patellar tendon injury among volleyball players. *J Sci Med Sport*. 2006;9(4):304-309. https://doi.org/10.1016/j.jsams.2006.03.015
7. Kaminski TW, Hertel J, Amendola N, et al. National Athletic Trainers' Association position statement: conservative management and prevention of ankle sprains in athletes. *J Athl Train*. 2013;48(4):528-545. https://doi.org/10.4085/1062-6050-48.4.02
8. Barrett A CB. Weight-bearing dorsiflexion is associated with sagittal plane kinematics during gait. *J Sports Med Phys Fitness*. 2009;39(10):A20. https://doi.org/10.23736/S0022-4707.17.07348-0
9. Hoch MC, Staton GS, McKeon PO. Dorsiflexion range of motion significantly influences dynamic balance. *J Sci Med Sport*. 2011;14(1):90-92. https://doi.org/10.1016/j.jsams.2010.08.001
10. Hoch MC, McKeon PO. Normative range of weight-bearing lunge test performance asymmetry in healthy adults. *Man Ther*. 2011;16(5):516. https://doi.org/10.1016/j.math.2011.02.012
11. Powden CJ HJ, Hoch, MC. Reliability and minimal detectable change of the weight-bearing lunge test: A systematic review. *Man Ther*. 2015;20(4):524-532. https://doi.org/10.1016/j.math.2015.01.004

Short Term Effects of a Pectoralis Minor Positional Release in Collegiate Swimmers: A Case Series

Jonathan Roman, MS, ATC and Noelle M Selkow, PhD, ATC
Illinois State University, Normal, IL

ABSTRACT

A tight pectoralis minor correlates to abnormal scapular kinematics, which can cause pain, loss of range of motion and even loss of function, due to the change in scapular position. With these muscular imbalances causing forward scapular posture, the pectoralis minor is a key component to address in the prevention and treatment of shoulder impingement and scapular dyskinesis. This study investigated the effectiveness of a single positional release therapy (PRT) treatment of the pectoralis minor on scapular posture in collegiate swimmers immediately and 24 hours post intervention. Seventeen Division III collegiate swimmers (7 males and 10 females) volunteered to participate, with only one shoulder being excluded due to recent injury (n=33). Researchers measured resting pectoralis minor muscle length, forward shoulder posture and scapular elevation of both shoulders. Data were collected a total of 3 times; prior to the PRT intervention, right after the intervention and again 24 hours post intervention. Each shoulder was treated with a single session of PRT on the pectoralis minor. There was a significant difference for resting pectoralis minor length immediately post-intervention compared to baseline (p=.016). Scapular positioning at 0° abduction had a statistically significant improvement in position from immediate post-intervention to 24 hours post-intervention (p=.014). Scapular positioning at 90° of abduction also had a statistically significant increase in position from baseline to immediate post-intervention (p=.042). For forward shoulder posture, there was a statistically significant improvement in position from baseline to immediate post- intervention (p≤.001). The results of this case series show that a single treatment of PRT has an immediate effect in reducing resting pectoralis minor muscle length and decreasing rounded shoulder posture. However, this single treatment of PRT was not enough to maintain these effects after 24 hours, and should be combined with other manual therapies or rehabilitation protocols to address scapular positioning in collegiate swimmers.

Key Phrases
Manual techniques, injury risk reduction, college and university patient population

Correspondence
Dr. Noelle M Selkow, Illinois State University, School of Kinesiology and Recreation, Cmaous Box 5120, Normal, IL, 61761.
E-mail: nselkow@ilstu.edu
Twitter: @docselkow

Full Citation
Roman J, Selkow NM. Short Term Effects of a Pectoralis Minor Positional Release in Collegiate Swimmers: A Case Series. *Clin Pract Athl Train.* 2018;1(2):42-48.
https://doi.org/10.31622/2018/0002.7

Submitted: August 29, 2018 **Accepted:** October 15, 2018

INTRODUCTION

There is a consistently growing population of collegiate swimmers within Division I, II, and III institutions totaling around 486,000 swimmers in the 2015-16 academic year.[1] Competitive swimming athletes are at risk for shoulder injury due to an excessive amount of shoulder revolutions that can cause the anterior shoulder musculature to hypertrophy.[2] During the freestyle, butterfly, and backstroke of competitive swimming, the athlete is consistently applying adduction and internal rotation forces from the shoulder in order to propel themselves through the water, which may lead to an imbalance of agonist-antagonist muscles.[3] This muscular imbalance often leads to scapular dyskinesis, which is defined as abnormal movement patterns causing alteration of optimal scapular kinematics.[4,5]

The pectoralis minor specifically has been related to shoulder pain in swimmers,[2] and scapular dyskinesis due to its shortened muscle length.[6,7] A tight pectoralis minor can be either a primary or secondary cause of shoulder pain,[8] and the diminished muscle length prohibits proper scapular upward rotation, posterior tilting and external rotation.[9-11] Often times swimmers with bilaterally tight pectoralis minor muscles develop forward scapular posture, which has been described as a forward head and rounded shoulders position, and contributes to shoulder impingement.[2,9,12] Previous studies have stated that the pectoralis minor muscle tightness is typically due to adaptive changes in the muscle belly from repetitive motions that involve scapular protraction and anterior tilting and/or by maintaining a static shortened position over time.[8,9] With these muscular imbalances causing forward scapular posture, the pectoralis minor is a key component to address in the prevention and treatment of shoulder impingement and scapular dyskinesis.[9,11,13,14] Manual therapies such as stretching,[13-15] Muscle Energy Technique (MET),[16] and Myofascial Trigger Point[17] have shown to be effective in treating shoulder impingement symptoms. Previous research articles have addressed the need for interventions that can increase the pectoralis minor resting length in shoulder rehabilitation protocols.[2,7,11,12]

Positional Release Therapy (PRT), under the umbrella of strain–counterstrain,[18] is similar to Myofascial Trigger Point.[19] Strain-counterstrain addresses dysfunctional tissue by putting them in a slacked position to decrease activity from proprioceptors.[20] However, PRT uses tender points and a position of comfort to resolve the associated dysfunction, instead of attempting to stretch the muscle.[21,22] Unlike Myofascial Trigger Points that are hyperirritable bands of tissue, tender points are discrete areas of tissue tenderness that can occur anywhere in the body.[21,22] PRT treatment begins by identifying a tender point, the clinician positioning the patient in a position of comfort that is typically obtained by shortening tissues around the tender point while a slight touch monitors the position.[23,24] This position is then held for 90 seconds, and then slowly returning the patient to normal resting position.[22,23] Although this technique has been around for many years,[25] and there has been some evidence of its clinical usefulness,[26-28] further research on the effects of PRT are still needed.[21,22,29-31]

The purpose of this study was to investigate the effectiveness of a single PRT treatment of the pectoralis minor on scapular posture in collegiate swimmers immediately and 24 hours post intervention. The hypothesis is that the PRT intervention will lengthen the pectoralis minor, decrease the forward scapular position and increase scapular upward rotation in the group of collegiate swimmers.

METHODS

Design

This design of this investigation was a case series, where the athletic trainer for the swim team performed all PRT treatments and measurement. The athletic trainer was certified for 1.5 years. The athletic trainer attended a PRT course for the upper extremity and was trained in the technique utilized in this study. All participants received the intervention on both shoulders, unless excluded. There was no true control group, as the athletic trainer and coach wanted all swimmers to receive a potentially beneficial treatment. Hence, this was a sample of convenience. The independent variables were intervention (PRT to the pectoralis minor) and time (baseline, immediately post intervention, and 24-hours post intervention). The dependent variables were pectoralis minor length (cm), forward shoulder posture as measured with the double square (cm), and scapular position in 0°, 45°, and 90° of shoulder abduction (cm).

Participants

Participants included 17 Division III Collegiate swimming athletes (7 males and 10 females; Age: 20.0 ± 1.4 years; Height: 170.9 ± 8.6 cm; Mass: 69.3 ± 12.8 Kg). Shoulders of swimmers that had a recent history (past 6 months) of upper extremity injury or any history of upper extremity surgery were excluded from the study Only one participants' shoulder was not measured due to recent injury (n=33). All participants were in the post season at the time of data collection. Both left and right shoulders were used for data collection. The institutional review board at the university approved this study and all participants signed informed consent.

Resting Pectoralis Minor Length Measurement

Participants were instructed to lie supine with arms at their side in a relaxed position. The measurement landmarks were from the medial inferior angle of the coracoid process to the anterior-inferior edge of the 4th rib, 1 finger width lateral to the sternum.[32] Using the Pectoralis Minor Index (PMI),[9] each shoulder was measured in centimeters then divided by the participants height in centimeters and multiplied by 100 to account for limb height. (Figure 1)

Forward Shoulder Posture Measurement

After palpating the anterior tip of the acromion process on the participants shoulder, the location was marked on the participant's skin with a permanent marker. The participant was then instructed to move backwards towards the wall until their heels and back touched the wall. The examiner then positioned the double square instrument over the shoulder being examined. With one square flush against the wall, the other square adjusted until it touched the tip of the acromion process marked previously measured in centimeters (cm).[33] (Figure 2)

Scapular Positioning

We measured the participant's scapular mobility using the Lateral Scapular Slide Test (LSST).[34] The examiner used a cloth measuring tape to determine the distance from the inferior angle of the scapula to the nearest spinous process in 3 different shoulder positions in centimeters (cm). The first position was with their arms relaxed at their sides (0° abduction). The second was with the participant's hands on their hips with their fingers on the anterior side and thumbs on the posterior side of their waist, with about 10° of shoulder extension (45° abduction). The third position is with their arms at 90° of shoulder elevation with their thumbs pointed downward. (Figures 3-5)

Positional Release Therapy for the Pectoralis Minor

The participant was placed supine on the table. Using one hand to palpate for tender points, the examiners other hand grasped the forearm of the treatment side. Upon finding a tender point, the examiner monitored the palpation and began to move the treatment arm across the body towards the opposite hip, and then applied a distraction force with internal rotation to fine tune the position so that the fasciculation response was most prominant.[22] The fasciculation response is a continuous small amplitude twitch, similar to a pulse, where the tender point is located and examiner's fingers are located. The position of comfort was painless and allowed the participant to relax. The examiner held this position for 90 seconds (Figure 6) and then slowly returned the arm to neutral and re-evaluated the tender point. A successful treatment was determined by a decrease in pain on the tender point as indicated by the patient. The examiner repeated the procedure for all tender points located on the involved pectoralis minor muscle. No other interventions were used.

Procedures

Data measurements were collected a total of 3 times on each participant. They were measured prior to the PRT intervention, right after the intervention and again 24 hours post intervention. During the length of the study (24 hours), the participants were not to participate in any physical activity.

Statistical Analysis

Separate paired-samples t-test were conducted to evaluate the effect of PRT for the pectoralis minor on pectoralis minor length, scapular positioning, and forward shoulder posture. Cohen's d effect sizes were calculated for significant findings. Alpha was set *a priori* at $\alpha=0.05$. IBM SPSS Statistics 25 (Chicago, IL) was used for statistical analysis.

RESULTS

Means and standard deviations, along with p-values and effect sizes are presented in Table 1. The only significant finding with an effect size that did not cross zero was for forward shoulder posture. Forward shoulder poster decreased immediately after the PRT intervention, but the results were not maintained 24 hours post-intervention.

DISCUSSION

Due to the nature of the sports, repetitive motions of the shoulder tend to cause muscular imbalances and can lead to injury.[2,3] Because of this, clinicians and health care professionals utilize a variety of manual techniques to address the over active anterior muscles that may contribute to injury.

Table 1. Means, SD, and p-values of Clinical Outcomes. Effect sizes for significant p-vales provided

	Baseline	Post-Intervention	Post-Intervention to Baseline p value	24 hrs Post-Intervention	24 hrs Post-Intervention to Post-Intervention p value	24 hrs Post-Intervention to Post-Intervention p value
Pectoarlis Minor Length (cm)	18.02±1.14	18.38±1.25	P=.016 ES=.36 (-.12 -.85)	18.06±1.17	P=.016 ES=.26 (-.22 -.75)	P=.813
Scapular Position 0° (cm)	9.40±1.53	9.47±1.67	P=.701	9.76±1.89	P=.014 ES=.18 (-.31-.66)	P=.098
Scapular Position 45° (cm)	10.18±1.44	10.18±1.48	P=.955	10.26±1.45	P=.162	P=.441
Scapular Position 90° (cm)	10.53±1.84	10.23±1.71	P=.042 ES = -.17 (-.65-.32)	10.79±1.82	P≤.001 ES = .35 (-.13-.84)	P=.172
Forward Shoulder Posture (cm)	15.81±1.55	14.85±1.5	P≤.001 ES = -.67 (-1.16–-.17)	15.64±1.42	P≤.001 ES = -.54 (-1.03–-.05)	P=.379

Although PRT is becoming more popular among clinicians, there is no previous research using PRT on the pectoralis minor in swimmers. This case series has indicated that there is merit to PRT, when used to address the pectoralis minor in asymptomatic swimmers, to decrease rounded shoulders posture after a single treatment session.

A tight or shortened pectoralis minor has been correlated to abnormal scapular kinematics, causing the rounded shoulder posture observed in most swimming athletes.[2,6,12,15,16] The increased anterior tilting, internal rotation and downward rotation of the scapula is partly due to the line of pull of the pectoralis minor,[9] along with other muscles, such as the pectoralis major and scapular retractors.[35]

From our findings, PRT seems to influence forward shoulder posture immediately after intervention to the pectoralis minor. Clinicians can utilize this technique during a rehabilitation session to help position the scapula in more neutral position before strengthening exercises are implemented.

Therefore, the muscles around the scapula will be strengthened in a more optimal position. Strengthening exercises alone may take as long as 8 weeks to correct scapular positioning.[36] Compared to other manual therapy treatments, muscle energy technique has been shown to increase pectoralis minor length and decrease forward shoulder posture after a 6-week intervention,[16] although it is unknown what changes would occur after 1 session of muscle energy technique. With limited research on manual therapy for forward shoulder posture, PRT seems to be a good option when initially addressing this condition.

There were some limitations to this study that could attribute to the results that were found. The PRT treatment session was altered from the current treatment protocol of holding the position of comfort until fasciculation decreases significantly

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or ceases, to holding for a set time of 90 seconds, to help standardize the treatment for all participants in this study.[21,22,31] Furthermore, when using PRT to treat injuries of the shoulder, such as shoulder impingement or scapular dyskinesis, multiple muscles need to be identified and treated over multiple sessions to correct the problem.[22,31] Lastly, the single PRT session was done by a clinician with novice training, and not a full certified PRT clinician.

For future research studies a full PRT treatment involving multiple targeted muscles should be performed as outlined by Speicher.[22] The treatment should be performed by a PRT certified clinician, and there needs to be more than one treatment session. Furthermore, more measurements should be taken, such as a visual analog pain rating scale, humeral abduction ROM and humeral horizontal abduction ROM. Also, future research should look into seeing if dominant arm and breathing side plays a role in ROM restrictions in each swimmer.

CLINICAL APPLICATION

This case series was used to identify if PRT was an effective treatment method to influence scapular posture in collegiate swimmers. The results of this case series show that a single treatment of PRT may have an immediate effect in reducing resting pectoralis minor muscle length and decreasing rounded shoulder posture. However, this single treatment of PRT was not enough to maintain these effects after 24 hours, and should be combined with other manual therapies or rehabilitation protocols to address scapular dyskinesis in collegiate swimmers.

REFERENCES

1. Irick E. *NCAA Sports Sponsorship and Participation Rates Report 1981-82 – 2015-16*. Indianapolis, IN: National Collegiate Athletic Association; 2016.
2. Kluemper M, Uhl T, Hazelrigg H. Effect of stretching and strengthening shoulder muscles on forward shoulder posture in competitive swimmers. *J Sport Rehabil*. 2006;15(1):58-70. https://doi.org/10.1123/jsr.15.1.58
3. Troup JP. The physiology and biomechanics of competitive swimming. *Clin Sports Med*. 1999;18(2):267-285. https://doi.org/10.1016/S0278-5919(05)70143-5
4. Kibler WB, Ludewig PM, McClure P, Uhl TL, Sciascia A. Scapular Summit 2009: Introduction. July 16, 2009, Lexington, Kentucky. *J Orthop Sports Phys Ther*. 2009;39(11):A1-A13. https://doi.org/10.2519/jospt.2009.0303
5. Kibler WB, Ludewig PM, McClure PW, Michener LA, Bak K, Sciascia AD. Clinical implications of scapular dyskinesis in shoulder injury: The 2013 consensus statement from the 'Scapular Summit'. *Br J Sports Med*. 2013;47(14):877-885. http://dx.doi.org/10.1136/bjsports-2013-092425
6. Ludewig PM, Cook TM. Alterations in shoulder kinematics and associated muscle activity in people with symptoms of shoulder impingement. *Phys Ther*. 2000;80(3):276-291.
7. McClure P, Greenberg E, Kareha S. Evaluation and management of scapular dysfunction. *Sports Med Arthrosc*. 2012;20(1):39-48. https://doi.org/10.1097/JSA.0b013e31824716a8
8. Morais N, Cruz J. The pectoralis minor muscle and shoulder movement-related impairments and pain: Rationale, assessment and management. *Phys Ther Sport*. 2016;17:1-13. https://doi.org/10.1016/j.ptsp.2015.10.003
9. Borstad JD, Ludewig PM. The effect of long versus short pectoralis minor resting length on scapular kinematics in healthy individuals. *J Orthop Sports Phys Ther*. 2005;35(4):227-238. https://doi.org/10.2519/jospt.2005.35.4.227
10. Muraki T, Aoki M, Izumi T, Fujii M, Hidaka E, Miyamoto S. Lengthening of the pectoralis minor muscle during passive shoulder motions and stretching techniques: A cadaveric biomechanical study. *Phys Ther*.

 ISSN Online 2577-8188

2009;89(4):333-341. https://doi.org/10.2522/ptj.20080248
11. Lee JH, Cynn HS, Yi CH, Kwon OY, Yoon TL. Predictor variables for forward scapular posture including posterior shoulder tightness. *J Bodyw Mov Ther*. 2015;19(2):253-260. https://doi.org/10.1016/j.jbmt.2014.04.010
12. Hibberd EE, Oyama S, Spang JT, Prentice W, Myers JB. Effect of a 6-week strengthening program on shoulder and scapular-stabilizer strength and scapular kinematics in division I collegiate swimmers. *J Sport Rehabil*. 2012;21(3):253-265.
13. Rosa DP, Borstad JD, Pogetti LS, Camargo PR. Effects of a stretching protocol for the pectoralis minor on muscle length, function, and scapular kinematics in individuals with and without shoulder pain. *J Hand Ther*. 2017;30(1):20-29. https://doi.org/10.1016/j.jht.2016.06.006
14. Turgut E, Duzgun I, Baltaci G. Stretching Exercises for Subacromial Impingement Syndrome: Effects of 6-Week Program on Shoulder Tightness, Pain and Disability Status. *J Sport Rehabil*. 2018;27(2):132-137. https://doi.org/10.1123/jsr.2016-0182
15. Williams JG, Laudner KG, McLoda T. The acute effects of two passive stretch maneuvers on pectoralis minor length and scapular kinematics among collegiate swimmers. *Int J Sports Phys Ther*. 2013;8(1):25-33.
16. Laudner KG, Wenig M, Selkow NM, Williams J, Post E. Forward shoulder posture in collegiate swimmers: A comparative analysis of muscle-energy techniques. *J Athl Train*. 2015;50(11):1133-1139. https://doi.org/10.4085/1062-6050-50.11.07
17. Bron C, de Gast A, Dommerholt J, Stegenga B, Wensing M, Oostendorp RA. Treatment of myofascial trigger points in patients with chronic shoulder pain: A randomized, controlled trial. *BMC Med*. 2011;9:8. https://doi.org/10.1186/1741-7015-9-8
18. Jones LH. Spontaneous release by positioning. *AAO Journal*. 2012;22(1):54-61.
19. Segura-Ortí E, Prades-Vergara S, Manzaneda-Piña L, Valero-Martínez R, Polo-Traverso JA. Trigger point dry needling versus strain-counterstrain technique for upper trapezius myofascial trigger points: A randomised controlled trial. *Acupunct Med*. 2016;34(3):171-177. http://dx.doi.org/10.1136/acupmed-2015-010868
20. Jones L, Kusunose R, Goering E. Jones Strain-counterstrain. Boise, ID: Jones Strain-Counterstrain, Inc; 1995.
21. Speicher TE, Draper DO. Top-10 positional-release therapy techniques to break the chain of pain: Part 1. *Athletic Therapy Today*. 2006;11(5):60-62.
22. Speicher TE. *Clinical Guide to Positional Release Therapy*. Champaigne, IL: Human Kinetics; 2016.
23. Chaitow L. *Positional release techniques*. 3rd ed. Philadelphia: Churchill Livingstone Elsevier; 2007.
24. D'Ambrogio K, Roth G. *Positional release therapy: Assessment and treatment of musculoskeletal dysfunction*. St. Louis: Mosby; 1997.
25. Jones L. *Strain-counterstrain*. Indianapolis: Jones Strain-Counterstrain Inc; 1995.
26. Meseguer A, Fernandez-de-las-Penas C, Navarro-Poza J, Rodriguez-Blanco C, Bosca Gandia J. Immediate effects of the strain-counterstrain technique in local pain evoked by tender points in the upper trapezius muscle. *Clinical Chiropractic*. 2006;9:112-118. https://doi.org/10.1016/j.clch.2006.06.003
27. Dardzinski JA, Ostrov BE, Hamann LS. Myofascial pain unresponsive to standard treatment: Successful use of a strain and counterstrain technique with physical therapy. *J Clin Rheumatol*. 2000;6(4):169-174. https://doi.org/10.1097/00124743-200008000-00001
28. Kelencz CA, Tarini VA, Amorim CF. Trapezius upper portion trigger points treatment purpose in positional release therapy with electromyographic analysis. *N Am J Med Sci*. 2011;3(10):451-455. https://doi.org/10.4297/najms.2011.3451
29. Wong CK. Strain counterstrain: Current concepts and clinical evidence. *Man Ther*.

2012;17(1):2-8. https://doi.org/10.1016/j.math.2011.10.001
30. Wong CK, Abraham T, Karimi P, Ow-Wing C. Strain counterstrain technique to decrease tender point palpation pain compared to control conditions: A systematic review with meta-analysis. *J Bodyw Mov Ther*. 2014;18(2):165-173. https://doi.org/10.1016/j.jbmt.2013.09.010
31. Speicher TE, Draper DO. Top-10 positional-release therapy techniques to break the chain of pain: Part 2. *Athletic Therapy Today*. 2006;11(6):56-58.
32. Borstad JD. Measurement of pectoralis minor muscle length: Validation and clinical application. *J Orthop Sports Phys Ther*. 2008;38(4):169-174. https://doi.org/10.2519/jospt.2008.2723
33. Peterson DE, Blankenship KR, Robb JB, et al. Investigation of the validity and reliability of four objective techniques for measuring forward shoulder posture. *J Orthop Sports Phys Ther*. 1997;25(1):34-42. https://doi.org/10.2519/jospt.1997.25.1.34
34. Kibler WB. The role of the scapula in athletic shoulder function. *Am J Sports Med*.1998;26(2):325-337. https://doi.org/10.1177/03635465980260022801
35. Ludewig PM, Reynolds JF. The association of scapular kinematics and glenohumeral joint pathologies. *J Orthop Sports Phys Ther*.2009;39(2):90-104. https://doi.org/10.2519/jospt.2009.2808
36. Paulson G, Selkow NM, Begalle RL. The effects of a shoulder strengthening program on scapular positioning in collegiate swimmers. *J Ath Train*. 2018; 6 (53):S42. https://doi.org/10.4085/1062-6050-53.6s.s1