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Deep Vein Thrombosis in Lower Extremity of a Female Collegiate Volleyball Athlete: A Case Study

Lucas D. Dargo, DAT, LAT, ATC - Manchester University
Kendra Borton, LAT, ATC - Manchester University
Rachel Roths, LAT, ATC - Manchester University
Zachary Dougal, DAT, LAT, ATC - Ball State University

Thank You for Your Service!

Lindsey E. Eberman, PhD, LAT, ATC
Indiana State University, Terre Haute, IN

Thank You for Your Service!

The editorial board wants to thank all those who serve or have served *Clinical Practice in Athletic Training*, this year. As we continue to evolve, we have had several Section Editors move on, while we are honored to welcome new Section Editors. Let us first thank Brian Vesci, Esther Nolton, and Alison O'Connor Sutherland for their service to the Journal. Thank you for your continued support, contributions, and dedication to clinical practice research. And, a great welcome to Tim Nicollelo (Disablement Model Case Studies and Reports), S. Andrew Cage (Validation Case Studies and Reports), Kim Barber Foss (Point-of-Care Research), and Nick Pfeifer (Quality Improvement Reports).

We continue to evolve as a Journal and we are happy to announce Dr. Zachary Winkelmann will be joining the Senior Editorial Board and Dr. Matthew Drescher and Ms. Kelcey Granger will be joining the team as Staff Editors. We are hopeful that these small changes will help better support Section Editors, Reviewers, and Authors.

Below we recognize our section editors and reviewers who have contributed to the Journal over the past year:

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Rethinking Quality Improvement in Athletic Health Care

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Key Phrases
Continuous Improvement, systems-level, individual process improvement

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EDITORIAL

The concept of continuous quality improvement (CQI) has gained more recognition within the profession of athletic training in recent years. With the new transition into the professional-level master's degree and the Commission on Accreditation of Athletic Training Education standards related to quality assurance in health care, it is no surprise that we are starting to talk about CQI more seriously. The purpose of this editorial is to speak frankly to our audience about how potentially unattainable large-scale, systems-level CQI is for an individual athletic trainer. From a behavioral change perspective, we are asking athletic trainers to equivocally overtake a mountain with no training. Our goal is to make CQI achievable for each athletic trainer in their own system, on their own terms. Some may question this philosophy, but because we are relative infants in this world of quality improvement, we propose an alternative.

Forms of CQI can vary, which may cause confusion, especially since formal training has been omitted in athletic training education to this point. Currently, a majority of the literature that exists in athletic training that focuses on CQI involves broad-level, large systems process improvement. Here, practicing athletic trainers serve to enter data into large databases such as the Athletic Training Practice-Based Research Network (ATPBRN); High School Reporting Information Online (High School RIO), National Athletic Treatment, Injury, and Outcomes Network (NATION); or NCAA Injury Surveillance Program. This evidence and information is meaningful and informs clinical practice in a way that can help us align our practice with best evidence. But, this asks athletic trainers not to reflect on their own practice or system, but to enter data to inform the larger profession. Meaningful, but not the fuel necessary to create change within their own practice.

There is a need for athletic trainers to share their experiences and data that they gather both in individual and systems level CQI processes. By sharing these experiences through dissemination, other athletic trainers can become aware of these individual CQI processes and improve their own practice. This identification and initial process improvement at the individual level is what will aid in athletic trainers becoming involved in process improvement within their organization at a system-level (**Figure 1**). Imagine an athletic trainer at a secondary school performs a small scale improvement project with a specific patient panel that they provide care for. They implement incremental change and track outcomes to make data driven decisions on the improvement project. This athletic trainer can then share their findings with another athletic trainer at the secondary school or at a similar school within the same system (e.g. healthcare system). They collaborate to expand the project. This shared project can then continue to grow between schools and eventually become a

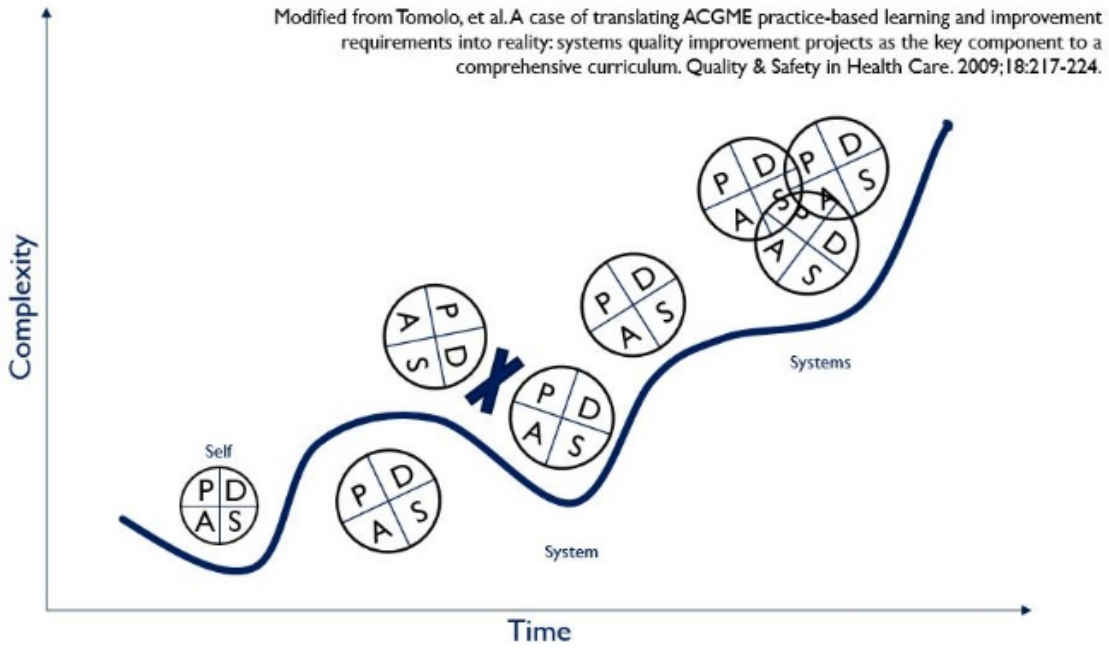

Figure 1. Translation of Individual PDA Cycles to Systems-Level Approach

project that is implemented within the whole system. This is the eventual goal of CQI on the system-level. However, these progressive steps remain grounded in individual action.

Systems-based evaluation of clinical outcomes is the pinnacle of CQI, but there are many different frameworks, theories, or approaches to CQI in health care, most of which require action down to an individual level. Regardless of the patient care or process that is the target for improvement, individual actions will lead to overall, sustainable change within the system. It is these individual actions that can build upon one another, spread across multiple providers that can lead to larger process improvement and larger change. This initiation of CQI at an individual level can fuel the momentum into larger systems-level change.

There are many different CQI practices that athletic trainers can begin to implement on either an individual or systems-level. We have summarized a small portion of these in **Table 1** to help begin to expose athletic trainers to these methods. Of particular interest within athletic training is the practice of checklist or standard work. By creating tools such as checklists for the processes within an athletic training clinic individual athletic trainers can help mitigate errors or make requirements explicit can help ensure quality of care. Further, by standardizing the processes or the work in individual clinics athletic trainers can ensure that work is done in a consistent way, leading to improvements in care.

With the addition of quality assurance in the CAATE Standards as well as the push for CQI in health care it is important we continue to disseminate the findings of athletic trainers from various settings using various CQI methodologies. Therefore we are excited to announce the expansion of our Quality Improvement Section to include more methods than the Model of Improvement (Plan, Do, Study, and Act (PDSA) cycle) to include various CQI methodologies examining improvements in practice. Readers can find the new expanded section at our Manuscript Guidelines. We encourage authors to consider submitting their work in CQI for consideration for publication to continue to disseminate their experiences and help other athletic trainers learn and engage with improvement measures.

Table 1. Continuous Quality Improvement Practices

Tool	Brief Description and When to Use
Affinity Diagram[1]	Affinity diagrams are the organized output of brainstorming with a group of individuals. Affinity diagrams can be used when: • A problem must be solved at all costs • An easy solution is not found • Time is needed to analyze the problem • Participation of individuals promotes mutual understanding
Waste Reduction[2]	Waste reduction is a strategy to improve the function of a system by eliminating waste. Common examples of where waste can be found include overproduction (e.g. unnecessary referrals), waiting, unnecessary processing, staff movement, defects, transportation, and inventory.
Checklist[3]	The idea of a checklist is a simple tool. Critical quality control steps are sometimes overlooked without checklists. Many healthcare functions benefit from the use of checklists which makes explicit the requirements for quality. A good checklist assures that the work has been done correctly and completely.
Standard Work[4]	Good quality requires that work be done in a consistent way. Interventions to develop a better way will only have an impact on practice if the new practice results in change that is consistent and reliably implemented. Standard work is a written description which is communicated and followed by all staff involved in a specific process.

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Quality Improvement in Athletic Training Education on Female Athlete Triad

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ABSTRACT

There are significant health risks associated with the female athlete triad (Triad), therefore early detection and prevention is key. Athletic trainers often serve as the frontline defense and can have a crucial role in identifying the Triad. Yet knowledge, confidence, and practice standards in the recognition, referral and treatment is lacking. The purpose of the following Quality Improvement document is to provide athletic trainers with a framework for improving Triad-specific knowledge, confidence, and practice standards. The 2014 Female Athletic Triad Coalition consensus statement provides an evidence-based risk stratification system for detection and referral of the Triad. The Coalition suggests including Triad-specific preparticipation examination (PPE) screening questions and utilization of the Female Athlete Triad Cumulative Risk Assessment on all clearance and return to play decisions for female athletes. Though there are efforts to educate athletic trainers about disordered eating in athletes, these efforts do not specifically include the Triad. Many female athletes are currently being cleared at their PPE without being adequately assessed for this syndrome or without appropriate referral for management and treatment. Therefore, it is important for ATs to improve their knowledge, confidence, and practice standards specific to the Triad.

Key Phrases
Injury risk reduction, preparticipation exams and screening, college and university patient population, female athlete triad

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CURRENT MODEL

The syndrome of female athlete triad (Triad) was defined in 1997 in an American College of Sports Medicine position statement.[1] Modified from its original definition, the three components of the Triad now include low energy availability with or without disordered eating, menstrual dysfunction, and low bone mineral density.[1,2] Previously, the prevalence of the Triad was thought to be 1-4% and impacting mostly endurance athletes.[1,2] However the current definition is much more encompassing and emphasizes the fact that the components do not need to present simultaneously. Therefore, the prevalence of the Triad expected to be much higher and among a much larger population.[1,2] Since the Triad was identified, recognition and prevention strategies have emphasized a collaborative effort among healthcare providers.[2-4] Due to the nature of many traditional athletic training settings and the high level of interaction with athletes, certified athletic trainers (ATs) often act as the frontline defense and an integral part of the Multidisciplinary team in identifying athletes at risk for eating disorders.[4]

The current processes in place to educate entry-level athletic trainers on the assessment, identification, and management of the Triad fall under competency PHP-43, PHP-46, and PHP-47 in the 5th edition of the competencies published by the Commission on Accreditation of Athletic Training Education (CAATE).[5] The competencies are[5]:

- PHP-43: describe the principles and methods of body composition assessment to assess a

patient's health status and to monitor changes related to weight management, strength training, injury, disordered eating, menstrual status and/or bone density status.

- PHP-46: Identify and describe the signs, symptoms, physiological and psychological responses of patients with disordered eating or eating disorders.

- PHP-47: Describe the methods of appropriate management and referrals for patients with disordered eating or eating disorders in a manner consistent with current practice guidelines. (NATA, 2011, p.15).

A new edition of the competencies will be published in 2020 by the CAATE, however the new standards continue to not specifically mention the Triad.[6] In 2008, the National Athletic Trainers' Association (NATA) published a position statement on preventing, detecting, and managing disordered eating in athletes.[4] This statement emphasizes that a crucial action for the AT is to establish a screening approach for disordered eating that "recognizes signs and symptoms of the full spectrum of maladaptive eating and weight loss behaviors, as well as predisposing risk factors associated with their development" (p.81).[4] This can be achieved through medical history questions on the PPE as well as standardized, self-reported screening questionanaires.[4] These questionnaires are not without their flaws for the athletic population. Athletes can feel shame, guilt, and denial associated with eating disorders or could be worried that their athletic careers could be jeopardized if their coach found out about their eating disorder. Therefore, the accuracy of responses in a self-reported screening questionnaire may be poor.[4,7-9] Numerous screening instruments have been designed specifically for the athletic population. However, the concern about these screening instruments is the lack of extensive testing for internal and criterion validity, response bias, and generalizability.[4,10] Therefore, the combination of screening methods to include the PPE, standardized self-reported questionnaires, individual interviews, and direct observation of athletes is described to be best practices for identifying and preventing disordered eating.[4]

The dissemination of knowledge regarding the screening and treatment of the Triad is lacking.[11, 12] In a recent investigation of collegiate athletic trainers' knowledge of the Triad, it was found that while about half of ATs have heard of the Triad, most could not accurately define the disorder.[12] Further, most ATs are not engaging in appropriately targeted screening or treatment recommendations.[12] It is possible that since CAATE competencies and the NATA position statement addresses disordered eating as a more general category and do not specifically address the Triad, the knowledge, identification, appropriate screening, and treatment of the Triad remain low[12] and do not lend to early detection of this syndrome specifically.[12] Specifically, only 38% of ATs are able to correctly identify the three components of the Triad. While about half of athletic trainers screen collegiate athletes for unspecific eating disorders, only 26% of ATs screen specifically for the Triad.[11, 12] Furthermore, only 18% of ATs felt comfortable treating the Triad.[11] In 2014, a consensus statement was published which included the "Female Athlete Triad Cumulative Risk Assessment Score" focusing on the clinical management of athletes affected by the Triad.[13] The publication also includes a screening tool to identify and assess at-risk athletes. These guidelines, which are uniquely specific to the Triad rather than other screening instruments identifying unspecific disordered eating, were not found in most athletic training literature or implemented into practice within the athletic training profession.

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In a review of the practice processes for athletic trainers at the target collegiate setting, we found no formal screening tool were used to evaluate for the Triad. For two years prior to the start of the current study, 18 stress fractures in female athletes were recorded out of 234 total female athletes' measures (rate of .077 per 100 athlete-exposures (AEs)). For national comparison, data from a 10-year NCAA Injury Surveillance Program reported a total of 671 stress fractures over 1,1778,145 AEs for an overall injury rate of 5.70 per 100,000 AEs.[14] Within our practice review, athletes who suffered these injuries lost a total of 848 days of sport participation, averaging 56 days of lost time. Of the 18 female athletes with recorded stress fractures, 14 saw the team Registered Dietitian (RD). Two athletes quit their athletic participation and no longer received services so were excluded from the study and two other females were referred but never met with the RD. Of the 14 athletes seen by the team RD, 85% were identified as having low energy availability with or without disordered eating and other Triad components. At this time, we questioned if there may be an improved process to help ATs increase knowledge specific to the Triad and confidence in early recognition which would result in improved practice.

The purpose of this quality improvement study was to determine if there were significant gains in knowledge, recognition/referral confidence, and practice standards in the Triad through an educational in-service and introduction to PPE Triad-specific screening questions and the Female Athlete Triad Cumulative Risk Assessment in a four-year, Division I institution with 17 collegiate ATs.

PDSA CYCLE

Plan

We first began by researching the specific recommendations for screening female athletes for the Triad and the Female Athlete Triad Cumulative Risk Assessment. Recommendations are to screen female athletes focusing on full menstrual history, energy availability, disordered eating history, and reasons for hormonal therapy use.[15] In this research phase, we found the Triad Coalition reported that early detection of athletes at risk for the Triad is crucial to prevention. While there are concerns of efficacy for many screening tools, the recommendation is that all female athletes undergo annual screening with the triad-specific self-report questionnaire.[13] A list of recommended screening questions may be viewed in **Table 1**. The Triad Coalition further recommends that if the athlete has any risk for one Triad component as identified through the screening process, a more in-depth interview and evaluation should occur. In addition, evidence on risk factors for the Triad demonstrate that low bone mineral density and bone stress injuries is greater with cumulative risk factors for the Triad and therefore should be considered before making clearance or return to participation decisions.[13,16,17] The Female Athlete Triad Cumulative Risk Assessment developed by the Triad Coalition provides an objective method of determining the athlete's risk for the Triad by using evidence-based factors and assigning a point value based on the magnitude of risk (low, medium, high) for assessment criteria and scores.[13] This risk assessment tool was used with permission and may be viewed in **Table 2**. The Triad Coalition recommends utilization of the Female Athlete Triad Cumulative Risk Assessment for all participation and return to participation decisions for female athletes.[13]

Next, we had conversations with our Team Physician, Team RD, and the Head AT. We first spoke with the Team Physician to see if he would support the implementation of the Female Athlete Triad Cumulative Risk Assessment and screening

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Table 1: Triad Consensus Panel Screening Questions*

Have you ever had a menstrual period?
How old were you when you had your first menstrual period?
When was your most recent menstrual period?
How many periods have you had in the past 12 months?
Are you presently taking any female hormones (oestrogen, progesterone, birth control pills)?
▸ Do you worry about your weight?
Are you trying to or has anyone recommended that you gain or lose weight?
Are you on a special diet or do you avoid certain types of foods or food groups?
Have you ever had an eating disorder?
Have you ever had a stress fracture?
Have you ever been told you have low bone density (osteopenia or osteoporosis)?

*The Triad Consensus Panel recommends asking these screening questions at the time of the sport pre-participation evaluation.
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questions into the preparticipation physical examinations for all female athletes. We explained that he would have a role in ordering the bone dual-energy X-ray absorptiometry (DEXA) scans on all athletes (part of the Female Athlete Triad Cumulative Risk Assessment) as well as reviewing all scores and screening question responses before giving final clearance in the preparticipation physical examinations. We discussed the risks and benefits of preforming bone DEXA scans on all athletes and ultimately decided, given the very low radiation used, it was important to include these scans so that we could follow the Female Athlete Triad Cumulative Risk Assessment protocol in its entirety. We also explained that we would involve the ATs by first educating them on the Triad through an in-service and then having them take a role in administering/reviewing screening questions and conducting aspects of the Female Athlete Triad Cumulative Risk Assessment. He reviewed the evidence and agreed to support this.

We spoke to the Team RD (who was also part of the interdisciplinary research team) about her role in implementing the Female Athlete Triad Cumulative Risk Assessment and screening questions in the preparticipation physical exam. Her role would be to educate athletes that scored a moderate or high risk in the assessment on the Triad and develop nutrition goals with the athlete through individual meetings. She agreed to take on this role. It is important to note that the RD for our institution is based on-campus and has a high amount of direct interaction weekly within the athletic training room. There is potential for push-back on requiring large commitments from interdisciplinary team members such as the RD at institutions if their services are structured differently.

Finally, we spoke with the Head AT about 1) implementing the Female Athlete Triad Cumulative Risk Assessment and screening questions into all pre-participation physical examinations for all female athletes at the college, and 2) meeting with and educating all collegiate ATs on the tools and process. We predicted that by meeting with and educating all collegiate ATs on the tools and processes, their knowledge of the Triad, confidence in recognition and when to refer, as well as practice standards involving the Triad would increase. We determined as a group that was best to plan for the implementation of these two goals prior to both pre-participation physicals and before fall practices began.

The last step we took in planning was to develop a knowledge, confidence, and practice standards assessment tool that we could deliver to the athletic trainers. The research team created a 22–question survey assessment that measured all variables. The knowledge, confidence, and practice standards survey assessment were examined for face validity by a panel of experts (n=5) who had experience in survey design. No changes were made to the survey instrument

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Risk Factors	Magnitude of Risk		
	Low Risk = 0 points each	Moderate Risk = 1 point each	High Risk = 2 points each
Low EA with or without DE/ED	☐ No dietary restriction	☐ Some dietary restriction‡; current/past history of DE;	☐ Meets DSM-V criteria for ED*
Low BMI	☐ BMI ≥ 18.5 **or** ≥ 90% EW** or weight stable	☐ BMI 17.5 < 18.5 **or** < 90% EW **or** 5 to < 10% weight loss/month	☐ BMI ≤17.5 **or** < 85% EW **or** ≥ 10% weight loss/month
Delayed Menarche	☐ Menarche < 15 years	☐ Menarche 15 to < 16 years	☐ Menarche ≥16 years
Oligomenorrhea and/or Amenorrhea	☐ > 9 menses in 12 months*	☐ 6-9 menses in 12 months*	☐ < 6 menses in 12 months*
Low BMD	☐ Z-score ≥ -1.0	☐ Z-score -1.0*** < - 2.0	☐ Z-score ≤ -2.0
Stress Reaction/Fracture	☐ None	☐ 1	☐ ≥ 2; ≥ 1 high risk or of trabecular bone sites†
Cumulative Risk (total each column, then add for total score)	**_____ points +**	**_____ points +**	**_____ points = _____Total Score**

Table 1. Female Athlete Triad: Cumulative Risk Assessment

based on their feedback. Reliability of the survey instrument was determined by running a Cronbach alpha on a sample of athletic trainers (n=17) to determine the internal consistency or average correlation of the items in the survey instrument. The overarching alpha for the whole instrument was calculated as a value of 0.92 which suggests the instrument has acceptable reliability.

Do

A pretest posttest design with the survey instrument was utilized to assess if knowledge, confidence, and practice standards in the Triad improved through the educational session and implementation of the PPE screening questions and Female Athlete Triad Cumulative Risk Assessment. On the day of the athletic training educational session, the survey instrument was administered to all 17 ATs (10 full time, 7 intern/graduate assistants) at the college. Responses served as the pretest assessment of Triad knowledge, confidence, and practice standards.

Following the pretest, in an educational session that lasted approximately one hour, the team RD presented information utilizing a self-developed PowerPoint Presentation on the Triad including components, effects of the syndrome, risks, signs and symptoms to watch for, and when to refer. In addition, information specifically on the universities' history with missed time for female athletes with previous Triad diagnoses and goals of the quality improvement study including the athletic trainers' role in the study was included. Finally, a review of the Triad-specific PPE screening questions and the components of the Female Athlete Triad Cumulative Risk Assessment tool was provided. It was explained to the ATs that they would have a role in assisting in the review of the PPE screening questions to identify areas of concern. It was also explained to the ATs that they also may have a role in assisting in administering the Female Athlete Triad Cumulative Risk Assessment. The research team decided it was best for the Team RD to lead this educational session because they were most familiar with the Triad and the Female Athlete Triad Cumulative Risk Assessment tool. Immediately after participating in the educational in-service, the survey instrument was again given to the athletic trainers which served as the posttest assessment of Triad knowledge, confidence, and practice standards.

The educational in-service with the ATs was the quality improvement strategy that we focused on for this study as a way to improve ATs' Triad-specific knowledge, confidence, and practice standards as measured by the results of the pretest posttest survey. However, we would like to disclose that following this educational in-service, action did occur to further implement what was discussed. Like other years, ATs assisted in the preparticipation physical examinations of new and returning athletes on their assigned athletic teams which coincided with the start of specific athletic seasons. It was the ATs' role to review all screening questions (now including those specific to the Triad) in the medical history section of the PPE with the athletes on their team(s). Following this, several graduate assistant ATs completed the Female Athlete Triad Cumulative Risk Assessment on all female athletes in the universities' biomedical laboratory. When considering implementation of this process, please note DEXA scans must be completed by a trained administrator and it is not required that this person be an AT. DEXA scans were performed on all female athletes by the ATs under the order of the Team Physician. Lastly, after the review of all PPE screening questions and the generation of a score for the Female Athlete Triad Cumulative Risk Assessment, those who scored a moderate or high risk for the triad were identified and referred to the Team RD for follow up. We followed this detailed process annually over the next 3 full academic years and tracked new Triad referrals and diagnoses over this time period.

Study

Prior to computing analyses, the responses on the knowledge assessment was screened for accuracy, missing data, outliers and assumptions (normality). The knowledge assessment had 9 items on the pretest and posttest; however, a summary score for both tests were derived and these values were screened and included in the statistical analysis. Data appeared to be accurate without missing values. Also, there were no outliers assessed by boxplots in JASP. Lastly, the data did not appear to be normal as the distribution of the data showed a slight negative skew and had a significant value, using the $p<.05$ criterion, for the Shapiro-Wilk Test of Normality ($p= .022$). However, given that a Paired Samples t-Test is considered a robust analysis, especially with a large sample size, this was the test performed with a total sample size of 17.

A Paired Samples t-test was performed to examine differences in knowledge between the pretest and posttest. Results revealed a significant difference between these two measures, $t(16) = -8.90$, $p< .001$, $d= -2.16$. In other words, knowledge in the Triad significantly increased after participating in the education seminar (Pretest; $M= 6.53$, $S = 0.80$, Posttest; $M= 8.47$, $S= 0.62$). See **Figure 1** for a visual display of the means and +2 standard deviations.

Prior to computing analyses, the responses on the confidence and practice standards assessment was screened for accuracy, missing data, outliers and assumptions (normality). The confidence assessment had 6 items on the pretest and posttest while the practice standards assessment had 7 items; however, a summary score for both assessments for each test (i.e. pretest and posttest) were derived and these values were screened and included in the statistical analysis. Data appeared to be accurate without missing values or outliers assessed by boxplots in JASP. Lastly, the data appeared to be normally distributed as assessed by the distribution and the Shapiro-Wilk Test of Normality (confidence, $p= .859$; practice standards, $p= .193$). There was a total sample size of 17 participants.

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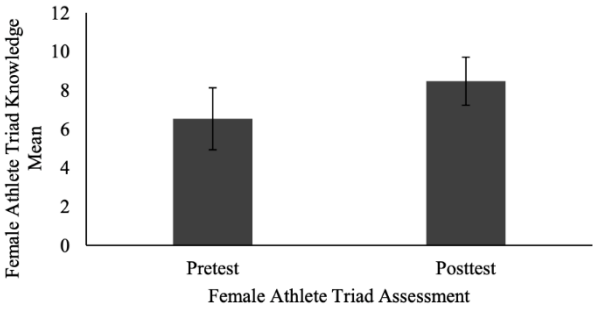

Figure 1. Athletic Trainers' Knowledge on the Female Athlete Triad Assessment

A Paired Samples t-Test was performed to examine differences in confidence between the pretest and posttest. Results revealed a significant difference between these two measures, t(16) = -3.46, p= .003, d= -0.84. In other words, confidence significantly increased after participating in the seminar (Pretest; M= 35.24. S = 10.20, Posttest; M= 40.82, S= 9.22).

A Paired Samples t-test was performed to examine differences in practice standards between the pretest and posttest. Results revealed a significant difference between these two measures, t(16) = -4.24, p< .001, d= -1.03. In other words, practice standards significantly increased after participating in the education seminar (Pretest; M= 4.06. S = 1.78, Posttest; M= 5.12, S= 1.32).

The most significant barrier we found to implementing this educational session was finding a common time where the 17 ATs would all be together and fitting this into their already busy schedules. We determined it was best to provide the educational session separate from the annual in-service day. Due to this barrier it was determined that it should be explored if future educational sessions could be offered as an electronic training module to be completed independently.

Act

Based on what we learned from this quality improvement investigation study, short-term knowledge, confidence, and practice standards in ATs' recognition and referral of the Triad can be significantly improved with a specific educational in-service including an introduction to utilizing Triad-specific screening question on the PPE and the Female Athlete Triad Cumulative Risk Assessment as a guideline for athletic clearance determinations.

Despite widespread awareness and efforts of the Triad, many female athletes are currently being cleared at their PPE without being adequately assessed for this syndrome or without appropriate referral for management and treatment.[13,18] Even with structured education in athletic training education programs and the NATA Consensus Statement as a practice guide, there is a lack of standard of care guidelines for the evaluation and management of the Triad.[13,18] Female athletes with the Triad have significant health risks therefore early detection and prevention is key. The 2014 Female Athlete Triad Coalition Consensus Statement on Treatment and Return to Play of the Female Athlete Triad Expert Panel provides an evidence-based approach to a developed risk stratification system that helps to increase the knowledge, confidence, and practice standards in detection and referral for the Triad. This quality improvement study provides evidence that when athletic trainers receive specific education on the Triad and utilize the PPE screening questions and Female Athlete Triad Cumulative Risk Assessment, their knowledge, confidence, and practice standards for the Triad significantly improves.

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Implementation of a Novel Return-to-Ride Concussion Management Policy for Collegiate Hunter/Jumper Equestrian Athletes

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ABSTRACT

A concussion return-to-participation protocol specific to equestrian is critical in the safe return of athletes to their respective discipline. When the care of the hunter/jumper equestrian teams became the responsibility of the Sports Medicine staff at Sweet Briar College, a return-to-participation concussion management policy was needed to ensure the safety of the equestrian student-athletes. A quality-improvement project focusing on the development of a "Return-to-Ride" protocol was started in the fall semester of 2016. The Sports Medicine staff collaborated with the Sweet Briar College riding center to create and ensure compliance of the protocol. The intended aim of developing this protocol was to create a guideline for concussion management of the equestrian student-athlete that would standardize care across sports and between providers. At the time of this quality improvement cycle, no specific concussion management protocol had been adopted or approved for any discipline of equestrian. Due to the differences between equestrian sports, changes would be need to be made in order to best serve the athlete(s) affected. Using a traditional five-day return-to-play program as an example, the Return-to-Ride (RTR) protocol is seven days of gradual riding for equestrian athletes. This protocol accounts for the specific physical demands and vestibular disruptions associated with equestrian. This Plan, Do, Study, Act (PDSA) cycle was conducted during the fall semester of 2016 to the fall semester of 2019. The purpose of this PDSA cycle was to provide athletic trainers and other healthcare providers with insight on the development and outcomes of a concussion return to participation protocol for equestrian athletes.

Key Phrases
Policy and procedure development, risk management and mitigation, professional standards

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CURRENT MODEL

In 2017, the Sport Science Institute (SSI) of the National Collegiate Athletic Association (NCAA) released updated recommendations on concussion safety management in intercollegiate athletics.[1] The Concussion Safety Protocol Checklist and Diagnosis and Management of Sport-Related Concussion Best Practices interassociation consensus documents serve as the standard to which colleges and universities associated with the NCAA hold their concussion safety management programs.[1] Athletic trainers often serve as the management personnel of student-athletes with concussions from initial evaluation to return to activity.[2] In order to best serve athlete populations, concussion management recommendations state that Return-to-Play (RTP) protocols must include sport-specific exercise.[1] In August 2016, equestrian was granted full access to the Sports Medicine Clinic at Sweet Briar College. The Sports Medicine staff had limited knowledge regarding the demands of the sport, especially when it came to sport-specific activities for concussion management. A RTP protocol specific to equestrian did not exist.

Presently, no aspects of equestrian are considered champion sports in the NCAA, though it has been considered an emerging sport for women at Division I and II since 2002.[3-5] As of September 2019, the NCAA Committee on Women's Athletics voted in favor of a proposal to add equestrian to the NCAA Emerging Sports for Women program at the Division III level.[5] A vote by the Division III membership on the proposal, conducted in January 2020, was narrowly defeated.[5] In order to be considered a champion sport and have

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recognized competitive seasons that end with a championship, 40 programs must declare intent to have a varsity program.[3] For collegiate programs, the options for competition associations include the Intercollegiate Horse Shows Association (IHSA) and National Collegiate Equestrian Association (NCEA).[6,7] At the time of publication, membership in the NCEA extends over all three NCAA divisions with 17 schools in Division I, five in Division II and three in Division III.[8] The IHSA membership extends to 48 states and Canada with over 10,000 participating student-athletes from 577 member schools.[6] No specific concussion management protocol has been adopted or approved by either organization, leaving each member school to manage concussions individually.[6,7] The availability of a concussion management protocol specifically for equestrians would allow for a consistent level of care among member schools within an association.

The purpose of the following document is to describe the use of a quality improvement process in developing an equestrian-specific Return-to-Ride (RTR) concussion management protocol for a collegiate equestrian program. The aim was to develop and implement a guideline for concussion management of the equestrian student-athlete that would standardize care provided by all members of the sports medicine team to the same level given to all other existing sports managed by the sports medicine department. The process for the development and implementation of a sport-specific concussion management protocol, challenges and barriers and outcomes will be discussed.

PDSA CYCLE

Plan

The first step of the development phase was determining individuals who would be critical in a successful creation of a protocol. The primary writer on the protocol in this instance was the Director of Sports Medicine for Sweet Briar, with input and direction from the Team Physician for Sweet Briar Athletics and the Director of Riding at the College.

Equestrian access to sports medicine services varies on the institution. According to the IHSA 2018-2019 Rulebook and NCEA Rulebook (revised in February 2019), a qualified medical professional must be on site for all schooling sessions and the entire length of a performance or show.[10,12] A qualified medical professional is listed as a certified and/or licensed emergency medical technician, paramedic, physician or nurse who is trained in pre-hospital trauma.[10,12] At the collegiate level, access to sports medicine services vary based on the school's distinction of the team, whether it be club or varsity status. Further research and advocacy is currently being conducted to propose the creation of a standard by which collegiate equestrian teams receive access to sports medicine services and the allowance of athletic trainers to be deemed qualified medical professionals by IHSA and NCEA standards.

Researching the specific demands, physical and mental, is needed for the creation of sport-specific policies. Although created and initially implemented using hunter/jumper athletes, the goal of the protocol was to allow for adjustments to fit the needs of all equestrian athletes based on the demands of the sport. This included development of skill session parameters for traditional five-phase policies.[1] There were several physical demands that needed to be met in order to have the protocol be successful. Hunter/jumper equestrian is about the relationship between the rider and the horse. The two are teammates and the success of one is equally dependent on the success of the other.[9] Due to the changes in pace (walk, trot, canter and/or gallop) and height variations, there are also vestibular disruptions that must be accounted for. Jumps in collegiate competition in the NCEA and IHSA can range from two feet six inches to three feet six inches in height.[8,10] Theses demands on the rider were discussed with the Sports Medicine staff by

the Riding Center staff, including physical demands (particularly on the hip, back, shoulder and lower leg) and vestibular disruptions throughout the pace and height variances.[9,11]

Do

The Sweet Briar College Return-to-Ride protocol was developed for hunter/jumper equestrian athletes in the fall semester of 2016. The protocol (**Appendix A**), was created in conjunction with the Director of the Harriet Howell Rogers Riding Center at Sweet Briar College in Sweet Briar, Virginia. The protocol was designed to slowly increase the rider's control over the horse, cardiovascular intensity, musculoskeletal involvement and changes in vestibular disruption. The purpose of the protocol was to outline an equestrian-specific return to participation for student-athletes competing on the College's competitive equestrian teams. It also served as a way to build a rapport and relationship with the College's equestrian program's student-athletes and coaches. Prior to the 2016-2017 academic year, there had been no significant interaction between the equestrian program and the sports medicine team.

The RTR protocol was designed in compliance with the *NCAA Interassociation Consensus: Diagnosis and Management of Sport-Related Concussion Practices.*[13] At the initial conception of the RTR protocol, a five-phase policy was proposed to the Director of Riding at Sweet Briar (**Table 1**) after discussing with the Director the demands placed on equestrian athletes as they return after any injury. **Table 2** outlines the sections present in the RTR policy and procedure document that were developed using best-practice guidelines. The proposed protocol followed the standard five-phase outline as expected by the NCAA.[1] The purpose of the original five-phase protocol was to serve an outline for all three members of the creation team to follow and work from as well as giving the Director of Riding an idea as to the types of activities that might be needed in a final version of a protocol.

The decision to extend the protocol from five days to seven days was jointly made by the Director of Sports Medicine, the team physician, and the Director of Riding. One of the concerns when a five-phase protocol was proposed was that the athlete might not have enough time to gain confidence on the horse and manage the fine and gross motor control demands put on the body as well as vestibular disruptions. The extension of the RTR protocol to seven days also accounted for the addition of the horse as part of the student-athlete's full participation in equestrian events. Because the horse is a significant part of the sport, it was important to involve use of a horse in the protocol to allow for the student-athlete to work on gaining control in gradual monitored steps. A RTR protocol completion sheet was created with the return to ride phases and places for instructor sign-off after completion of each phase. This sheet was created to track rider progression throughout the protocol.

The RTR protocol consists of seven days of gradual increases in riding under the participation direction of a coach and medical direction of a certified athletic trainer. Athletes are able to proceed to the next phase if they are asymptomatic at the satisfaction of the current phase and the subsequent 24 hours.[2] If symptoms occur during activity, the athlete is removed from activity and instructed to rest for 24 hours prior to considering starting from the previous level that did not produce symptoms. Symptoms that were exacerbated at this progression stage must dissipate prior to attempting the previous stage. Per the recommendation of the National Athletic Trainers' Association (NATA) position statement, final clearance for full participation following completion of the protocol is required from a medical doctor.[2]

During the creation of the policy and procedure, several audiences had to be considered including student-athletes, coaches, horse trainers, and stakeholders. As access to sports medicine services varies across secondary school, collegiate, and

Table 1. Original Proposed Five-Phase Return-to-Ride Protocol

Phase 1: Light aerobic exercise	20 minutes stationary bike at 70% maximum heart rate
Phase 2: Moderate aerobic exercise	Interval bike ride: 10 sets of 30 second sprints/30 seconds recovery Body weight circuit: Squats/Push-Ups/Sit-Ups: Three sets of 20 each 60 yard shuttle run
Phase 3: Sport-Specific Exercises	Plyometric Circuit (examples): 10 yard bounding/10 medicine ball throw/10 vertical jumps; three times each 15 minutes of walking on a horse with trotting (based on the rider's abilities)
Phase 4: Full-contact practice	Limited participation in full contact practice and monitoring of symptoms Inclusion of jumping small obstacles (based on the rider's abilities)
Phase 5	Full participation in practice

Table 2. Sections of the Return to Ride Policy and Procedure Document

Education	Mandatory educational session for all student-athletes and coaches, informational document provided to all student-athletes and coaches, acknowledgement of concussion understanding for all student-athletes and coaches
Pre-Participation Assessment	Completed annually for all student-athletes and includes the competition of the most current version of the Sport Concussion Assessment Tool (SCAT) with full Balance Error Scoring System (BESS) test. All history questions must be completed as part of the SCAT assessment.
Post-Concussion Management	Immediately upon suspicion of concussion: • Removal from participation • Completion of SCAT test with balance (BESS or tandem walk as available) • Evaluation of head and cervical spine • Initiation of Emergency Action Plan if necessary • Serial evaluation and monitoring for deterioration post-injury. • Home instructions with discharged from medical care
Return to Academics	A four-phase stepwise progression that works to allow student-athletes to increase in their workload and class attendance safely with multiple evaluations with the managing athletic trainer with communication with members of the academic community necessary for the student-athlete's success.
Return to Activity	Utilized in initial recovery, return to learn (RTL) progression and return to play/ride progression
Return to Play	Termed "Return to Ride" for Equestrian athletes in this policy and procedure. **Appendix A**.

private settings, it is important to educate coaches and horse trainers on the impact of concussions and the importance of progression-based concussion management in the return of a student-athlete to activities of daily living, academics and riding participation.[13] This also serves as an opportunity to educate stakeholders on the value of athletic trainers and their possible collaboration when working with student-athletes who compete in equestrian sports. The final policy and procedure document as updated in September 2019 (**Appendix A**) outlines the purpose of concussion management for student-athletes as well as the full policy for pre-participation examinations, return-to-learn (RTL) progression, and RTR policy (**Table 3**).

Table 3. Seven-Day Return-to-Ride Protocol

Phase 1	• Mount/Dismount/Lead in Hand/Walk Undersaddle (mounted) • Mount/Dismount, lead for five minutes (Complete two times) • Mount, walk undersaddle for 15 minutes • Dismount and put the horse away
Phase 2	• Mount and walk for 10 minutes • Trot two laps around the indoor arena • Walk five minutes • Trot two laps around the indoor arena • Walk for 10 minutes • Dismount and put the horse away
Phase 3	• Mount and walk for 10 minutes • Trot four laps around the indoor arena ○ Walk two minutes • Trot four laps around the indoor arena • Walk for 10 minutes • Dismount and put the horse away
Phase 4	• Mount and walk for 10 minutes • Trot four laps around the indoor arena ○ Walk two minutes • Trot four laps around the indoor arena • Walk for one minute • Canter a lap in each direction • Walk for 10 minutes • Dismount and put the horse away
Phase 5	• Mount and walk for 10 minutes • Work at the trot and canter for 15 minutes with periods of walk • Finish with walk for 10 minutes • Dismount and put the horse away
Phase 6	• Repeat Phase 5 • Add jumping small obstacles
Phase 7	• Full participation in practice or lesson without restrictions

Study

The RTR protocol was created, developed and implemented at the beginning of the Fall 2016. The first equestrian related concussion occurred in Spring 2017. To determine how the RTR protocol compared to the RTP protocol, the following items were collected:

- Date of Injury
- Date of Evaluation
- Number of Days from Injury to RTL phase 4 (RTL 4)
- Dates each phase of the student's respective return to participation protocol was completed
- Number of days from the date of injury to date of protocol completion

All the collected dates were placed in a password protected spreadsheet and updated daily throughout the athlete's recovery. The average number of days from injury to RTL4 and from injury to concussion resolution were collected for all athletes in sports managed by the Sweet Briar College Sports Medicine Department. This included athletes who completed any of the three concussion return to participation protocols (RTP, RTR or a combination protocol). Any observations were documented on the athletes' concussion evaluation for that day and/or in the notes section of the athlete's injury in the electronic medical record system.

At the time of submission, the protocol had been completed a total of 16 times with collegiate hunter/jumper equestrian athletes. As with all student-athletes, they were required to also complete their four-phase RTL protocol prior to the RTR protocol. Since the introduction of the RTR protocol in September 2016, a total of 85 return to participation protocols for all sports at Sweet Briar college were completed (69 RTP and 16 RTR) (**Figure 1**). A total of seven NCAA varsity programs and two competitive equestrian teams used the appropriate return to activity protocol. Five concussion management cases (four RTP and one RTR) were not included in this analysis

because the return to participation protocol was not completed for reasons such as medical withdrawal, athlete non-adherence, athlete transfer to another institution and graduation from the institution. Concussions included in this analysis were categorized as incoming (occurred prior to enrollment at Sweet Briar College), athletic mechanism of injury or non-athletic mechanism of injury.

In this analysis, the average number of days lost to concussion recovery was followed (**Figure 2**). This was defined as the time frame from the date of injury evaluation to the date of full athletic return. It is important to note that the averages from the Fall 2018 semester were higher due to several protocols implemented over Winter Break and being completed at the start of the Spring 2019 semester. In both the Spring 2018 and Spring 2019 semesters, protocols were delayed due to Spring Break and were completed when the student-athlete(s) returned to campus. Overall as of September 30, 2019 the seven-day RTR protocol presented similar averages of days lost to concussion as its five-day RTP counterpart. Due to the additional two days in the RTR protocol, it was surprising to see that the averages of days lost was as close as they were.

A major success was the quick adaption of the protocol by the equestrian staff. The coaches and instructors were open to the use of the protocol and served as advocates for the athletes if an injury (concussion or other) occurred as well as encouraging them to seek medical attention. They were receptive to education relative to concussions and were willing to assist in concussion management when needed and necessary.

As in any setting with a new possible policy, there were challenges to implementation of the new concussion policy with procedures. The RTR protocol was designed for use with collegiate hunter/jumper equestrian student-athletes who had limited to no prior access to an athletic trainer either at the institution or at their high school and/or private barn. The initial challenge was working with the student-athletes to gain their buy-in into being able to use an athletic trainer, not just for concussion management, but also for general athletic health care. Cooperation from the student-athletes began with an introductory meeting at the beginning of the year to introduce the athletic trainer and explain offered services with locations and available times. This introduction is now offered annually as part of the onboarding experience for both new and returning student-athletes. Another step towards buy-in of the policy was meeting with student-athletes at the barn and campus arenas. This was a time for both the athletic trainer and student-athletes to ask questions. This allowed for the athletic trainer to speak with the coaching staff and build relationships with them as to how to best utilize the athletic trainer for their student-athletes. At the beginning of the research phase of writing this protocol, the majority of student-athletes were very open to explaining the sport of hunter/jumper equestrian and the psychological connect they have with the barn, as well as the importance of the barn to their personal identify.

A second challenge was that no specific training with the sports medicine team or equestrian coaches was conducted on the implementation of the protocol. The athletic trainer met with the equestrian coaches to discuss the new protocol, athlete evaluations, completion of phases and how to respond if an athlete reports symptoms at any point (during recovery or return to ride phase).

Act

For clinicians in settings where they are building new relationships, it is important to learn about the sport they are working with. This includes understanding the physical competitive aspects of the sport as well as the psyche of the athletes and how their sport impacts their lives. In terms of understanding the sport, it is important that policies reflect sport participation and serve as a

Figure 1. Number of Return to Participation Protocols Completed from August 2016 to September 2019

Academic Term	Number of RTP Protocols Completed	Number of RTR Protocols Completed
Fall 2016	22	0
Spring 2017	7	5
Fall 2017	20	3
Spring 2018	6	1
Fall 2018	10	4
Spring 2019	3	2
Fall 2019 (as of September 23, 2019)	1	1
Total Number Completed	69	16

Figure 2. Average Days Lost from Evaluation to Completion of Designated Return to Participation Protocol

Academic Term	Average Days from Evaluation to RTP 5	Average Days from Evaluation to RTR 7
Fall 2016	20.4	-
Spring 2017	16.2	16.8
Fall 2017	20.7	24.3
Spring 2018	20.0	32.0
Fall 2018	48.1	21.25
Spring 2019	19.0	27.0
Fall 2019 (as of September 30, 2019)	12.0	12.0
Average Number of Days Lost	22.3	25.4

guide to clinical practice. This creates a standard for patient care and protects the clinician legally. When creating a new policy and procedure, especially when working with a new program or a program that has had little to no interaction with an athletic trainer, policy development serves as a good opportunity to learn about the sport and build strong relationships with coaches and other stakeholders.

One potential barrier to implementation of the RTR protocol is how the protocol needs to be adjusted when an athlete only rides two to three times per week. A lesson-based schedule can delay the completion of an athlete's protocol so adjustments might be necessary to keep the protocol from being completed over several weeks. This barrier can be overcome by working with the equestrian coaches and instructors to allow the athlete to complete supervised rides outside of their designated lesson times.

Another barrier is the skill level of each athlete. With abilities ranging from beginner Walk/Trot up to those able to jump three feet six inches, it is important to make sure the athlete can complete their protocol safely and in their own skill range. In the event an athlete does not canter and/or jump, it may be necessary to modify the protocol phase to make sure the intensity is increased without putting the athlete at risk due to lack of skill.

An opportunity for further research includes applying the RTR protocol to all equestrian athletes such as those who compete in eventing (dressage, jumpers, and cross country), fox hunting, polo, competitive trail riding, endurance riding, Western Styles (pleasure, reining, cutting, team pinning, working cow horse, trail class, halter), and rodeo events. This protocol was written to serve as a general outline for other competitive sanctions of equestrian so testing and utilization in those sanctions would be needed to determine how effective the policy is in return-to-ride participation for equestrian athletes. Further research is also needed to determine the psychological effects of concussion on the psyche of equestrian athletes and is currently in the initial stages of development.

Clinical Bottom Line

Equestrian currently is working towards becoming recognized as an emerging sport within the NCAA and over 10,000 students participate in the sport at the collegiate level annually. Therefore, more research and policy development is needed to ensure that sport-specific policies are created to fit the needs of the athletes competing and participating. Steps in this process include researching statements from the NCAA and sport's governing bodies to determine how one's current policies align with the expectations and standards set forth. It is important to involve important stakeholders in policy creation, editing and implementation. This allows for them to understand the standards expected of the policy as well as give valuable input on needed changes or recommendations. Education and evaluation by staff members and stakeholders are both part of the development and implementation processes. As equestrian continues to rise in status and participation numbers, it is important to develop policies that are sport-specific and align with standards of the sport's governing bodies, NATA, and NCAA. Creation, evaluation and improvement of policies allow for improved patient care that is specific to the needs of athletes and their sport.

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APPENDIX A: Return-To-Ride Protocol

Management of a concussion in sport can be challenging, as there are no universal standards on concussion care and return to play guidelines. The following document is a concussion policy and management plan that specifically outlines the role of the Sweet Briar College Sports Medicine health care providers. The goal of this protocol is to give athletic trainers and physicians dealing with concussions a common student-athlete concussion management program.

This policy is for the concussion care and management of student-athletes in the competitive programs of SWEET BRIAR COLLEGE Athletics and Riding. The Sports Medicine staff will provide concussion healthcare through baseline testing, education, injury diagnosis, management and rehabilitation. In order to return to participation, the student-athlete must complete the Return to Learn and Return to Play/Ride protocols through the Sports Medicine staff and be cleared to return to participation by the Team Physician or their designee.

Education

SWEET BRIAR COLLEGE will present all student-athletes with the NCAA Concussion Fact Sheet for Student-Athletes. Student-athletes are required to sign a *Student-Athlete Acknowledge Statement* annually stating that they received, read and understand the NCAA Concussion Fact Sheet. This document on concussions includes the definition of a concussion, how to reduce the risk of concussions, symptoms of concussions, and how to report any concerns for themselves or a teammate regarding a concussion. Student-athletes are required to attend a pre-season brief session with the athletic trainer prior to participation. Concussion education is also included in this meeting.

Coaches at SWEET BRIAR COLLEGE will receive the NCAA Concussion Fact Sheet for Coaches annually. They are required to sign the *Coach Acknowledge Statement* annually prior to the start of their season. Additional educational opportunities in relation to concussions is available upon request, as needed and/or when new information regarding concussions becomes available.

Members of the Sports Medicine staff will receive a copy of the NCAA Concussion Fact Sheet for Coaches and Student-Athletes annually to have as reference. In addition, all members of the Sports Medicine staff will participate in concussion education annually including a review of the concussion management policy during the Emergency Action Plan annual review.

Baseline Testing

Upon enrollment at SWEET BRIAR COLLEGE and before the first day of practice/tryouts, every student-athlete will undergo baseline testing. Baseline testing must occur annually prior to the student-athlete's first day of their first season for the academic year. If a student-athlete sustains a concussion during the academic year, a new baseline will be completed prior to their return to participation. In compliance with the Arrington Settlement and as

recommended by the NCAA, and the SWEET BRIAR COLLEGE Athletic Conference the baseline assessment for all SWEET BRIAR COLLEGE student-athletes will consist of the following:

- Sport Concussion Assessment Tool- 5th Edition (SCAT5)
- Balance Error Scoring System (BESS) Test
- ImPACT Computerized Concussion Test (Baseline)

Concussion

The SWEET BRIAR COLLEGE Sports Medicine Staff will determine whether or not a concussion has occurred, realizing that each concussion and each student-athlete is different, and individual treatment plans are necessary. A concussion is a brain injury that may be caused by a blow to the head, face, neck or elsewhere on the body from an impulsive force transmitted to the head. Concussions can also be a result from contact with another player, hitting a hard surface such as the ground, or being hit by a piece of equipment such as a bat, basketball or softball. A concussion may present differently from one student-athlete to another.

A concussion can happen even if the athlete DOES NOT lose consciousness.

Following a concussion, a student-athlete may exhibit the following signs and symptoms:

Physical Symptoms	**Cognitive Symptoms**	**Emotional Symptoms**
Headache	Memory Loss	Irritability
Vision Difficulty	Attention Disorders	Sadness
Nausea and/or Vomiting	Concentration Problems	Nervousness
Dizziness and/or Lightheadedness	Confusion	Sleep Disturbances
Balance Difficulties	Disorientation	Personality Changes
Light Sensitivity		Feeling of Being Stunned
Noise Sensitivity		Depression
Fatigue		
Slurred/Incoherent Speech		
Ringing in the Ears		
Loss of or Altered Consciousness		
Vacant Stare		
Loss of Bowel Control		
Loss of Bladder Control		
Seeing Bright Lights or Stars		

When a student-athlete exhibits signs, symptoms or behaviors consistent with a possible concussion, they shall be removed from practice or competition and evaluated by the Certified Athletic Trainer and/or Team Physician. Signs and symptoms of a concussion can take up to seven (7) days to present fully. It is important that student-athletes be truthful and forthcoming about signs and symptoms of a concussion as soon as they present. The student-athlete will be evaluated and monitored to determine their status as it relates to being concussed. Once a student-athlete has been diagnosed with having a concussion, they shall be removed from physical activity for the remainder of that day, and not allowed to participate in

academic activities for the remainder of that day. The student-athlete, or their parent, guardian or roommate (as needed depending on the needs and requests of the student-athlete), will be provided with instructions on further care and the *Home Concussion Information Sheet* upon discharge.

The student-athlete will be monitored for progression of symptoms during the ongoing course of their concussion by the SWEET BRIAR COLLEGE Sports Medicine Staff. Immediately following injury, the student-athlete will be placed on cognitive brain rest for 24-48 hours unless noted by the athletic trainer and/or team physician. The SWEET BRIAR COLLEGE Sports Medicine Staff will use the SCAT5 and BESS tests daily, along with other examinations deemed necessary during the evaluation of the concussed student-athlete until the symptoms have subsided and/or have been resolved. All of these evaluations will be compared to the baseline scores of the student-athlete and will aid in the Return to Learn and Return to Play/Return to Ride progressions.

Once the student has sustained a concussion, the athletic trainer will set up an appointment for evaluation with the team physician during their the next sports medicine clinic day. When the student-athlete is either approaching the end of Return to Learn Phase 1 or enters Return to Learn Phase 2, the athletic trainer will notify the Director of Academic Resource Center so they can arrange a meeting with the student-athlete to create a plan for post-injury academic success.

With permission for release of information from the student-athlete, the Academic Resource Center will be notified and updated on the condition of the student-athlete after they suffer a concussion in order for the Dean's Office to notify professors. Notifications include:

- The Office of the Dean (Dean and Secretary)
- Team Physician
- Dean of Students
- Director of the Academic Resource Center
- Athletic Director
- Riding Director (in the event the injured student-athlete is on an equestrian team)
- Head Coach(es) of the team(s) the injured student-athlete is a member of

The Dean of Students, the Office of the Dean and Director of the Academic Resource Center will be notified during the student-athlete's Return to Learn protocol. Once the student-athlete progresses out of Return to Learn and into Return to Play and/or Return to Ride, they will no longer receive email updates as the student will be returned to full academic participation at this point.

Student-athletes will complete the ImPACT test as part of their concussion recovery plan. They will take the test a total of three times: 48 hours post-injury, at the completion of Return to Learn phase 4 (RTL 4) and at the completion of Return to Play day 5 (RTP 5) or Return to Ride day 7 (RTR 7).

It is important to note that all Return-to-Learn, Return-to-Play, Return-to Ride, and Return-to-Play/Return-to-Ride Combination protocols are individualized on a case-by-case basis, allowing for the student-athlete to receive the best available and most accurate care to aid in their recovery.

Return to Learn (RTL)

The SWEET BRIAR COLLEGE Athletic Training Staff, Team Physicians, and the Academic Resource Center will work together to determine Return to Learn status of a post-concussed student-athlete. The Office of the Academic Dean will inform the student-athlete's professors and any accommodations that may be necessary in their return to the classroom and activities that are associated with their full academic return.

Once a student-athlete has been diagnosed with having a concussion, they shall be removed from physical activity for the remainder of that day and not allowed to participate in academic activities. The Office of the Academic Dean will be notified of the status of the student-athlete.

Following a concussion, the student-athlete will be seen daily by a SWEET BRIAR COLLEGE Athletic Training Staff member prior to the start of their first academic class. At that time, the decision will be made if the student-athlete's symptoms have progressed to allow them to attempt to attend class, study hall, and tutoring sessions that day. The Office of the Academic Dean will then convey the status of the student-athlete to their professors. If a student-athlete is allowed to return to class, they will be evaluated that afternoon in order to complete an updated SCAT5, to aid in determining how the day of learning progressed. This is repeated until the student-athlete successfully completes RTL 4; then they will be seen once per day until the completion of their designated return to participation protocol.

Guidelines for Progression

- Student-athlete proceeds to the next level only if asymptomatic at the current level of progression.
- Following a recovery phase, if they are symptom-free for 24 hours they will progress to the next level.
    - If symptoms occur, they rest until they are symptom-free and return to the previous stage that did not produce symptoms.
- During recovery, it is important for the student-athlete's work and assignments to be prioritized so they can make up all missed work without inducing additional stress and emotional distress.
- Phases of Recovery
    - Phase 1: Complete Physical and Cognitive Rest
        - No school attendance
        - Strict limitations on technology usage and reading
        - Rest
    - Phase 2: Return to School with Academic Accommodations
        - Initiated once student-athlete reports four or less symptoms with a total severity score of four or less
        - Continue limits on technology usage

        - Avoid heavy backpacks
        - No tests/exams/quizzes/reading/homework, athletics, band or chorus
        - Monitor symptoms
        - Rest at home
    - Phase 3: Continue Academic Accommodations
        - Attend school full-time if possible
        - Increase workload gradually (testing, homework, etc)
        - Monitor symptoms
        - Rest at home
    - Phase 4: Full Return to Academics
        - Attend school full-time
        - Self-advocate at school (meet due dates, etc)
        - Resume normal activities

In any concussion case when a student-athlete needs or requests counseling, the Sports Medicine Staff will assist in referring them to a Counselor, located at on the second floor of Protho Hall in Student Life.

Return to Play (RTP)

The gradual exertion return to play process is designed to allow for a gradual increase in exercise volume and intensity during the return to play process.

Guidelines for Progression

- Student-athlete proceeds to the next level only if asymptomatic at the current level.
- If symptoms occur during activity: Stop activity, rest for 24 hours and begin at the previous level that did not produce symptoms.
- Levels of Progression
    - Phase 1: Light aerobic exercise
        - 20 minutes stationary bike at 70% maximum heart rate
    - Phase 2: Moderate aerobic exercise
        - Interval bike ride: 10 sets of 30 second sprints/30 seconds recovery
        - Body weight circuit: Squats/Push-Ups/Sit-Ups: Three sets of 20 each
    - Phase 3: Sport-Specific Exercises
        - 60 yard shuttle run
        - Plyometric Circuit (examples): 10 yard bounding/10 medicine ball throw/10 vertical jumps; three times each
        - 15 minutes of sports-specific non-contact drills
    - Phase 4: Full-contact practice
        - Limited participation in full contact practice and monitoring of symptoms
    - Phase 5: Full Participation in Practice

Return to Ride (RTR)

The gradual exertion return to ride process is designed to allow for a gradual increase in exercise volume and intensity during the return to ride process.

Guidelines for Progression

- Student-athlete proceeds to the next level only if asymptomatic at the current level.
- If symptoms occur during activity: Stop activity, rest for 24 hours and begin at the previous level that did not produce symptoms.
- Due to the nature of the aerobic and anaerobic demands of the sport of equestrian, each phase increases in the demand of those systems on the body during sport-specific controlled activity.
- Levels of Progression
  - Phase 1
    - Mount/Dismount, lead for five minutes (Complete two times)
    - Mount, walk undersaddle for 15 minutes
    - Dismount and put the horse away
  - Phase 2
    - Mount and walk for 10 minutes
    - Trot two laps around the indoor arena
    - Walk five minutes
    - Trot two laps around the indoor arena
    - Walk for 10 minutes
    - Dismount and put the horse away
  - Phase 3
    - Mount and walk for 10 minutes
    - Trot four laps around the indoor arena
    - Walk two minutes
    - Trot four laps around the indoor arena
    - Walk for 10 minutes
    - Dismount and put the horse away
  - Phase 4
    - Mount and walk for 10 minutes
    - Trot four laps around the indoor arena
    - Walk two minutes
    - Trot four laps around the indoor arena
    - Walk for one minute
    - Canter a lap in each direction
    - Walk for 10 minutes
    - Dismount and put the horse away
  - Phase 5
    - Mount and walk for 10 minutes
    - Work at the trot and canter for 15 minutes with periods of walk
    - Finish with walk for 10 minutes
    - Dismount and put the horse away
  - Phase 6
    - Repeat Phase 5
    - Add jumping small obstacles
  - Phase 7
    - Full participation in practice or lesson without restrictions

Return to Play/Return to Ride Combination

In the case of students who are both considered student-athletes for both an NCAA team and a competitive equestrian team, they will complete a combination of the Return to Play and Return to Ride protocols. Completion of this combination protocol will be considered sufficient in allowing them to return to both activities. This protocol is a guideline and can be adjusted by the Director of Sports Medicine and designated Team Physician to best accommodate the recovery of the student-athlete and their participation schedules.

- Student-athlete proceeds to the next level only if asymptomatic at the current level.
- If symptoms occur during activity: Stop activity, rest for 24 hours and begin at the previous level that did not produce symptoms.
- Levels of Progression
    - Phase 1: Return to Ride Phase 1
        - Mount/Dismount/Lead in Hand/Walk Undersaddle
        - Mount/Dismount, lead for five minutes (Complete two times)
        - Mount, walk undersaddle for 15 minutes
        - Dismount and put the horse away
    - Phase 2: Return to Play Phase 2
        - Interval bike ride: 10 sets of 30 second sprints/30 seconds recovery
        - Body weight circuit: Squats/Push-Ups/Sit-Ups: Three sets of 20 each
    - Phase 3: Return to Play Phase 3
        - 60 yard shuttle run
        - Plyometric Circuit (examples): 10 yard bounding/10 medicine ball throw/10 vertical jumps; three times each
        - 15 minutes of sports-specific non-contact drills
    - Phase 4: Return to Ride Phase 5
        - Mount and walk for 10 minutes
        - Work at the trot and canter for 15 minutes with periods of walk
        - Finish with walk for 10 minutes
        - Dismount and put the horse away
    - Phase 5: Return to Play Phase 5
        - Full Participation in Practice
    - Phase 6: Return to Ride Phase 6
        - Repeat Phase 5
            - Mount and walk for 10 minutes
            - Work at the trot and canter for 15 minutes with periods of walk
            - Finish with walk for 10 minutes
            - Dismount and put the horse away
        - Add jumping small obstacles
    - Phase 7: Return to Ride Phase 7
        - Full participation in practice or lesson without restrictions

No student-athlete will be allowed to return to full activity or competition until they are asymptomatic in limited, controlled, and full-contact activities. **Any student-athlete diagnosed with a concussion must be medically cleared by a Team Physician before returning to**

competition. This includes any student-athlete who arrives to SWEET BRIAR COLLEGE with a pre-existing concussion, and/or have continuing symptoms from a resolved concussion.

The Return-to-Learn, Return-to-Play, Return-to-Ride and Return-to-Play/Return-to-Ride Combination protocols are different and can be completed at different times. Return-to-Learn will be initiated before Return-to-Play, Return-to-Ride and Return-to-Play/Return-to-Ride Combination. They can also occur simultaneously. For student-athletes who also participating in the Equestrian Program, they must complete the Return-to-Play/Return-to-Ride Combination protocol. It is important to note that the listed progression timelines can take place over a period of days, weeks, or months. It could potential result in medical disqualification from participation in SWEET BRIAR COLLEGE Athletics and Equestrian for a season or indefinitely.

Athletes with Multiple Concussions

The SWEET BRIAR COLLEGE Athletic Training Staff and team physicians have the right to review all student-athlete's medical history, both previous and current, and reserve the right to withhold from participating in college sponsored athletic events (i.e., practices, game, weight-lifting, conditioning, shows, competitions, travel, etc).

Travel with Athletes Recovering from a Concussion

The ability of a student-athlete recovering from a concussion to travel to athletic or equine competitions or trainings with their team is at the discretion of the SWEET BRIAR COLLEGE Athletic Training and Sports Medicine Staff. The SWEET BRIAR COLLEGE Athletic Training Staff and team physicians have the right to forbid travel for a student-athlete recovering from a concussion until they are cleared for full athletic, equine and academic participation.

Returning to Work

In the case that a student-athlete sustains a concussion, they will be recommended to refrain from work (on or off campus) while in the initial phases of recovery. Once a student-athlete has completed Return to Learn Phase 4 (RTL 4), they can consider returning to work. If a student-athlete is on work-study at the College, a member of the Human Resources team will be put on the student-athlete's release and notified of the student-athlete's injury as well as when they are permitted to return to work.

Returning to Drive

When a student-athlete sustains a concussion, they be recommended to refrain from driving a motorized vehicle. This includes but it not limited to a car, trunk, motorcycle, motorized scooter, gator, golf cart. They will also be recommended to refrain from riding in a motorized vehicle driven by another person, unless in

the case of an emergency. Once a student-athlete completes Return to Ride or Return to Play Day 3 (RTR 3 or RTP 3), they consider returning to driving and riding in motorized vehicles.

Annual Review

In accordance with the NCAA, this policy will be reviewed annually by the institution's athletic health care administrator (AHCA). The AHCA is a designated health provider within the athletic department who oversees the administration and delivery of healthcare for the institution's student-athletes.

Point-of-Care Research: Retrospective Analysis of the Evaluation and Classification of Tendon Pathology in Athletic Training

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ABSTRACT

Tendon pathology has been studied across healthcare professions but remains poorly understood. Imaging and clinical findings have been used to diagnose tendon pathology, but these findings are discrepant. It is vital that clinicians use sound clinical judgment to determine the most accurate clinical diagnosis and treatment options given documented clinical findings. The purposes of this study were to assess athletic trainers': 1) documented clinical findings for patients presenting with tendon pain, 2) use of documented findings to inform clinical diagnosis of tendon pathology, and 3) change in tendon pathology classification when presented with a novel diagnostic term. A total of 430 patients (20.70 ± 7.35y) from a multisite research database were included in the study. Pain at the site of injury was documented in 95.8% of cases (n = 412). Pain during exercise that changed activity (n = 274, 63.7%), and an identified tender point (n = 259, 60.2%) were also present in almost two-thirds of cases. Of the patients diagnosed with tendinitis, 35.0% had pain as the only documented inflammatory sign. Of the initial set of clinical diagnosis options, tendinopathy was the most commonly (n = 290, 67.4%) selected. There was a 46.0% and 15.0% decrease in the number of tendinopathy and tendinitis diagnoses, respectively, when 'tendinalgia' was an option as a diagnostic classification term. There does not appear to be adequate clinical evidence to label tendon pathology as either inflammatory or degenerative. Furthermore, clinicians either appear to be: 1) relying on few symptoms to identify a diagnosis or 2) not at first fully considering all clinical findings when diagnosing a patient. According to these findings, tendinalgia seems to be the most appropriate term to describe tendon pain, to help clinicians understand tendon pathology as a pain condition rather than as inflammatory or degenerative.

Key Phrases
Diagnostic testing, upper extremity, tendinopathy, clinical reasoning

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INTRODUCTION

Tendon pathology is a common problem among physically active individuals, but is poorly understood by researchers and clinicians alike.[1-3] Previously, pain at a tendon has been termed *tendinitis* or *tendinosis*, describing either an inflammatory or degenerative condition, respectively.[3-6] Tendinitis involves signs and symptoms of inflammation, which include heat, redness, pain, swelling, and decreased function.[3-9] Clinicians grade tendinitis from first to third degree based on the severity and consistency of the patient's symptoms.[10] Generally, symptoms become progressively more persistent as the condition worsens, advancing from pain noted only after activity to more consistent pain and decreased performance.[10] Even though tendon pain is often referred to as tendinitis, tendinosis may be a more correct description, as evidenced by the lack of inflammatory markers in histological studies.[3,6,11] In contrast to tendinitis, which describes a primarily inflammatory condition, tendinosis describes changes in tissue integrity (i.e., degeneration) without signs of active inflammation.[3-6,12,13] Tendinosis is categorized according to the assumed severity of the condition, with Stage I correlating to transient pathology and Stage II correlating with more lasting changes to less than half of the tissue structure.[14]
Imaging studies (e.g., magnetic resonance imaging [MRI] and diagnostic ultrasound) provide further

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evidence of the potential inaccuracy of a tendinitis diagnosis, in which imaging findings are often uncorrelated to patient symptoms.[3,15-23] For example, in a sample of 253 healthy, asymptomatic individuals ages 13-89 years old, 65% of individuals had tissue abnormalities of the proximal hamstring tendon on MRI (13% unilateral, 52% bilateral).[23] Of note, none of the participants had a history of hamstring pathology.[23] In a second study, which involved ultrasound examination of 51 asymptomatic males, 96% had some form of pathological change to the rotator cuff.[20] Of those individuals with positive findings, 75% had rotator cuff pathology, with the most commonly affected structure being the supraspinatus tendon (65% of total; 5 full thickness tears, 12 partial-thickness tears).[20] These findings indicate that pathological changes to the tissue may not be the actual cause of a patient's symptoms, if asymptomatic individuals have the same tissue abnormalities on imaging studies that would typically only be expected in symptomatic patients.[3,15-23]

Due to these discrepancies, imaging has not been advocated as the most accurate form of assessment, nor does it increase the limited understanding of tendon pathology.[3,15-23] Most often, tendon pathology is diagnosed clinically based on the patient's pain narrative, previous history, and outcomes of pain provocation tests.[3,10,24,25] Palpation may also identify pain, increased tendon thickness, and/or crepitus.[3,25-29] Pain upon palpation has been found to be reliable across multiple studies when identifying tendon pathology, especially when moderate to high levels of pain upon palpation are present.[26,27,29] However, when moderate to high pain levels upon palpation and patient-reported symptoms were considered together, these findings were not an adequate predictor of positive imaging findings ($p > 0.05$).[26] These findings again reinforce the idea that symptoms and tissue pathology are not always congruent.[3,15-23,26]

As the uncertainty surrounding tendon pathology continues to increase across healthcare despite extensive research, alternate diagnostic classification terms, such as *tendinopathy* and *tendinalgia,* have been introduced.[3,30,31] Tendinopathy is an generic term to describe tendon pathology that presents with tendon pain and increased tendon thickness.[3] Tendinopathy, as opposed to the previously used tendinitis or tendinosis, implies some type of tissue-based tendon pathology, without specifying a particular cause, reflecting the inconsistencies between imaging, histological, and clinical findings.[3,11,15-23] The newest term, tendinalgia, is an expansion of the term *lateral epicondylalgia,* originally coined by Waugh to describe pain at the anatomical location (i.e., lateral epicondyle) without indicating that abnormal changes in the tissue are the cause of the symptom presentation.[30,31]

Patient outcomes further support the notion that actual tissue changes may not be the underlying cause of a patient's symptoms. With respect to tendon pain, eccentric loading, which aims to create changes in tissue structure, is often incorporated into rehabilitation.[3] However, according to a recent literature review, the use of eccentric exercise, though helpful for patient symptoms, did not result in a concomitant improvement in tendon thickness on imaging studies.[32] If tendon pathology was primarily due to a tissue abnormality, eccentric exercise should have resulted in both a change in patient symptoms and tissue structure. These discrepancies give reason to question the traditional classifications of tendon pathology, many of which imply tissue-related causes of pain (e.g., tendinitis, tendinosis). Although treatments such as eccentric exercise may be effective for reducing patient symptoms, it does not appear that these treatments are having the hypothesized effect (i.e., change in tissue structure).[3,32] This may indicate that tendon pain is actually due to a pain processing dysfunction rather than actual tissue pathology.[3,33] Using a more general term like tendinalgia would free the clinician to treat the source of pain as a processing dysfunction rather than a tissue pathology.

Due to the lack of consensus among imaging studies and patient outcomes, clinical assessment remains the primary strategy for evaluation and

diagnosis.[3,15-24] However, limited data exists on healthcare providers' evaluation findings. Most studies regarding tendon pathology have involved physical therapists and orthopedic surgeons, but the evaluation has often been standardized as part of a controlled study.[26,27,29] Moreover, there is little literature regarding the evaluation practices and reported findings of athletic trainers with respect to tendon pathology, even though tendon conditions are common in physically active individuals.[1,2] Despite evidence negating the validity of imaging, and therefore the emphasis on clinical evaluation, it is unknown what athletic trainers are reporting from their clinical evaluations of patients with tendon pain. By extension, it is also unknown if athletic trainers are matching their clinical diagnoses to their reported clinical findings based on the current evidence and recommendations for tendon pathology. In order to maximize the likelihood of positive treatment outcomes for patients presenting with tendon pain, it is important to gain a better understanding of the current practices of athletic trainers to identify practices that facilitate optimal treatment choices and areas needing improvement. Therefore, the purposes of this study were to assess athletic trainers': 1) documented clinical findings for patients presenting with tendon pain, 2) use of documented findings to inform clinical diagnosis of tendon pathology, and 3) change in tendon pathology classification when presented with a novel diagnostic term.

METHODS

This study was a retrospective descriptive analysis of a research database created and stored in Qualtrics (Provo, UT, 2002). Athletic trainers currently pursuing their doctorate in athletic training contributed to the database for this multisite research study. Clinicians were practicing in a wide range of clinical settings and working with patient populations of various physical activity levels. Participating clinicians were asked to input de-identified patient data into the database for later analysis. Before entering data, patients signed an informed consent form to allow for the inclusion of de-identified information in the research database. The study protocol was approved by the University of Idaho Institutional Review Board.

Procedures

The database contained open-ended, multiple choice, and multiple select items pertaining to each portion of a standard clinical evaluation. To be included in the present study for retrospective analysis, patients had to present to the intake clinician with: 1) involvement of a specific muscle or tendon, 2) localized tendon pain, and 3) point tenderness over the involved tendon, as pain is one of the primary clinical symptoms that serve as a focus of treatment[10,14,25] Due to the nature of the study, evaluations were not standardized. Clinicians were encouraged to perform their typical evaluation, which allowed for an authentic picture of typical athletic training practices in the evaluation of suspected tendon pathology.

Clinicians were asked to enter data regarding patient history, which included, but was not limited to: 1) age, 2) patient sport or occupation, and 3) pain scores rated on the 0-10 Numeric Pain Rating Scale (NRS; i.e., current pain, pain at best within the past 24 hours, pain at worst within the past 24 hours, pain at onset, and pain at rest). Clinicians also described pain characteristics based on the classifications set forth by Nirschl and Ashman regarding tendinosis and any objective findings (e.g., swelling, changes in tissue appearance, palpation findings, special tests performed, etc.) from the evaluation.[14] It should be noted that although the classifications defined by Nirschl and Ashman are meant to describe the severity of pathology, and are therefore ordinal in nature, clinicians were allowed to choose more than one category based on patient presentation.[14]

At the completion of the evaluation, clinicians identified a working clinical diagnosis based on their documented findings under two separate conditions. First, they chose from a list of traditionally recognized tendon pathologies (i.e., first-, second-, or third-degree tendinitis; first or second stage tendinosis; or tendinopathy). A

second question then asked them to classify the same tendon pain with tendinalgia, a more general term, added as a classification option to the previous list. The definition of all diagnostic terms, including tendinalgia, had been previously operationally defined and provided to the clinicians involved in the study.

Data Analysis

Data were analyzed in Statistical Package for Social Sciences (Version 25.0, IBM, Armonk, NY) and Microsoft Excel (Version 16.16.10, Microsoft, Redmond, WA). Patient cases with missing clinical diagnoses were excluded from analysis to keep sample sizes equal across analyses and to facilitate comparisons across the data. If the text entry from an open-ended response was unclear, the data was classified as "unknown". Means and standard deviations were calculated for patient age and pain scores. Frequencies and percentages were calculated for all other data to derive comparisons across documented clinical findings.

RESULTS

Patient Demographics

A total of 430 patient cases involving a primary complaint of tendon pain were extracted from the database. On average, patients were 20.7 ± 7.3 years old (range: 14-62 years old) and participated in over 20 different sports and/or activities. The five most common sports or activities included basketball (n = 75, 17.4%), track and field (n = 48, 11.2%), soccer (n = 45, 10.5%), football (n = 44, 10.2%), and baseball (n = 42, 9.8%).

Reported Clinical Findings

Documented clinical findings are presented in **Tables 1a-c.** Pain at the site of injury was the most commonly documented clinical finding during evaluation (n = 412, 95.8%), followed by pain that changes activity (n = 274, 63.7%). The most commonly documented tissue changes included the presence of a tender point (n = 259, 60.2%), changes in tissue tension (n = 60, 14.0%), and changes in tissue thickness (n = 53, 12.3%), as determined from the clinician's evaluation. Overall, 87.2% of patients (n = 375) had two or fewer documented signs of inflammation (i.e., pain, loss of function, local swelling, redness, and/or heat).[7-9] A total of 103 individuals were diagnosed with some degree (i.e., first, second, or third) of tendinitis. Of these 103 individuals, 35.0% (n = 36) had pain at the site of injury as their only documented sign of inflammation. Furthermore, pain and loss of function were the only documented signs of inflammation in 10.7% (n = 11) of these 103 cases. Finally, clinicians reported using at least one orthopedic special test (e.g., tests for structural integrity of the ligaments, joint capsule, musculotendinous unit, etc.), 76.7% (n = 330) of the time.

Table 1a. Prevalence of Reported Inflammatory Signs

Sign/Symptom	Frequency (n)	Percent (%)
Pain	412	95.8
Heat	45	10.5
Redness	23	5.3
Swelling	98	22.8
Loss of Function	101	23.5

Table 1b. Prevalence of Reported Tissue Changes

Sign/Symptom	Frequency (n)	Percent (%)
Spasm	34	7.9
Trigger Point	44	10.2
Tender Point	259	60.2
Change in Tissue Tension	60	14.0
Change in Tissue Texture	40	9.3
Change in Tissue Tone	25	5.8
Change in Tissue Thickness	53	12.3
Change in Sensation	17	4.0

Table 1c. Prevalence of Reported Pain Patterns

Sign/Symptom	Frequency (n)	Percent (%)
Pain Post-Exercise - Resolves in <24 Hours	148	34.4
Pain Post-Exercise - Resolves in >24 Hours	83	19.3
Pain Post-Exercise - Resolves with Warm-Up	31	7.2
Pain During Exercise - Does Not Alter Activity	101	23.5
Pain During Exercise - Does Alter Activity	274	63.7
Pain with Heavy ADLs	126	29.3
Pain with Light ADLs but Intermittent at Rest	116	27.0
Constant Pain at Rest that Disturbs Sleep	38	8.8

Categories adapted from Nirschl and Aschman[15]

Pain Descriptions

Using the pain characteristics defined by Nirschl and Ashman, clinicians documented that 63.7% (n = 274) of patients experienced pain that changed their activity, and patients reported that their pain after activity resolved within 24 hours in 34.4% (n = 148) of cases.[14] Pain scores were also recorded for each patient. The 'worst' pain ranged from 2/10 to 10/10 for all patients, with the average worst pain being 6.7 ± 1.7 points. Current pain across the entire sample averaged 3.2 ± 2.2 points, and overall average pain (i.e., averaged current, best, and worst scores) ranged from 0.7 to 9.0, with a sample average of 4.0 ± 1.5 on the NRS. Descriptive statistics for NRS scores are provided in **Table 2.**

Classification of Tendon Pathology

Clinician classifications of tendon pathology based on reported clinical findings are presented in **Table 3** and **Figure 1**. Without tendinalgia as a classification option, the most common clinical diagnosis was tendinopathy (n = 290, 67.4%), with the second most common being some degree (i.e., first, second or third) of tendinitis (n = 103, 23.9%). When tendinalgia was added as a classification option, there was a 46.0% decrease in the number of cases classified as tendinopathy, and tendinalgia instead became the most common diagnosis (n = 272, 63.3%). Of the 103 patients originally diagnosed with some degree of tendinitis, 51.5% (n = 53) of those diagnoses were switched to tendinalgia when this was an option. Furthermore, of the 290 (67.4%) cases originally diagnosed with tendinopathy, 125 individuals (43.1%) were given a final diagnosis of tendinalgia.

Table 2. Pain Scores

Pain Score	Mean	±SD	Minimum	Maximum
Onset	4.8	2.1	0.0	10.0
Rest	1.8	1.8	0.0	8.0
Current	3.2	2.2	0.0	10.0
Best	2.0	1.9	0.0	8.0
Worst	6.7	1.7	2.0	10.0
Average[a]	4.0	1.5	0.7	9.0

[a]Average = Avg(Current,Best,Worst)

Table 3. Classification of Tendon Pathology with and without Tendinalgia as an Option

	Without	With
Classification	Frequency (n)	Frequency (n)
Tendinitis	103	38
First Degree	78	27
Second Degree	23	9
Third Degree	2	2
Tendinosis	37	28
Stage I	28	17
Stage II	9	11
Tendinopathy	290	92
Tendinalgia	N/A	272

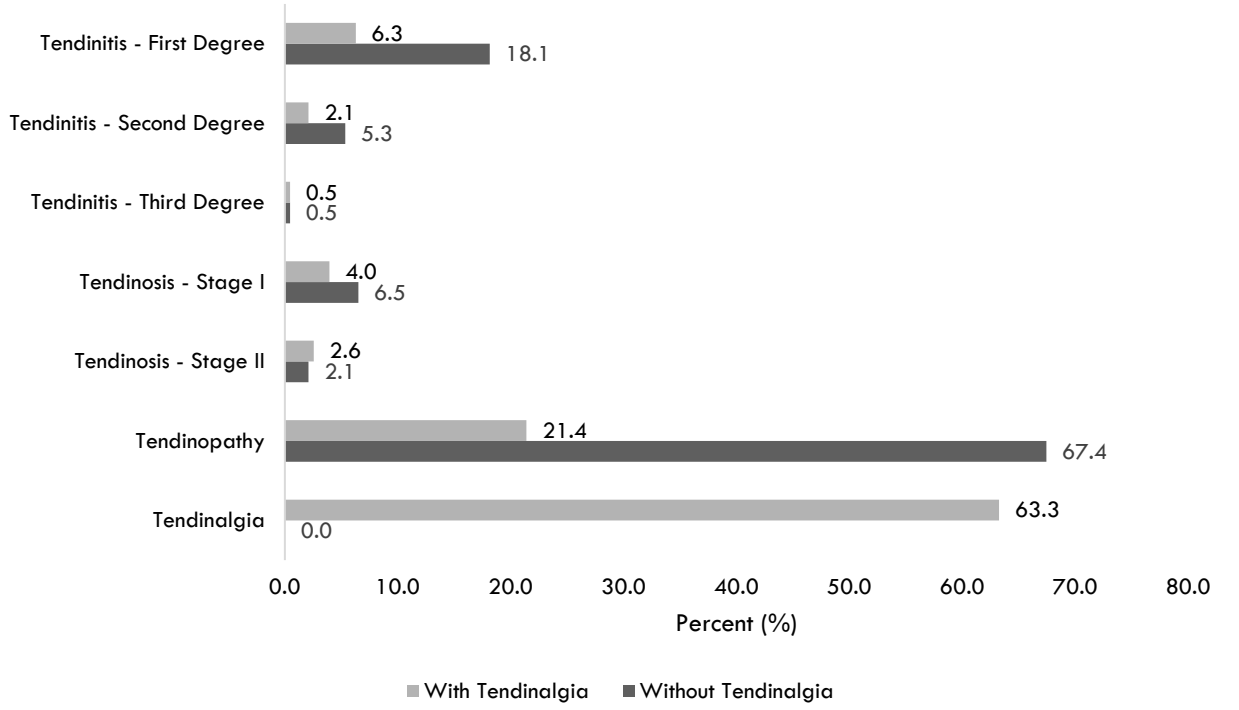

Figure 1. Classification of Tendon Pathology from Reported Clinical Findings

CLINICAL APPLICATION

Through the analysis of patient data included in a broader patient outcomes database, the frequency of various documented clinical findings in patients presenting with tendon pathology in athletic training clinics was assessed. This study also aimed to evaluate the clinical diagnoses chosen by athletic trainers based on these findings. Finally, changes in clinical diagnosis were evaluated with the introduction of the term tendinalgia, which has been proposed as an alternate term to account for the discrepancies currently surrounding tendon pathology.[3,11,15-23,30,31]

In the present study, the three most frequently documented clinical signs and symptoms were all related to pain (i.e., pain at site, 95.8%; pain that changes activity, 63.7%; tender point, 60.2%). Theoretically, because localized pain over the involved tendon was part of the inclusion criteria for the present study, pain at the site of injury should have been reported for all patients, rather than only 95.8%. These inconsistencies could be due to: 1) different interpretations of the definitions between inclusion criteria and clinical findings, 2) failure to evaluate for the presence of pain at the site of injury, or 3) clinician error in reporting findings. Regardless of the reason, a primary finding of pain is consistent with the tendency for individuals to continue activity despite pain, only seeking treatment as the condition worsens to the point that they can no longer participate in physical activity at their desired level.[3,6,24] The average reported pain scores from the present study (current pain: 3.2 $\pm$ 2.2; worst pain: 6.7 $\pm$ 1.7) also support this pattern. Pain scores at initial evaluation (i.e., current) were high enough to allow for a decrease of at least one minimal clinically important difference on the NRS (i.e., 2 points), meaning patients would be able to identify a difference in pain after treatment, thereby giving them reason to seek care.[34]

Point tenderness and the general pain characteristics found in the present study were

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representative of clinical presentations outlined in the literature, but clinical diagnoses did not always align with documented signs and symptoms.[3,6,10,13,14,28] For example, tendinitis was the second most common diagnosis when tendinalgia was not given as an option, and over one-third of patients had pain as the only documented inflammatory sign of the five cardinal signs of inflammation. However, pain by itself does not indicate a primarily inflammatory condition. Patients with tendon pathology often present with pain, but histological and imaging studies do not always support the presence of inflammation within the tissues.[3,6,10,11,14,24-27] Therefore, pain – without other key signs or symptoms of inflammation – cannot conclusively indicate an inflammatory condition.

Loss of function was the second most documented sign of inflammation. However, because pain can affect movement, loss of function may be a notable finding regardless of the nature of the pathology (e.g., inflammatory, degenerative, etc.).[35] Just over 10% of individuals diagnosed with tendinitis had pain and loss of function as their only signs of inflammation. Therefore, the accuracy of many of the tendinitis diagnoses in the present sample is questionable, though it could be argued that clinicians were aware of this possibility. Two-thirds of patients originally diagnosed with tendinitis were eventually diagnosed with tendinalgia when this was an option. It seems clinicians may not be using their documented findings to inform their clinical diagnoses when using a common, generic term like tendinitis or tendinopathy. This disconnect is a potential problem because if clinicians label a condition as inflammatory, they should also be choosing treatments that directly affect the inflammatory process, but the patient may not optimally benefit from treatment if the tendon pain is not truly inflammatory in nature.[3,11,24,25]

It is also important to ask why clinicians, who originally diagnosed their patients with tendinitis but then changed their diagnosis to tendinalgia, did not originally choose tendinopathy, as tendinopathy is at least a more general term.[3] In identifying tendinalgia as their final diagnosis, it could be argued that clinicians demonstrated their understanding of the obscurities of tendon pathology described in the literature.[3,11,15-23,30] Under this premise, tendinopathy would have been a more representative term given the first group of diagnostic options (i.e., without tendinalgia).[3] These discrepancies could be due to: 1) clinician error in data entry, 2) failure to report clinical findings that were actually present, and/or 3) failure to consider the implications of all reported clinical findings. If clinicians are not considering the interrelatedness of all documented findings, diagnoses could be misled, again increasing the risk for ineffective treatment.[24,25]

Similar arguments could be made for the observed number of tendinosis diagnoses in relation to reported signs and symptoms. Increased tissue thickness was documented 12.3% of the time, but Stage I and Stage II tendinosis were only diagnosed in 8.6% of cases. Because the presence of tissue thickening was less than the number of tendinosis diagnoses, clinicians may, in this case, have considered this one sign in conjunction with the rest of their clinical findings, rather than considering it in isolation. In contrast, Nirschl and Ashman have also identified that lateral elbow tendinosis is most common in individuals in their thirties to fifties, but the majority of the patients included in the present study were younger.[14] Therefore, the likelihood of true tendinosis in the present study is less probable, given the average age was just over 20 years old. Considering the average age of individuals in this study, along with the fact that imaging studies were not performed, ultimately bring into question the accuracy of the tendinosis diagnoses, and instead reinforce the use of terms tendinopathy or tendinalgia.

Despite the patterns noted previously in clinicians' classifications of tendon pathology, with 67.4% of patients being diagnosed with tendinopathy,

diagnoses generally seemed to reflect the lack of understanding of tendon pathology described in the literature.[3,11,15-23,30] Moreover, when the term tendinalgia was added, there was a 46.0% decrease in the number of tendinopathy diagnoses, and a 15.0% decrease in tendinitis diagnoses. Specifically, 178 total classifications were switched from tendinitis or tendinopathy to tendinalgia. The large shifts in clinical classification to tendinalgia may reflect the lack of accurate understanding of tendon pathology. Or, it may indicate that clinicians are not effectively using their clinical findings to inform their initial working diagnosis. Under the assumption of the former, this could imply that tendinopathy may even be misleading in both describing the nature of tendon pathology and determining treatment choices. Of note, 125 of the 290 original tendinopathy cases were changed to tendinalgia when this term was included as a possible diagnosis. Perhaps the use of the term tendinalgia more accurately describes the current level of knowledge and primary findings regarding tendon pathology. Specifically, these findings suggest that tendon pain is the only consistent finding, and clinicians must perform more through examinations to determine the root cause of the tendon pain.

This exploratory study has several implications for clinical practice. There is a need for comprehensive evaluation of tendon pathology if clinicians are to more fully understand how these types of conditions manifest clinically and what causes, other than local tissue inflammation or degeneration, may be the cause of the patient's root dysfunction. According to numerous imaging studies, tissue changes can often occur without symptoms.[3,15-23] For patients presenting with pain, this indicates that degenerative or inflammatory changes noted with imaging may not actually be the cause of a patient's symptoms. Moreover, if observable changes in tissue structure that appear on imaging studies do not match a patient's symptoms – or lack of symptoms – then clinical findings, which indirectly indicate the nature of pathology through observation of inflammatory signs and pain provocation, may not give clinicians much further information about a patient's pain.[3,15-25] This idea was supported in the present study, with many clinicians ultimately diagnosing their patients with tendinalgia, simply indicating pain at the tendon.[30,31] These findings reinforce the need for detailed evaluation to determine local and regionally interdependent causes of pain and dysfunction that may result in localized tendon pain instead of treating local tissue pathology alone.[24,25,35,36] Thus, more general terms, such as tendinalgia, may be more appropriate when classifying and labeling tendon pain.

The lack of understanding of the nature of pathology, and the possibility that clinical diagnoses do not accurately represent these pathologies, is not uncommon. There is evidence that the same is true for lateral ankle sprains, range of motion limitations, and meniscal lesions, in which tissue is the supposed cause of the dysfunction.[36-38] The tissue model hypothesis has not been supported across any of these pathologies because the time to discharge, change in function, and/or resolution of pain was faster than the time that would be necessary for true tissue healing and/or changes to have occurred.[36-39] While the present study did not include a treatment component, similar questions could be raised about the actual cause of tendon pain. In a case study performed by Baker et al., a patient presenting with reactive tendinopathy of the proximal biceps tendon was pain-free and discharged after three days of manual therapy treatment, with no return of symptoms after resuming physical activity.[30] If the patient had reactive tendinopathy, which implies pathological tissue changes, it should have taken longer for symptoms to be eliminated, and would have most likely required intermittent rest during training to avoid the return of symptoms.[25,39] Therefore, at this point in time, it does not seem appropriate for clinicians to confidently label tendon pathology based on the tissue model hypothesis. Instead, it

seems most acceptable to describe suspected tendon pathology as pain manifesting near a tendon, which is best captured with the term tendinalgia. At the very least, clinicians should acknowledge the limitations in the clinical understanding of tendon pathology, and subsequently treat patients accordingly. Terms such as tendinalgia may help remind clinicians to treat the patient's pain as it presents, rather than treating under the assumption of an inflammatory or degenerative condition without evidence to support these notions.

Limitations

While the limited understanding of tendon pathology that exists across healthcare has been reinforced, the present study does have limitations. Several possible patterns were not assessed, including how patients may differ in clinical presentation based on sport or occupation, age, or sex, nor how clinicians may differ in their clinical diagnoses based on years of experience or other factors. Additionally, data analyzed within the database did not allow for assessment of whether or not the sign or symptom was assessed. It is possible that a sign or symptom was assessed but was not reported because it either was not present or was not documented by the clinician inputting the examination. Therefore, limitations and inaccuracies may exist within the data due to clinician error. However, the goal of the present study was to assess everyday clinical practice. Thus, completely accurate results with solely clinician judgment will be difficult to obtain no matter the nature of the study, so long as researchers and clinicians are only analyzing daily clinical practice without confirmation from imaging or other histological studies. In the future, it would be beneficial to assess: 1) patient presentation stratified by various demographic factors, 2) factors that affect clinician choice in diagnosis, and 3) the relationship between clinical diagnosis and treatment. Gaining a better understanding of the clinical presentation of tendon pain and clinical reasoning may subsequently lead to improved treatment decisions and patient outcomes.

CONCLUSION

According to the present study, the most frequent symptom of tendon pathology appears to be the presence of pain (e.g., at the site of injury, during activity, etc.). Given the discrepancies in tendon pathology diagnosis and imaging results, clinicians must critically analyze patient presentation to identify an appropriate clinical diagnosis and subsequent treatment plan. Understanding of the term tendinalgia, like the previously introduced term of lateral epicondylalgia, may be more relevant to clinicians to improve the documentation of clinical findings, diagnostic classification, and the matching of treatments to address causes of pain. Specifically, patient outcomes may be improved if clinicians operate under the premise that tendon pathology is a pain-related condition, rather than treating from the perspective that there are inflammatory or degenerative changes within the tissue.

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Functional Balance Assessment of Firefighters during Mass-Screening Examinations

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ABSTRACT

Firefighters are tactical athletes who are required to complete rigorous tasks as part of their job functions. The focus of this clinical outcomes assessment was to assess functional balance assessment through the use of the anterior reach test with and without personal protective equipment (PPE) during a mass-screening examination. The screening was completed with 61 active firefighters in a local fire department with access to athletic training services. The results of the anterior reach assessment identified a significant difference of a firefighter's anterior reach when donning and doffing PPE. Anterior reach distances were significantly reduced ($P \leq 0.001$) on the right leg with (mean = 55.78 cm ± 7.53 cm) and without PPE (mean = 58.92 cm ± 6.47 cm). Similarly, significant decrements ($P = 0.003$) in left leg anterior reach distance in firefighters donning (mean = 57.67 cm ± 8.25 cm) and doffing (mean = 59.82 cm ± 6.31 cm) PPE. Clinical application of these findings suggests that healthcare providers working with tactical athletes, specifically firefighters, should consider the risks associated with donning PPE such as functional balance deficits.

Key Phrases
Pre-participation exams and screenings, emerging settings

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PATIENTS

Sixty-one firefighters from a Midwestern fire department were included in this mass-screening examination. All of the firefighters were considered career, full-time employees of the city municipality. Sixty firefighters identified as male and 1 firefighter identified as female. The firefighters ranged in age from 25 to 64 years of age (mean = 41.07 ± 9.23 years) and had between two and 34 years of experience (mean = 15.31 ± 9.41 years) in the fire service. The body composition of the firefighters was of average height (28.03 ± 1.08 cm) and above-average mass (105.58 ± 20.87 kg).

During the intake process, the firefighters completed a past medical history form. From this process, 12 firefighters (19.7%) reported having chronic pain, 16 firefighters (26.2%) reported a previous head/neurological injury, 42 firefighters (68.9%) reported having a previous surgery, and 24 firefighters (39.3%) indicated an ongoing orthopedic injury at the time of the mass-screening examination. It is important to indicate here that while 39.3% of the firefighters reported an ongoing injury, none of these individuals were on restricted or light duty. Thus, they were required to execute and perform all job-related tasks.

INTERVENTION

The intervention was a three-day, mass-screening event at the fire department's training center. The firefighters arrived at the firefighter training center during their shift in crews of three to seven people. Each firefighter completed a past medical history form and patient-reported outcome measures via an online survey (Qualtrics, Inc, Provo, UT). Once the patients completed the online survey, they proceeded to complete a series of functional screenings throughout the training center. **Figure 1** outlines the flow chart of Mass-Screening Intervention Process.

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Figure 1. Flow Chart of Mass-Screening Intervention Process

The first stage of the functional screening included patient intake (height, weight, leg length, tibial tuberosity height, and hand length), the weight bearing lunge test, and the closed kinetic chain upper extremity stability test. Once all patients completed these stations, they proceeded to the second stage of the function screenings that consisted of the anterior reach portion of the Y-Balance Test, the Landing Error Scoring System (LESS), and the Functional Movement Screen (FMS). The firefighters completed each of these tests while donning their station attire that included a t-shirt, athletic shorts/pants, and tennis shoes, or while donning their personal protective equipment (PPE) which included their jacket, pants, boots, helmet, mask, and condensed air tank. During the anterior reach, the firefighter's mask was not connected to the condensed air tank during the completion of the anterior reach. The mask is the piece of equipment that covers the firefighter's face into which the condensed air tank attaches to provide the firefighter with oxygen. Once the patient completed the tests while donning and doffing their PPE, their mass-screening examination was completed.

OUTCOME MEASURES

The focus of this clinical outcomes' assessment was dynamic balance assessed using the anterior reach portion of the Y-Balance Test. The Y-Balance Test measures dynamic balance using single limb stance excursion.[1] Prior to the Y-Balance Test, the Star Excursion Balance Test (SEBT) was used to identify chronic ankle instability, at-risk athletes for lower extremity injury, and assess overall physical performance.[1] The Y-Balance Test was developed to improve the repeatability of the SEBT.[1] The anterior reach assessment was utilized because previous research suggests that asymmetries in the anterior direction indicated balance deficits that increased the risk for injury.[2,3] Specifically, the anterior reach has high intrarater reliability at 0.91.[1,2] To be mindful of time guided by the literature, we only assessed the anterior reach out of the three directions for the Y-Balance Test.

Prior to the firefighter completing the assessment, the athletic trainer provided verbal and modeling instruction on how to complete the anterior reach assessment of the Y-Balance Test. During the anterior reach assessment, each firefighter successfully completed the test three times while donning PPE (**Figure 2**) and three times doffing PPE (**Figure 3**) for a total of six trials of the anterior reach completed using an established protocol.[1] The order was not controlled for the patients to start with or without their PPE. The anterior reach test was completed using the Y-Balance Test Kit, which includes three pipes in the anterior, posteromedial, and posterolateral direction.[1] For the mass-screening examination, only the anterior pipe was measured. The pipe was marked in 0.5 centimeters increments for measurements, where the firefighter pushes the reach indicator box along the pipe, marking the determination of the reach distance, and returning

Figure 2. Anterior Reach Assessment with Personal Protective Equipment

to the starting point while maintaining their balance on their stance leg.[1]

Once all patients completed the anterior reach assessment, the data were entered into a custom spreadsheet application and analyzed in a commercially available statistics package. First, the absolute reach distance was calculated by summing the three reach distances and dividing by three for the average on the right and left leg with and without PPE. Next, the data were normalized by dividing the maximum reach distance in each leg for each condition by the limb length of the patient. This number was multiplied by 100 to calculate the relative anterior reach distance.[1] Normalizing the data occurred to be able to compare the data among the individuals with different leg lengths.

Figure 3. Anterior Reach Assessment Without Personal Protective Equipment

RESULTS

The majority (54/61, 88.5%) of the firefighters were self-reported right leg dominant. **Table 1** provides the descriptive statistics for the anterior reach assessment. A paired sample t-test was utilized to analyze the data. Results of the data analysis identified a significant difference ($P < 0.000$) for the right leg anterior reach distance when the firefighters were doffing their PPE (mean = 58.92 cm ± 6.47 cm) as compared to when they were donning their PPE (mean = 55.78 cm ± 7.53 cm). Similar results were identified on the left leg with a significant difference ($P = 0.003$) for anterior reach distance donning and doffing PPE.

Table 1. Anterior Reach Results

Condition	Mean (cm)	Standard Deviation (cm)	Standard Error (cm)
Right Leg - PPE	55.78	7.53	0.96
Right Leg - No PPE	58.92	6.47	0.83
Left Leg - PEE	57.67	8.25	1.06
Left Leg - No PPE	59.81	6.30	0.81

PPE = Personal Protective Equipment

After normalizing the measurements per patient, we identified a significant difference in relative anterior reach distance for the right ($P \leq 0.01$) and left ($P = 0.026$) leg when donning and doffing their PPE. **Table 2** provides relative normalized reach distance descriptive measures per assessment condition.

Table 2. Anterior Reach Normalized Results

Condition	Mean (cm)	Standard Deviation (cm)	Standard Error (cm)
Right Leg - PPE	69.23	21.26	2.72
Right Leg - No PPE	72.72	22.19	2.84
Left Leg - PEE	71.31	22.79	2.92
Left Leg - No PPE	73.49	22.76	2.91

PPE = Personal Protective Equipment

DISCUSSION

In 2018, 58,835 firefighters were injured on the fireground.[4] Strain or overexertion were the leading cause of fireground injuries.[4] With the high rate and risk of injury during the job, firefighters are required to don PPE that limits smoke inhalation, chemical exposure, and fire contact resulting in burns.[5] As a part of their PPE,

firefighters must also wear a compressed air tank which was identified in previous literature to have a negative effect on postural control and functional balance.[6] There are various PPE designs that are worn by firefighters, but regardless of the design, PPE significantly impairs functional balance.[7] When donning PPE, firefighters had a decrease in movement speed by a 13% increase in performance time and made more errors on a balance exam.[7] By knowing that the PPE could impair functional balance, it is vital to understand how decreases functional balance may predispose a firefighter to a musculoskeletal injury on the fireground.

Results of this study found that there is a significant difference between the relative anterior reach distance for the right leg as compared to the left leg when patients are donning and doffing their PPE. Anterior reach decreased when donning PPE, due to the impairments of the functional balance. The anterior reach assessment was completed while donning and doffing firefighter PPE. Previous research has identified that the thermal layer (pants and jacket) alters a firefighter's gait speed during balance testing. PPE negatively effects gait by decreasing step length thus slowing one's speed.[8]

Although we were not assessing gait, we did identify that wearing the PPE significantly altered the firefighter's functional balance. Based on the literature, functional balance and gait are affected by donning PPE. This is of concern to the safety and wellness of the firefighters. The longer someone is in a live fire, the more functional balance is affected. If someone is moving slower and paired with balance decrements at the onset, there is a grave concern that exposure to heat while donning PPE may result in the trips and falls that contribute to the high statistics of sprains and strains in the United States fire service.

One mechanism that may improve functional balance while donning PPE is by increasing resistance and aerobic training, as the literature supports that a more physically active firefighter has less physical impairment. [9] In regard to the limited anterior reach that was found in this study, one proposed mechanism for the decrements is limited dorsiflexion at the ankle. Ankle dorsiflexion for firefighters is impacted by their boots.[10-12] The literature supports that boot type (rubber versus leather) influences a firefighter's balance with rubber boots, increasing their risk for falls.[10-12] Common tasks of firefighters include climbing ladders, emergency lifts to rescue victims in burning buildings, and assembling equipment to put out fires. As such, ankle dorsiflexion and functional balance are both required. Future research on PPE gear analysis would assist the industry in identifying how to create protective turnout gear that limits chemical exposure and exposure to fires that also allows for movement and range of motion.

CLINICAL APPLICATION

The data collected can assist in determining limitations that the patient's experiences with their PPE. This allows clinicians to be able to understand the potential causes of the mechanism of injury and design rehabilitation plans to prevent the injury from reoccurring. By determining the limitations during the mass screening, the clinician can work with the patient on goal setting and injury prevention. Due to the equipment having a negative effect on the patient's performance in the anterior reach, it may be beneficial to have the patient complete exercise, physical activity, and therapeutic rehabilitation with their PPE to train the body to replicate the conditions in which they are required to work. This change may result in more job-specific rehabilitation, with future investigations necessary to explore firefighters' ability to complete movements. Clinicians are also able to develop resistance and aerobic training exercise plans to increase the firefighter's overall physical fitness to reduce their physical impairments, which can result in improving their physical ability while donning PPE.

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Posterior Glenoid Dysplasia as a Secondary Finding to Labrum Tear and Subscapularis Strain: A Case Study

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ABSTRACT

The purpose of this disablement model case study was to describe the case of a collegiate baseball pitcher suffering from a labral lesion and supraspinatus strain that may have been the result of posterior glenoid dysplasia. Despite gross instability and glenohumeral external rotation weakness, the patient was initially able to continue to pitch. While posterior glenoid dysplasia has been described in literature, there have not been studies that have evaluated soft tissue changes that may be associated with this bony morphology abnormality. In this case, the patient reported to the athletic training staff complaining of pain, tightness, and a "clunking" sensation in and around his glenohumeral joint. The patient reported right shoulder pain being worse following pitching, but not experiencing symptoms during the act of pitching. The patient was initially treated with cupping and therapeutic exercise and was able to continue pitching. As the season progressed, the patient reported needing increasingly longer time to recover from pitching outings. The patient continued to present with a positive O'Brien's (Active Compression) test, weakness with internal and external rotation, and visible scapular protraction at rest. Upon referral to the team physician, radiographs were ordered to evaluate for bony pathology. The patient was diagnosed with posterior glenoid dysplasia and referred for magnetic resonance arthrogram. This imaging revealed a labrum tear and subscapularis strain. The patient was referred for surgery, at which time a labrum and subscapularis debridement, and subacromial bursectomy were performed. The patient was then instructed to follow up with the athletic training staff to initiate therapeutic exercise as prescribed by the attending surgeon. When evaluating glenohumeral weakness and instability, the clinician must consider bony abnormality as a potential factor. If initial treatment attempts do not result in improvements, the clinician must exhaust all diagnostic options to determine the exact nature of the offending pathology.

Key Phrases
Glenoid fossa, labrum pathology, rotator cuff

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INTRODUCTION

Posterior glenoid dysplasia is a relatively uncommon condition affecting the glenoid fossa of the scapula.[1] Generally, this condition has been described in osteoporotic patients, but has also been found to have a high incidence in young baseball players.[1,2] Glenoid dysplasia is believed to be the result of a failure of the glenoid pre-cartilage to ossify during gestation and early childhood.[1] Additionally, it has been suggested that there may be a hereditary component, with individuals potentially passing the morphology to future generations of their genetic line.[3] It has been suggested that the stresses applied to the anterior and posterior glenoid during overhead throwing my result in changes to the structure of the glenoid over time.[4] While there have been some data collected regarding the incidence and description of this condition, the authors were unable to find a study that reported the effects of this abnormal morphology on soft tissue structures such as the glenohumeral labrum.[1]

In a study examining the role of glenoid abnormalities in shoulder pain, Kirimura and his colleagues found that 89 of 91 young baseball players reporting with shoulder pain exhibited posterior glenoid dysplasia.[2] Currently the primary focus of existing literature is on bony

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pathologies associated with this abnormal morphology.[5] Thus, it is the purpose of this case study to describe a labrum tear and subscapularis strain of the right shoulder in a collegiate baseball player who also exhibited posterior glenoid dysplasia. This case will describe the presentation of injury, diagnosis, treatment, patient reported disablements, and outcomes.

Patient Information

The patient described in this case is a 19-year-old collegiate baseball pitcher. The patient reported a history of long term, high intensity, high frequency bouts of pitching, but had previous only been troubled by muscular tightness and delayed onset muscle soreness in his right shoulder. While he did not associate the symptom with pitching or pain, the patient also stated that his shoulder would "clunk" or "pop" when taken through certain motions. The patient noted that he did not experience symptoms while pitching, but would begin to feel pain and tightness within the first 24-hours post pitching. Initial evaluation revealed a positive O'Brien's (Active Compression) Test, negative Anterior Apprehension Test, negative Jobe's Relocation Test and weakness with glenohumeral internal and external rotation. The patient was placed on a preventative therapeutic exercise program that incorporated cupping therapy to address his reported muscular tightness and reported instability.

Differential Diagnosis and Evaluation

After initially reporting symptoms, the patient was evaluated following each pitching outing. The patient stated that the pain he was experiencing made it difficult to use his right arm during driving, and that he was unable to hold his cellular telephone in his right arm while talking for an extended period of time. The patient reported that his pain felt as though it was "too deep to touch," and that while treatment and exercise provided temporary relief, he would still experience the same level of pain after pitching. Given that the patient stated he was experiencing increasing levels of dysfunction, and presented with positive labrum symptoms, the treating athletic trainer made the decision to have the patient evaluated by the team physician. At this time, the differential diagnosis included: Labrum Pathology, Scapular Dyskinesis, Rotator Cuff and Scapula Stabilizer Weakness.

Two weeks after the patient initially reported his symptoms, during the team physician's evaluation, it was noted that the patient has multidirectional glenohumeral instability. However, instability tests did not elicit the pain that the patient stated was his primary concern. Following initial evaluation, the team physician determined it was necessary to pursue diagnostic imaging. Radiographs revealed posterior glenoid dysphasia. Consultation with the team orthopedic surgeon led to the patient being schedule for a magnetic resonance (MR) arthrogram to further evaluate the soft tissue structures of the shoulder. The MR arthrogram revealed significant inflammatory signal, leading the orthopedic surgeon to conclude that the patient had suffered an injury to his labrum and rotator cuff (**Figure 1**).

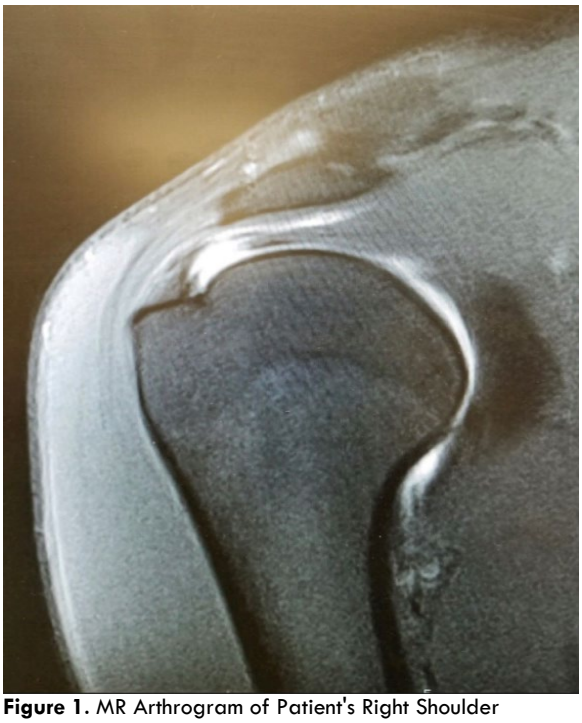

Figure 1. MR Arthrogram of Patient's Right Shoulder

At this time, the surgeon explained to the patient that without performing arthroscopic surgery it would be difficult to fully appreciate the severity of the damage to labrum and rotator cuff. The patient stated that the intensity and duration of the pain he felt following pitching was affecting his activities of daily living, and he wished to undergo surgery to address any damage that had been sustained.

Body Structure and Function

Given the injury and patient population, the primary diagnostic tools utilized to determine the need for an MRI arthrogram were orthopedic special tests, strength and range of motion tests, and patient reported history. At the initial time of injury, the patient presented with full range of motion, inability to pitch for long durations, and a 4/5 strength deficit with glenohumeral internal and external rotation.

Activity and Participation

In order to help the patient determine if he would be able to continue to participate in further competitions, the patient was allowed to pitch in one more competition following diagnostic imaging. The patient stated that while he was pitching, he did not notice significant pain. However, the patient experienced fatigue faster than he normally would have, and was unable to pitch longer than two innings. The following day the patient reported an increase in pain and stiffness compared to his previous pitching appearances.

Environmental and Personal Factors

Outside of baseball related activities, the patient stated that the pain he was experiencing in his shoulder was affecting his activities of daily living. Specifically, the patient stated that the intensity of pain inhibited his ability to obtain adequate quality sleep. Additionally, the patient reported difficulty turning the steering wheel of his car without patient. After his last pitching appearance, the patient stated that he was unable to brush his hair and teeth without pain. Given this increase in pain and the knowledge that there was some form of structural damage within his shoulder, the patient stated his desire to have his injuries surgically addressed as soon as possible. When consulting with the team orthopedic surgeon, the patient made the decision to delay surgery until after he had taken his final examinations out of concern for being unable to focus properly on his studies.

INTERVENTION

Immediately after initially reporting symptoms, the patient began participating in a rehabilitation plan consisting of elastic tubing and dumbbell exercises designed to address the present rotator cuff and scapula stabilizer weakness. These exercises were completed five to six times a week. In addition to these exercises, the patient continued to participate in his normal elastic tubing and range of motion exercises as part of his normal warmup prior to throwing. During this time the patient was allowed to continue throwing as tolerated.

Once the patient began to experience worsening symptoms and it was determined that continuing to pitch was not a viable option, the patient was instructed to discontinue all throwing and upper body weightlifting activities. The patient was then consented and scheduled for surgery following his final examination. Upon performing arthroscopic surgery, the surgeon found subacromial bursitis, a 20% subscapularis tear and fraying of the labrum at the attachment site of the long head of the biceps brachii. Based off of these findings, the surgeon performed a subacromial bursectomy, subscapularis debridement, and biceps brachii debridement. During his evaluation, the surgeon determined that the present posterior glenoid dysphasia was not severe enough to warrant surgical correction.

OUTCOMES

Body Structure and Function

After one week of rest following surgery, the patient began participating in light range of motion and strengthening exercises. As the patient regained range of motion and strength, exercises progressed in terms of intensity and volume. Throughout the progression in exercise the patient experienced intermittent bouts of expected soreness, but stated that his shoulder was beginning to feel increasingly stronger and pain free. Within four weeks, the patient had regained sufficient strength and range of motion to begin a throwing program. Over the course of the summer, the patient was able to progress in terms of distance and repetitions until he was cleared to begin training to pitch during the following fall baseball practices.

Activity and Participation

Through the surgical intervention and the initiation of the therapeutic exercise and throwing program, the patient was able to increase his amount and distance of throwing in order to be prepared to pitch when non-traditional practices began the following fall. After throwing, the patient noted that his soreness was not as intense or severe as it had been prior to surgery and rehabilitation. When asked, the patient noted that he felt as if he was able to recover more quickly than he had been prior to surgery.

Aside from baseball and pitching, sleep and activities of daily living that required extensive upper body usage began to grow easier as strength and range of motion improved. Had the patient not elected to undergo surgery, his symptoms would have likely continued to worsen to the point where they were affecting his activities of daily living even worse. Fortunately, the patient lived locally with his family who were able to assist him as needed, and he was able to complete his final examinations without incident.

Environmental and Personal Factors

Given the patient's expressed desire to be able to complete his final examinations in as little pain as possible, he remained adherent to his limitation regarding throwing and upper body weightlifting. Following surgery, the patient adhered to all scheduled rehabilitation times and was only absent from the athletic training clinic for a short period in order to vacation with his family. Because the ultimate decision was to discontinue activity until the patient's structural damage could be appropriately addressed there were no adverse effects from the chosen course of treatment.

DISCUSSION

This case describes the diagnosis and management of a patient suffering from subacromial bursitis, labral tear, and subscapularis partial tear with a secondary finding of posterior glenoid dysphasia. While posterior glenoid dysphasia is an uncommon finding, it has been described in a number of young baseball players complaining of shoulder pain.[2] Furthermore, in this case the posterior glenoid dysphasia did not appear to be the source of pain in the patient's shoulder. The team orthopedic physician did state that the glenoid dysphasia could have contributed to the humeral head resting against the glenoid fossa differently, but could not definitively attribute the soft tissue damage to the structural abnormality.

Overall, the choice to discontinue throwing even though the patient was still able to pitch effectively at the time was made based off the patient's concerns regarding educational goals. Had the patient chosen to continue to participate, it is possible that they would have been able to continue pitching. However, this continued participation may have led to worsening symptoms or further structural damage. Ultimately, the patient was able to return to throwing following surgery and therapeutic activity, and no adverse outcomes were reported.

CLINICAL BOTTOM LINE

Within the scope of clinical practice, it is entirely possible for clinicians to encounter diagnostic findings that are not well described in literature. In some instances, the available literature may indicate that these findings are part of the cause of the symptoms with which a patient presents. In all cases, clinicians must use their clinical qualifications to evaluate and re-evaluate a treatment and rehabilitation plan. Should conservative treatment fail and surgical intervention be warranted, the clinician may learn that previous findings were not the ultimate cause of a patient's symptoms. In these cases, a clinician must be prepared to adjust their treatment and rehabilitation plans accordingly. At all times, a clinician must prioritize their patient's safety and personal values. Based off of these values, clinicians may change their course of action within reason.

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Deep Vein Thrombosis in Lower Extremity of a Female Collegiate Volleyball Athlete: A Case Study

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ABSTRACT

Deep vein thrombosis (DVT) occurs when a blood clot forms in deep veins in the body, usually in the lower extremity. DVT is commonly seen in older or hospitalized patients. This case is unique because the patient is a 20-year-old female division III collegiate volleyball athlete, which is not the typical age or population affected by DVT or clotting disorders. The patient presented with swelling, pain, and decreased knee flexion (3/5) and plantarflexion (4/5) strength in her left lower extremity. These impairments reduced her ability to walk or run. The patient's athletic trainer (AT) initially diagnosed her with a left gastrocnemius muscle strain, resulting in contraindicated treatments. The AT referred the patient to the team physician, who referred her to the Emergency Department (ED) where she received a real-time grayscale and Doppler ultrasound of the left lower extremity deep venous structures, leading to the DVT diagnosis. The patient received a dose of Lovenox, an intravenous anticoagulant, by the ED physician. The following day, she began 15 mg of Xarelto, twice per day for 21 days, to dissolve the blood clots. She could not participate in volleyball for approximately two weeks, which reduced her ability to socialize with teammates and coaches. The Wells' scoring system is a clinical prediction tool to identify patients with low risk of being diagnosed with DVT. The AT had a low suspicion of DVT and therefore did not use the Wells' scoring system, likely leading to a delay in the diagnosis and treatment. Although the patient reported that she had a positive outcome, ATs should be familiar with the Wells Clinical Prediction Rule. Blood clots in veins can dislodge and travel through the bloodstream. The loose clot can block blood flow in the lungs, forming a pulmonary embolism. Early diagnosis can prevent this life-threatening condition.

Key Phrases
Diagnostic testing, lower extremity, general medical conditions

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INTRODUCTION

Venous thrombosis is a condition that includes deep vein thrombosis (DVT) and pulmonary embolism (PE). An annual incidence rate of about 1 per 1000 adults,[1] which rapidly increases after the age of 45.[2] Incidence rates are slightly higher in men than women, and approximately two-thirds of episodes manifest as DVT, while one-third as a PE with or without DVT.[3] DVT occurs when a blood clot forms in one or more of the deep veins in the body, usually forming in the lower extremity. However, it can also occur in the upper extremities.[4] This disease typically occurs after surgical procedures and trauma in the presence of malignancy or inherited coagulation disorders, but can present without any apparent etiologic event.[5] Approximately half of all DVT cases occur in hospitalized patients or nursing home residents.[6] Symptoms of DVT include tachycardia, pyrexia, leg pain and tenderness, swelling, and dilation of the superficial veins.

The Well's Clinical Prediction Rule, commonly known as the Well's scoring system, is a valid, nine-item, clinical prediction rule for DVT. This clinical prediction rule previously demonstrated excellent interobserver reliability (Kappa = 0.85),[8] developed as a safe and feasible pretest with probability for DVT.[9] It is critical for ATs to be familiar with these 9 questions so they may consider using this tool if a patient presents with signs and symptoms consistent with DVT, particularly when the patient presents with three or more signs and symptoms. The number and location of the clots, patient's age, and absence of trauma created a unique case of DVT. In this

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case study, the patient first received a misdiagnosis due to the lack of suspicion.

Patient Information

This case follows a 20-year-old female Division III collegiate volleyball player. A timeline of this case is provided (**Figure 1**). On August 14, 2017, the patient reported to the athletic training facility (ATF) with a swollen lower left leg and discomfort with walking. The team's AT performed the initial evaluation. During this evaluation, the patient reported to the athletic trainer (AT) that she had no previous history of DVT. The patient revealed to the clinician that she took Propafenone-Ethinyl Estradiol (YAZ) 3-0.02 mg, a daily oral contraceptive medication. The patient reported that she had previously diagnosed with pes planus a few months earlier in the summer preceding camp, and received a walking boot for two weeks. Furthermore, she stated that a week before reporting to the ATF, her uninvolved leg had swelled, but reduced within a couple of days.

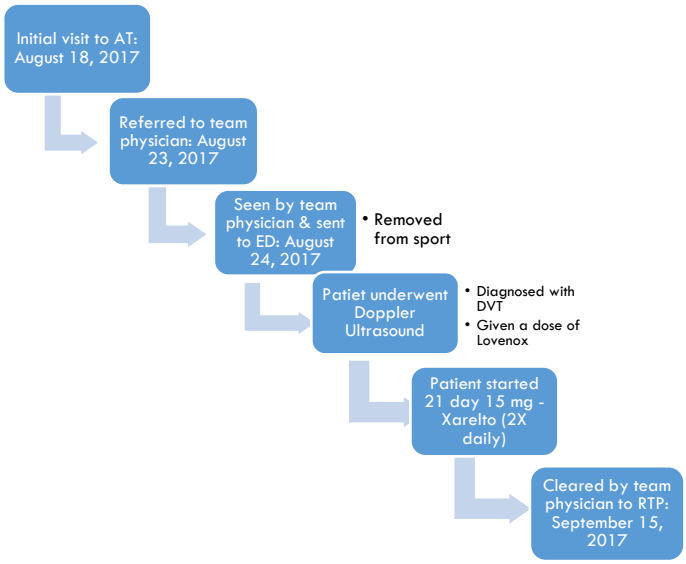

Figure 1. Timeline of Care;
AT, athletic trainer; ED, emergency department; RTP, return-to-play

Differential Diagnosis and Evaluation

After four days of treatment, the patient did not progress as the AT had expected for a gastrocnemius muscle strain. During this time, the patient returned-to-play without restrictions. The team physician later referred her for additional diagnostic testing due to her calf swelling and difficulty with walking. During his evaluation, the team physician referred her to the hospital for a Doppler ultrasound to rule out DVT. The patient drove to the ED via her mother's personal vehicle. After being admitted to the ED, the patient's mother reported to the ED physician that the patient had a factor V Leiden deficiency, an inherited blood-clotting disorder due to a mutation of the blood's factor V protein. Furthermore, the patient received a Doppler ultrasound, positive for DVT.

The patient had three blood clots, one in each of her left femoral vein, popliteal vein, and the profundal vein. The Wells' scoring system (**Table 1**) would have revealed a score of 3 at the initial evaluation; one point given due to her recent immobilization of the walking boot, one point given for her entire left leg swelling, and localized tenderness along the distribution of the deep venous system of her left lower extremity. Due to the low suspicion for DVT, there were no measurements of calf girth or the use of the Homan's sign to rule in or rule out DVT. Due to the location of pain, obvious swelling, use of contraceptive, suspicion for DVT should have been raised and the use of the Wells' score would have suggested a high probability for a DVT diagnosis.

Body Structure and Function

Manual muscle testing determined the severity within the left lower extremity: 3/5 knee flexion, 5/5 knee extension, 5/5 dorsiflexion, and 4/5 plantarflexion. The patient reported with knee flexion and plantarflexion limitations. Once the patient received the correct diagnosis of DVT, the focus of her treatment changed from the musculoskeletal system to the circulatory system. The ED physician referred the patient to a hematologist for additional care. The patient reported that she still had pain throughout the range of motion of the left knee.

Activity and Participation

During the initial evaluation, the patient could not walk without pain and had an observable limp. Functional tests were determined to be unnecessary to perform during this time. The AT withheld the patient from practice following the initial evaluation and established the goal to help control the patient's pain and swelling. Two days later, the patient returned to the AT without the need for crutches. Although the patient's calf still had some swelling, she returned to full practice participation for two days before she had to discontinue activity due to pain. During this time, the patient received treatment: 20-minutes of compression cryotherapy, seven minutes of a milk massage, instrument-assisted soft tissue mobilization, bike or treadmill warm up, and abdominal core workouts.

Following the DVT diagnosis, the patient received a single dose of Lovenox to dissolve her blood clots. The ED physician discharged her the same day as arrival. She returned to her dorm room, where she elevated the affected area above the level of her heart when sitting. She wore a compression stocking and applied a warm compress or heating pad to the affected area as directed by the ED physician. The physician encouraged the patient to avoid prolonged standing or bed rest, avoid smoking, to discontinue taking Meloxicam, and her oral contraception.

Table 1. Wells criteria for the prediction of deep vein thrombosis (DVT)[10,11]

Clinical Characteristic	Score
Active cancer (patient either receiving treatment for cancer within the previous 6 months or currently receiving palliative treatment)	1
Paralysis, paresis, or recent cast immobilization of the lower extremities	1
Recently bedridden for ≥ 3 days, or major surgery within the previous 12 weeks requiring general or regional anesthesia	1
Localized tenderness along the distribution of the deep venous system	1
Entire leg swelling	1
Calf swelling at least 3 cm larger than that on the asymptomatic side (measured 10 cm below tibial tuberosity)	1
Pitting edema confined to the symptomatic leg	1
Collateral superficial veins (non-varicose)	1
Previously documented DVT	1
Alternative diagnosis at least as likely as DVT	-2

Wells scoring system for DVT: -2 to 0: low probability, 1 to 2 points: Moderate probability, 3 to 8 points: High probability

After this time, the ED physician allowed her to return to activities of daily (ADL). The physician did not provide a specific progression for ADLs. Once the patient discontinued the 15 mg of Xarelto, taken twice a day for 21 days the physician determined the patient no longer had a risk for developing a PE. After that time, the patient returned to volleyball without restriction.

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Currently, there is not an established return-to-play protocol for individuals recovering from a venous thromboembolism. However, it is critical that providers develop a structured program of gradually increased activity as tolerated by the patient.[12] Roberts and Christie report a case of a female triathlete with acute lower extremity DVT that suggested a structured, gradual return-to-training protocol (Table 2).[13] In the first three weeks, the gradual introduction of ADLs is suggested, while patients complete their anticoagulation medication.[13] Once endothelialization and adhesion are achieved, the potential for clot migration and embolism is reduced.[12] Between the fourth to sixth weeks of this protocol, Roberts and Christie suggest a gradual return-to-training regimen that starts with non-weight-bearing exercises, next cycling, and finally, running.[13] If the patient reports any previous signs or symptoms returning, the protocol should be discontinued. Moreover, it is important the AT and patient note any bruising.[12] In this case, the patient completed the first three weeks of this protocol prior to fully return to play (RTP). Additional sport-specific activities should have been gradually integrated prior to full RTP.

Table 2. Post-anticoagulation return-to-training recommendations.

Weeks 1-3	Gradual return to ADLs
Week 4	Begin non-weight-bearing exercises (e.g., swimming)
Week 5	Begin nonimpact-loading exercises (e.g., cycling)
Weeks 6 +	Begin impact-loading exercises (e.g., begin running progression)

Environmental and Personal Factors

The patient hesitated to schedule the initial evaluation because she worried about losing her spot on the team. Also, she reported that the right calf presented similarly, earlier in the summer but resolved within a couple of days. After several days of pain and inflammation in her left calf causing difficulties with walking, she decided to seek help. The patient's pain affected her ability to perform ADLs such as walking, running, and going upstairs. The patient discontinued her oral contraception due to the increased increase risk of DVT.

INTERVENTION

The patient's AT initially provided treatment for a soft tissue injury, a left gastrocnemius muscle strain. The primary goals of the interventions were to reduce the patient's pain and swelling. Treatments included 20-minutes of compression cryotherapy, seven minutes of a milk massage, instrument-assisted soft tissue mobilization, bike or treadmill warm up, and abdominal core workouts. The AT performed these treatments for three consecutive days. Once the patient received the DVT diagnosis, this course of treatment was discontinued. The massage and soft tissue treatments are contraindicated for a DVT diagnosis because of the potential risk factors for developing a PE by dislodging a blood clot.[11] After the ED physician diagnosed the patient with DVT they did not suspect an active PE. The ED physician discharged the patient the same day as arrival and instructed her to begin ambulation within 24 hours, elevating her left calf above her heart when seated. The day following discharge, the patient began a 21-day series of twice-daily 15 mg of Xarelto. After the 21-day series, the patient could perform all ADLs. The team physician cleared the patient for full RTP. To reduce the potential of bleeding, the hematologist ordered the patient to reduce her dosage of Xarelto to one daily dose of 20mg.

The patient was instructed by the team physician to discontinue taking Propafenone-Ethinyl Estradiol (YAZ) 3-0.02 mg because of its known side-effect of increasing the risk for clot formation.[14] Additionally, the team physician told her to discontinue taking Meloxicam, an acne medication, due to its possible interactions with the Xarelto. The ED physician prescribed the patient 15mg of Xarelto, administered orally twice daily,

to treat the pre-existing blood clots and prevent new clots from forming. Following her visit to the hematologist, further testing confirmed that the patient was positive for factor V Leiden mutation. This is an inherited blood-clotting disorder due to a mutation of the blood's factor V protein.[15] As of January 2019, the patient continued to see both her hematologist and primary care physician several times throughout the year for a physical exam and a comprehensive metabolic panel to monitor the status of the blood clots.

OUTCOMES

Body Structure and Function

The Xarelto is expected to continue to shrink the blood clots. This allows the body to naturally dissolve them. The left leg continues to remain swollen. The hematologist deemed this as normal; this condition is referred to as post-thrombotic syndrome.[15] After 22 months following her diagnosis, the patient is now able to complete full range of motion without pain. Muscle strength returned to pre-injury performance. Strength was accessed by the patient's ability to perform both ADLs and sport participation without any restrictions.

Activity and Participation

The team's AT monitored the patient for signs and symptoms as she RTP. The team physician followed Roberts and Christie's suggested RTP protocol for the first three weeks,[13] keeping the patient out of sport participation. Neither the team physician nor the AT initiated a gradual RTP progression after this time. The patient successfully competed in the rest of the volleyball season without her symptoms returning or sustaining any additional injuries.

Environmental and Personal Factors

The patient reported that she was pleased with how she performed following her RTP. Since her left leg was more swollen than the right, people often asked her if it was safe for her to RTP. This caused her to be irritated. The oral contraception medication the patient was taking may have predisposed her the blood clots.

DISCUSSION

Deep vein thrombosis is a rare and emergent medical condition, especially in young active individuals.[14] It is critical that ATs are educated properly on the appropriate recognition and management for DVT. The Wells' scoring system is a helpful 9-item clinical diagnostic prediction tool for DVT;[6] based on yes or no questions. Each question is given a numeric value (Table 1). A score of zero or lower suggests DVT is unlikely (5%), 1-2 moderate risk (17%), 3 and above DVT is likely (17-53%).[9,10] An AT should consider using the Wells' scoring criteria if they suspect a patient presents with any combination of signs or symptoms of DVT, such as sudden shortness of breath, chest pain or discomfort that worsens when they take a deep breath or cough, feeling lightheaded or dizzy, have a pulse > 100 beats per minute, coughing up blood, or having posterior leg pain.

It is critical to ask patients about their current and past use of oral contraceptive medications because some brands and dosages can cause patients to be prone to blood clotting. Moreover, it is critical to determine if patients have a known medical history that includes genetic disorders. Vandenbroucke et al. found that there is an increased risk of DVT in oral contraceptive users who are carriers of factor V Leiden mutation.[16] Additionally, the AT in this case likely overlooked DVT as a differential diagnosis, due to lack of suspicion because of the patient's young age and active status.

The use of a patient-rated outcome measure, such as the SF-36, should be used throughout a patient's treatment to measure their health-related quality of life. The SF-36 would have complemented the use the Wells' scoring system, as it can be used to track the overall quality of life of patients with DVT.[17] The SF-36 can be used

to determine when a patient is ready to progress to the next step in the return-to-play DVT progression.[13] Additionally, patients who develop post-thrombotic syndrome PTS after DVT report poorer health related quality of life using both generic and disease-specific questionnaires.[18] For example, if the SF-36 was used in this case by the AT, they may have identified that the patient was having difficulty with ADLs as well as their emotional health. Although the patient's care was delayed, this patient was able to return to full participation and ALDs. Although the patient was able to fully return-to-play, as of 22 months post diagnosis the patient continued her treatment of 20 mg of Xarelto, taken once daily. We recommend that ATs consider implementing the Wells' scoring system when patient's present with signs and symptoms consistent with DVT. Although evidence supports anticoagulation and early mobilization, guidelines for return-to-play require additional research.[12] We propose ATs use Roberts and Christie's suggested return-to-play protocol (Table 2) and patient-rated outcome measures to determine when DVT patients' activity levels should progress.

CLINICAL BOTTOM LINE

When evaluating a patient who presents with calf pain, ATs should determine if other signs, symptoms, and risk factors associated with venous thrombosis are present (Figure 2). If warranted, ATs should consider implementing the Wells' scoring criteria. This will aid the clinician in determining if the patient is a low, moderate, or high probability of DVT. If further consultation is needed, ATs should consult with their supervising physician or activate their emergency action plan. Early diagnosis can help prevent the progression of a DVT to a PE. Compression ultrasonography is considered the gold standard to diagnose DVT.[19] Additional research is needed to determine specific clinical practice guidelines. If the patient is diagnosed with DVT, patient-rated outcome measures should be used in combination with clinician-rated outcome measures to confirm the patient's progress. Patients should be instructed to discontinue sport participation if signs or symptoms return. Particular attention should be given to bruising or loss of blood.

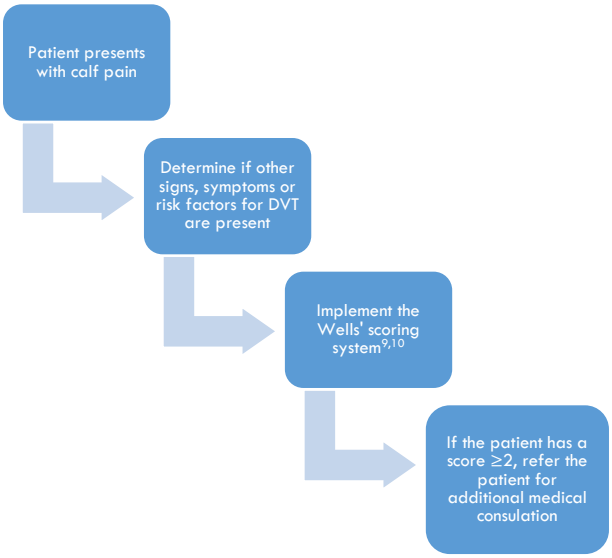

Figure 2. Evaluation process for patient with potential DVT

PATIENT PERSPECTIVE

The patient agreed to do an interview about her experience. The interview was conducted approximately a year after she returned-to-play. The patient thought the care she received was adequate. She reported that the athletic training staff provided care to the best of their abilities and used the knowledge that was best at the time. The patient was asked what the athletic training staff could do differently about her treatment. She answered, "No milk massage or scraping because it made my leg hurt more." When asked how she felt about her return-to-play, the patient answered, "I wasn't worried. They warned me that my leg would remain swollen. I was more worried about getting other injuries." When asked how the injury affected this year's season, the patient replied, "It didn't really affect this year. My leg still swells. I still have the blood clots, but they are shrinking. I am still on the medication. It'll take time for the clots to go away. The only thing that is different is that I take the medication at night now."

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