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Clin AT – The Year in Review, 2021: An Outlet for the Clinician

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A Look Back

Clinical Practice in Athletic Training had a monumental year as we continue to evolve and grow as a journal. In total, *Clin AT* had 25 articles published across the three issues throughout the year. In 2021, we saw our first Special Issue published that elevates the voices of athletic trainers and patients who represent historically marginalized and minoritized populations in their role in healthcare and scholarship contributions. There was a total of seven articles published in this issue including disablement model case studies, evidence-to-practice reviews, and clinical outcomes research resulting in nearly 1,500 downloads since publication. We look forward to continuing special issue opportunities and will be announcing our next topic soon.

Last year also saw both continued and growing partnerships with other organizations. We continued our partnership with the Athletic Trainers in Physician Practice Society (ATPPS) to publish the abstracts from their annual conference which included four abstracts this year, which can be found here. Furthermore, *Clin AT is* thrilled to announce a new partnership with the Southwest Athletic Trainers' Association (SWATA) from NATA District 6 to publish their annual conference free communication professional track abstracts. As a result of this partnership, we published 10 abstracts from the 2021 SWATA conference. We are excited for the future of these partnerships and continued development of sharing the work that athletic trainers are doing.

Lastly, we would like to thank the members of the editorial staff that have concluded their service to the journal. We want to thank Kim Barber Foss for her oversight as the section editor for the *Point-of-Care Research* section. Additionally, we want to recognize Ellie Rippy for her expertise and role as Copyeditor for the past two years. I want to personally thank them both for their time, dedication, and service to the journal. Without the contributions of the editorial staff, we would not be able to deliver the high-quality product that we do. We would like to also recognize our outstanding reviewers of the year for their dedication and quality of reviews provided in the last year: Dr. Kelly Brock, Dr. Kim Keely, Dr. Alicia Lacy, Dr. Nathan Newman, and Kacey Ohlemeyer.

Journal Advancements

Over the last year, the editorial staff has been working on advancements to elevate the process, timeliness, and quality of the journal. We have created a new section and manuscript style to the journal: *Translational Research*. With the advent of the COVID-19 pandemic and consequence of athletic training scholarship outlets closing, we want to offer authors an avenue to continue to share clinically relevant projects. Though this section is open to more traditional research designs, the focus should be clinically

applicable topics that are meaningful to clinicians and have impact for everyday clinical practice. You can find the full description of this section here. We want to emphasize our commitment to be a journal that focuses on practice-based research and clinician friendly resources to improve clinical practice.

Additionally, we have made major revisions to our *Preceptor Case Study* section to expand the opportunity for authors, clinicians, mentors and teachers to share the meaningful work they are doing. The newly minted *Clinical Mentorship Case Studies* section encompasses papers that span a variety of topics such as clinical immersion from the preceptor perspective, designing quality patient interactions, and assessment of student growth during the clinical experience. You can find the full description of this new section here.

Among our newest changes, we are working on changes to our submission process that are specifically targeted at improving the submission, review, and production procedures. As a journal that is sustained by only volunteers and do not charge article processing fees, these changes will help the editorial staff better serve the authors, reviewers, and readers. Starting Fall 2022, all authors who are submitting a new paper to the journal will be asked to use the corresponding template to the specific section. The template for each manuscript type can be located within the author guidelines for each of the different sections. Further, in an attempt to align with recommendations from the Strategic Alliance Research Agenda Task Force, authors will be asked to designate one of the five Research Agenda Priorities.[1] The research priorities are: Health Care Competency, Vitality of The Profession, Health Professions Education, Health Care Economics, and Health Information Technology.

We continue to evolve as a journal, and we are happy to introduce new editorial team members. We want to welcome Dr. Ashley Marshall (*Point-of-Care Research*), J'nai Pittman (*Clinical Mentorship Case Studies*), and Dr. Kelsey Picha (*Translational Research*) as section editors. Dr. Justin Young has also joined the Editorial team as a Staff Editor. We are honored that each of these individuals have accepted the invitation to join the editorial team and offer their time, expertise, and knowledge to the journal.

Finally, and most importantly we would like to recognize the reviewers and readers of *Clinical Practice in Athletic Training*. Without the invaluable contributions and service to the journal that our reviewers provide throughout the year, none of the other accomplishments would be possible. Particularly in a time where time seems to be scarce and athletic trainers are commonly asked to do more with less, we are immensely grateful. To our readers, we are thankful that you continue to turn to *Clinical Practice in Athletic Training* as one of the sources of information to advance and better the quality of care and education that you are providing to your patients, students, and stakeholders.

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Improving Ankle Range of Motion with the Use of Instrument Assisted Soft Tissue Mobilization: A Validation Case Study

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ABSTRACT

The purpose of this case validation study was to examine the effects of Instrument-Assisted Soft Tissue Mobilization (IASTM) on the ankle. The patient population consisted of nine participants (2 females, 7 males, age = 16± 2 years) from a suburban high school in Illinois. Each patient completed an IASTM treatment program, incorporating the Graston Technique® (GT). The program was completed over a three-week period with 2 sessions occurring each week, for a total of 6 sessions. Data collection of ankle dorsiflexion range of motion (DFROM) occurred after the completion of the GT. This was assessed by performing the weight-bearing lunge test at the start and end of each treatment day. Results demonstrated that ankle DFROM did improve by the last session. The findings from this case validation study suggest that the use of GT is an effective intervention for increasing joint DFROM.

Key Phrases
Manual techniques, clinician-rated outcomes, secondary schools patient population

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ARTICLE CITATION AND SUMMARY

Seffrin CB, Cattano NM, Reed MA, Gardiner-Shires AM. Instrument-assisted soft tissue mobilization: A systematic review and effect-size analysis. J. Athl. Train. 2019;54(7):808-821. Doi:10.4085/1062-6050-481-17

INTRODUCTION

We selected a systemic review[1] regarding the use of instrument-assisted soft tissue mobilization (IASTM). The authors completed a literature search from the years 2000 through 2016, using the following databases: Academic Search Premier, Alt Healthwatch, CINAHL, Cochrane Library, MEDLINE, NLM PubMed, Physical Education Index, PEDro, SPORTDiscus, and the Web of Science. The studies were evaluated and included if they met the following criteria: (1) the study was a randomized controlled trial, (2) range of motion (ROM), pain, strength, or patient-reported function was measured pre-intervention and post-intervention, (3) studies were written in English, (4) human patients were assessed, and (5) IASTM was compared with a control group (no IASTM). Thirteen of the initial 1,279 studies were included in the review and of these, 6 examined the upper extremities, 6 examined the lower extremities and 1 examined the thoracic spine. Six studies assessed outcomes in uninjured patients and the remaining studies assessed outcomes in injured patients. The review concluded that IASTM improves ROM in uninjured individuals as well as pain and patient-reported function for certain injuries.

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OBJECTIVE

The purpose of the validation case study was to examine whether the use of the Graston Technique® (GT) improves ankle dorsiflexion range of motion (DFROM) in secondary school (grades 9-12) participants from a variety of athletic programs.

PATIENT POPULATION

The setting was a secondary school in suburban Illinois. Female and male athletes from football, volleyball, and basketball programs were recruited to participate. Nine participants (2 females, 7 males, age = 16± 2 years) completed the GT treatment. Participants were included in the treatment program if they had 10 cm or less of ankle DFROM while performing the weight-bearing lunge test (WBLT) and were in a school sponsored athletic program. Less than 10 cm of DFROM while performing the WBLT has been cited as an indicator of ankle equinus.[2] Participants were excluded from the treatment program if their DFROM was greater than 10 cm.[2] Participants were also asked if they had any previous history of ankle injuries. If the ankle injury was on the right ankle they were excluded from the study (**Figure 1**). However, if the ankle injury was on the left ankle and their right ankle DFROM was less than 10 cm while performing the WBLT, they were included in the study.

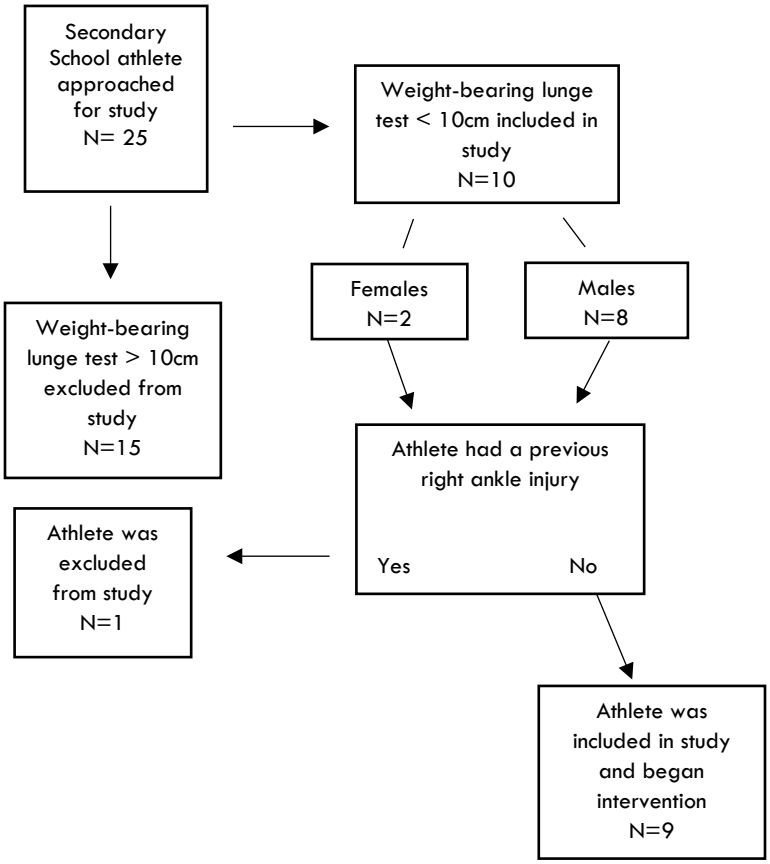

Figure 1. Participant Flow Chart

INTERVENTION

In this study, GT was performed by the primary investigator, who was certified in the technique, while being supervised by the head athletic trainer. The treatment protocol was based on previous work of GT on chronic ankle instability to increase ankle DFROM.[3] This program was initiated in the middle of the fall sports season and consisted of a 3-week phase for each participant. The 3-week phase required participants to complete 6 sessions, twice per week for approximately 10 minutes total per session. There was a minimum of 48 hours between each session of GT. Participants received treatment one hour before the start of their athletic practice time. This gave each participant enough time to receive treatment before heading to practice.

Before the start of each treatment session, each participant performed the WBLT[4] for ankle DFROM with all measurements taken on the right ankle. For this study, the right leg was chosen because all participants were right leg dominant and was used most often as their leading or kicking foot within the participants associated sports. Documentation of their dominant leg was asked before measurements. All measurement were taken using a tape measurer in centimeters. The tape measurer in this study acted as our measuring tool instead of a goniometer. Research shows that using either a goniometer or tape measure when measuring ankle DRFOM are both reliable tools.[4] The WBLT was performed in a kneeling position with the heel in contact with the ground, the knee in line with the second toe. The great toe was placed at 10 cm away from the wall (**Figure 2**). Participants were asked to lunge forward touching their knee to the wall, without removing their heel from the ground. If the participants were not able to touch, their knee to the wall or the heel was removed from the ground, their foot was moved forward 1 cm until the participant was able to touch the wall with their knee without lifting their heel from the ground. This measurement was then recorded. The participants then completed a warmup on a stationary bike for five minutes before the GT was applied. It is recommended that participants either use a modality or perform an active warm-up prior to GT administration.[5] The GT was then performed at four different locations, all on the right ankle, for a total of 8 minutes (2 minutes each site)[1] (**Table 1**). The four locations were the full length of the Achilles tendon, the gastrocnemius/soleus, the dorsum of the foot, the fibularis longus and the flexor digitorum longus. Three GT instruments were selected (GT2, GT3, GT4) to treat the restricted areas in the fascia, muscle, tendon, or ligaments both in a prone position (**Figures 3, 4**) and in a supine position (**Figures 5, 6**). Restrictions were acknowledged as soft tissue lesions and fascial restrictions.[14] Instruments GT2 and GT4 were used primarily to sweep and fan each specific location, whereas GT3 was used for performing fanning, brushing, and j-stroke when a restricted area was found.[3] The WBLT[4] was then re-assessed at the end of each treatment session.

Table 1. Graston Instrument Assisted Soft Tissue Mobilization

Graston Instruments	Patient Position	Strokes And Anatomical Area
GT 4, knob of GT 2 and GT 3 (Figure 3,4)	Prone, foot over end of table	Sweep plantar fascia and gastrocnemius/ soleus
GT 4, knob of GT 2 and GT 3 (Figure 5, 6)	Supine, foot over end of table	Sweep dorsum of foot and anterior tibialis Frame medial and lateral malleoli

STATISTICAL ANALYSIS

A two-way repeated measures analysis of variance (ANOVA) was used to examine differences in each ankle DFROM measure over time and weeks. Post hoc comparisons were completed using paired samples t-

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test to examine pairwise differences within each week and from baseline through week 3. Hedges' *g* effect size (ESs) with 95% confidence intervals (CIs) were calculated for our post-hoc comparisons. A positive ES indicated an increase in ankle DFROM after the application of GT while a negative ES indicated a decrease in ankle DFROM. A weak ES is considered < .40, while a moderate ES is .41 to .69.[8] A strong ES is considered > .59.[8] Significance level for all analyses was set at $p \leq .05$. Statistical analysis was completed using SPSS (version 27, SPSS Inc., Chicago, IL), and Excel 2016 (Microsoft Inc., Redmond, WA).

Figure 2. Weight-Bearing Lung Test Measurement

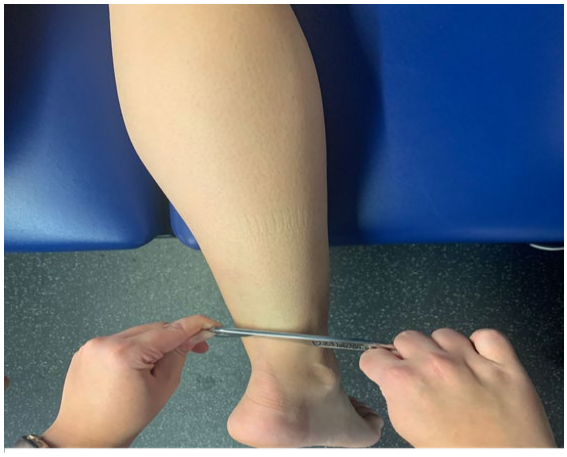

Figure 3. GT2 Achilles Tendon and Fibula

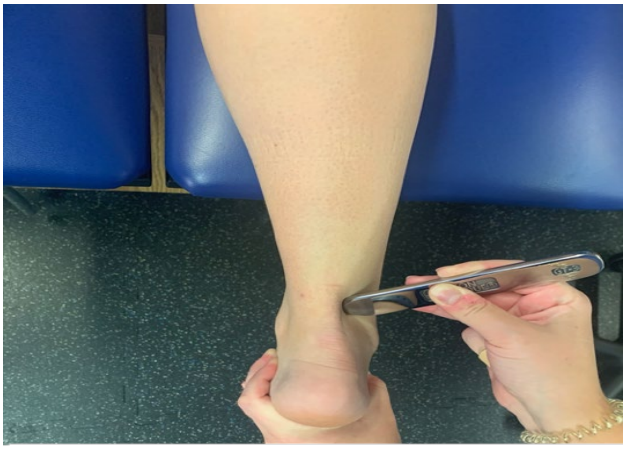

Figure 4. GT3 Gastrocnemius/Soleus and Achilles tendon

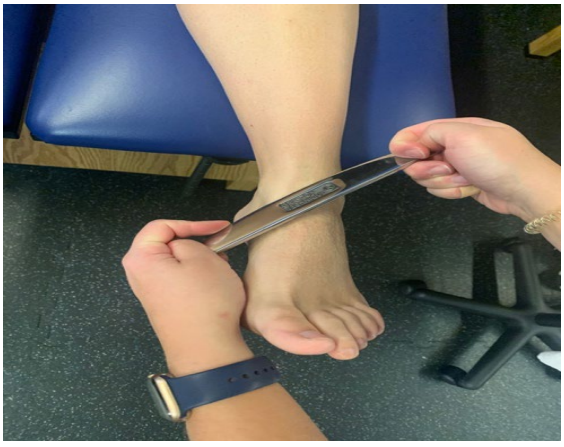

Figure 5. GT4 Anterior tibialis and dorsum of the foot

Figure 6. GT2 Medial and Lateral Malleoli-Knob of GT2

MAIN FINDINGS

During the three-week intervention, no injuries were sustained and there were no changes in the number of participants. A significant time main effect was found for right ankle DFROM ($p < 0.001$) with the WBLT. All participants except one improved in ankle DFROM from day-to-day and week-to-week (**Table 2**). Post hoc analysis identified a significant change in ankle DFROM from pre-to-post of week 1 ($p = .001$), pre-to-post of week 2 $p < .001$, to pre-to-post week 3 ($p = .001$). The results indicated that there was an improvement with right ankle DFROM within each week. The significant results were associated with medium to large effect sizes (0.58-4.12) (**Table 3**).

Table 2. Means (±Standard Deviations) for Ankle Dorsiflexion, Numbers Represent Degrees

	W 1/D 1	W 1/D 2	W 2/D 1	W 2/D 2	W 3/D 1	W 3/D 2
Right Ankle	4.74 ±5.42	7.10 ±4.80	10.91 ±5.33	15.60 ±4.32	21.2 ±5.53	24.4 ±5.63

Table 3. Effects Size with Associated Confidence Intervals

	P-Value	Effect Size	Lower Bound	Upper Bound
Pre-Post Wk1	0.001	0.55	-0.39	1.49
Pre-Post Wk2	<0.001	1.45	0.41	2.49
Pre-Post Wk3	0.001	1.02	0.03	2.01
PreWk1-Post Wk3	<0.001	3.91	2.28	5.54

DISCUSSION

The results from this study suggest that the application of GT alone may have an acute improvement on ankle DFROM. Similar improvements have been found in other studies which also evaluated the effects of GT on ankle DFROM.[8-10] Literature[11] has established normal range for ankle DFROM as 0-16.5 degrees for non-weight bearing measurement and 7.1-34.7 degrees during weight-bearing measurement. Traditionally, less than 10 degrees of ankle DFROM has been cited as a noticeable deficit.[2] Decreased DFROM can alter motor control and cause a lack of neuromuscular control. This deficit can also lead to a higher risk of injury of the lower limb in athletes, especially in the ankle, knee and hip region.[11] Therefore, improvement of ankle dorsiflexion may assist in lower extremity injury prevention.

One category of therapeutic interventions that can be used to increase DFROM is manual therapy, specifically GT.[15] There are many other reported benefits with GT, some of which have shown to increase the fibroblast response in healing to produce more collagen with the controlled movement of the instruments.[12] The theory behind the GT benefits is that the technique improves the extensibility of the tissues by treating the tissue restrictions, along with decreasing inflammation after an acute injury.[14] When heat is created from friction by the instrument, the viscosity of the tissue decreases, making it more pliable.[15] Physiologically, a decrease in the viscosity of tissue improves ROM.[16] Changes in ROM as a result of GT may also be explained with the hypothesis that the mechanical stress applied on the muscle fascia can cause the fascia to become stimulated.[14] This change in stimulation alters the proprioceptive input sent to the central nervous system, which in turn changes the tension in the tissue.[17]

In a cross comparison of studies, Palmer et al.[8] found improvements with ankle DFROM when GT was combined with stretching. In our study, the GT group received a total of ten minutes for the GT treatment from the proximal gastrocnemius to the metatarsal heads. Palmer et al.[8] completed a comprehensive treatment that focused on the anterior and posterior structures of the foot and the ankle, noting that these

locations of GT have a greater influence on ankle dorsiflexion. Similarly, Stanek et al.[9] through the use of the WBLT, identified DFROM improvements after the application of a single session of GT at two different locations, the Achilles tendon and the soleus/gastrocnemius region. Rowlett et al.[8] also identified significant improvements in DFROM with a single session of GT when ROM was measured using the WBLT. Rowlett et al.[10] also found that both GT and stretching appear to have a greater effect on the muscle flexibility than just GT alone. Overall, these studies found an acute increase in DFROM after completing one application of GT. [8-10]

Implementing a GT program in a secondary school setting may be challenging if the athletic trainer does not have GT instruments, as one must be certified[14] in the technique and have the financial means to attain the tools. However, implementing a general IASTM intervention, instead of specifically GT, may be more feasible as there is a wider variety of instruments and courses from which one can choose. Specifically, general IASTM tools may be more reasonable in terms of cost, access, and certification standards. In this current study, we focused on 10-minute treatment sessions which was time efficient. Similarly, other studies[8-10] attained acute results with DFROM when performing short treatment sessions that were done 1-2x/week with a minimum of 48 hours in between each session. It is recommended that GT treatment sessions have a minimum of 48 hours in between each session to allow the tissues to heal.[19] Following the use of GT, other treatments may be used in conjunction.[3,8,10] These treatments may include exercise such as stretching and strengthening, to aid in the tissue healing.[20] Rowlett et al.[10] also found that both GT and stretching appear to have a greater effect on the muscle flexibility than just GT alone. Nevertheless, including supplemental therapy or exercise can require more time commitment from the participant, coach, and the athletic trainer, and time itself is considered a limitation of prevention programs.[21] Since higher compliance rates can positively affect outcomes for the participants, it is important to create a supervised and efficient prevention program.[22,23] In this study, we chose to implement the program before the start of practice as pre-practice treatment sessions were already established throughout all sports. Furthermore, the participants gained the supplemental benefits of exercise as the participants could immediately begin warm-up drills and sport-specific activities post-GT treatment. However, each participant may have different degrees of DFROM along with various histories of previous ankle injuries that may bring additional symptoms that must be addressed. Therefore, athletic trainers should evaluate the needs of the patient when deciding complimentary treatments for GT.

Additionally, there are limitations within this study that needs to be addressed. First, having a small sample size may influence the results when examining the effects of GT on DFROM. Future studies will benefit from obtaining a larger sample size when completing a case validation study. The participants were recruited from a convenience sample within the traditional fall and winter athletics seasons. The athletic demands of the represented sports vary greatly, and therefore may have influenced inclusion and exclusion factors. Future case validation studies may benefit from investigating the effects of the intervention on individuals participating in other sports.

CLINICAL BOTTOM LINE

The findings from this case validation study concur with the guiding systematic review that the use of IASTM and GT is an effective intervention for increasing joint ROM at the ankle[1] when assessing ROM with the WBLT. Healthy ankle ROM is an important part of an injury prevention program, and GT may be an effective way of improving functional limitations. Athletic trainers should examine their patient population to determine the feasibility of using IASTM as a treatment.

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Safety of Blood Flow Restriction Training for Musculoskeletal Disorders: An Evidence-to-Practice Review

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ABSTRACT

Blood flow restriction training (BFRT) is low-level resistance training while partially occluding proximal blood flow. It is well documented that this style of training leads to increased muscle size as well as strength. It is theorized that these size and strength gains are due in part to the decreased oxygen environment. This results in increased muscular stress without the need for increased external load making this style of resistance training ideal for individuals who have restrictions due to musculoskeletal disorders. The guiding systematic review examined the safety of BFRT when used as a therapeutic intervention for patients with a variety of musculoskeletal disorders. Currently, there are no definitive set of parameters for clinicians to follow to ensure safe and effective use of BFRT. The purpose of the guiding review was to evaluate the safety and possible adverse events that may occur from different BFRT parameters in the rehabilitation or musculoskeletal disorders. There are many different types of devices used when implementing BFRT, but safety parameters suggest using a device that can measure the exact pressure so that occlusion can be personalized for each patient. Using a predetermined pressure for all patients could result in full occlusion, depriving the muscle of all oxygen and creating too much muscular stress. Conversely, not enough occlusion could result in a lack of muscular stress occurring to lead to muscular adaptations, ultimately rendering the treatment pointless. Additionally, timing of the exercises, which is work-to-rest ratios, as well as the frequency of training, is an important component for safe and effective use. Finally, the movement selection, load, and volume contribute to the parameters for safe and effective use of BFRT. Adverse reactions found in the guiding systematic review ranged from discomfort or dull pain to rhabdomyolysis. Following recommended safety guidelines decreased the risk of adverse reactions.

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ORIGINAL REFERENCE

Minniti MC, Statkevich AP, Kelly RL, et al. The safety of blood flow restriction training as a therapeutic intervention for patients with musculoskeletal disorders: A systematic review. Am J Sports Med. 2020;48(7):1773-1785. doi:10.1177/0363546519882652

SUMMARY

CLINICAL PROBLEM AND QUESTION

Blood flow restriction therapy (BFRT) is a relatively new therapeutic technique that can be utilized in a variety of musculoskeletal injuries. The guiding systematic review examined 19 studies with eight randomized control trials, seven case report studies, three case series, and one prospective longitudinal quasi-experimental study. Of the eight randomized control studies, four studies diagnosed participants with knee osteoarthritis, three studies of post-surgical anterior cruciate ligament (ACL) reconstruction and non-reconstructive arthroscopy, and a final study on anterior knee pain. This evidence to practice review will discuss the safety and adverse effects associated with all 19 articles, however there will be particular focus placed on the

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randomized control trials of patients with post-surgical ACL reconstruction and non-reconstructive arthroscopy. This is due not only to randomized control trials offering higher levels of evidence than the other study designs, but also due to ACL rupture being a common injury seen in athletic populations.

The ACL prevents the tibia from moving anteriorly in relation to the femur. When the ACL is torn, the patient can feel instability with certain motions.[1] Surgical repair or reconstruction is sometimes needed to correct the instability. In an 18-month period, 2793 ACL surgeries in Norway were performed at an incidence rate of 85 per 100,000 of those in the main at-risk age group.[2] Due to this relatively high incidence rate, ACL rehabilitation is a commonly researched subject with an emphasis being placed on finding increasingly effective therapeutic techniques.[1,3] Even with the high incident rate for ACL rupture and reconstruction, there is no gold standard for a specific rehabilitation plan following surgical intervention.

Commonly examined factors include time and ability to return to preinjury functional levels. For traditional athletes, ACL rehabilitation can cause them to miss 6-9 months or longer due to rehabilitation needs which can equate to their entire season.[4,5] While most patients want a quick return-to-activity, it is the athletic trainer's responsibility to ensure the knee is able to handle the stresses of returning to high level activity without the risk of performance deficits or reinjury.[4] A major consequence of ACL injury and subsequent surgery is thigh muscle atrophy and subsequent strength deficits in the first 12 weeks post-surgery and can remain for over 2 years post operation.[6,7] Traditional resistance training requires increasing external load on a muscle resulting in increased muscular stress allowing for hypertrophy and strength adaptations to occur. However, heavy external load is unsafe for an extended period following ACL reconstruction due to graft weakness and overall knee instability. The use of BFRT would allow the patient to provide adequate muscular stress for training adaptations to occur while bypassing the need for heavy external loads.

Blood flow restriction therapy is the partial occlusion of blood vessels using a tourniquet or, more commonly, an inflatable cuff around a limb to train a distal muscle using low-level resistance exercises.[8] The cuff decreases the amount of oxygen supplied to the muscle which could have detrimental effects if not applied correctly. These detrimental effects can range from mild pain and discomfort to more rare but serious conditions such as rhabdomyolysis (0.008%) and deep vein thrombosis (0.055%).[9] Due to the possibility of serious detrimental effects resulting from improper application of BFRT, it is vital to examine the necessary parameters for BFRT that result in the safest application of this therapeutic device. Although use of BFRT does not seem to have adverse side effects when used correctly on adults with musculoskeletal knee conditions, the benefits of the intervention have not been fully examined.[10] Therefore, the purpose of this evidence to practice review was to examine the safety and possible adverse events that can occur from different BFRT parameters in order to help guide clinicians in the rehabilitation of patients with musculoskeletal disorders with an emphasis on post-surgical ACL reconstruction.[3]

SUMMARY OF LITERATURE

The authors of the guiding systematic review, Minniti et al., conducted a literature search for articles related to BFRT using MEDLINE, CINAHL, and Embase with a comprehensive list of keywords. The studies had to satisfy the following inclusion criteria: (1) BFRT was the clinical intervention, (2) participants were patients with musculoskeletal system disorders, (3) adverse events are discussed by the authors, (4) studies were published in English, (5) all subjects were human. Exclusion criteria included systematic or narrative reviews.

The literature search yielded 5,692 studies plus an 8 additional from hand searching. Duplicates, articles that did not meet the search criteria, and studies that did not include a qualitative synthesis were excluded which yielded 19 studies. Three reviewers were utilized, with two reviewing the articles for quality and the third was utilized to settle disputes. Of the 19 studies, the study design of 8 articles were randomized controlled trials (RCT), 1 article was a prospective longitudinal quasi-experimental study, 3 articles were case series, and the final 7 articles were case reports. Two independent reviewers evaluated the RCT studies and the prospective longitudinal quasi-experimental study for bias. Of these 9 studies, two studies met the Downs and Black rating of "excellent," and the remaining 7 met the rating of "good".[10]

SUMMARY OF INTERVENTION

Parameters of BFRT used in each study varied slightly based on application and musculoskeletal system disorder. In the RCTs and case reports, the frequency of BFRT ranged from 1 to 6 sessions per week and 1 to 4 times per week, respectively. The intensity during the RCTs was 20-30% of the subjects calculated 1 repetition maximum (1RM). In the case-control designs, intensity was based on 15RM, 25RM, 20% 1RM, and 30% 1RM. For RCTs, the intervention lasted between 1 and 16 weeks while for case control studies it lasted between 1 and 12 weeks. For RCTs and case-control studies, intervention sessions varied from 1 to 5 sets of 15 to 30 repetitions or until failure. Rest intervals ranged from 30 seconds to 1 minute between sets. There was 1 case control study that reported no rest and 2 reported occlusion for 30 minutes to 1 hour. The BFRT devices included Sports Rehab Tourniquet®, Delphi PTS ii portable tourniquet system®, KAATSU master®, Hokanson AG101 cc17 thigh cuff™, 180 x 80 mm cuff size, 150 mm cuff size, 34-inch tourniquet, and knee wraps.[10] Parameters for the BFRT device for the RCTs ranged from 160-200 mmHG or 70% to 80% occlusion. However, the case series and case report designs varied between 100-110 mmHG or 50% to 80% occlusion.

Exercise selection in the RCTs included leg press, leg extensions, reverse press, or a combination of the exercises. In the case series and case reports, exercise selection included leg press, knee extensions, reverse leg press, squats, half squats, leg curls, resisted ankle eversion, seated, and standing calf raises, and Romanian deadlifts. However, exercise progression was not mentioned in all studies. In the RCTs, training load, final exercise occlusion pressure, and volume were altered. In the case series and case reports, load was altered so that the patient could not perform >15 repetitions, increased 10% if patient could perform 1 set in >2 minutes, and increased by 5 kg if the patient could perform >15 repetitions in the second set.

SUMMARY OF OUTCOMES

To examine the safety of BFRT, the authors for the guiding systematic review divided the results of the studies based on the reported events. Reported events were defined here as what adverse effects occurred during treatment if any. The data were categorized into one of 3 categories: no adverse events, common adverse events, and rare adverse events. No adverse events were defined as a study that reported no adverse effects from the intervention.[11] Common adverse events were defined as effects that were no more than moderate severity, short term, had no impact on the patient's function, all effects are transient or reversible, and there was no alteration to therapy needed due to the short term nature of the effects. Rare adverse events were defined as being severe, long term, distressing to the subject, and/or those that required further treatment to correct.[12] To separate the data, the authors used a modified scale that included qualitative descriptions as well as incidence rates for each event. The modified scale was based off previous literature that investigated adverse effects for other therapeutic interventions.[13] Specifically related to BFRT no adverse events were defined, as having had no harmful effects and the patient was able to complete the intervention as prescribed. Common adverse effects were defined as temporary muscle soreness, acute

muscle pain, acute fatigue, intolerance to intervention, slight discomfort, or dull pain. Rare adverse events were those that had an incidence rate between 1 and 10 in 10,000 cases as well as those where a serious medical condition occurred.[10]

FINDINGS AND CLINICAL IMPLICATIONS

The guiding systematic review identified that BFRT was a safe intervention for adult patients based on predetermined safety recommendations.[10,14] **Table 1** provides the recommended safety guidelines. These recommendations specified cuff application, cuff type, occlusion pressure, exercise stimulus, type, and load, training volume, rest time, and training frequency.[14,15]

A RCT performed by Tennent et al. on postoperative non-reconstructive knee arthroscopy patients utilized single and multi-joint leg exercises at 30% of the subjects one rep max (1RM) at 80% limb occlusion pressure.[16] These subjects completed 4 sets of 30, 15, 15, 15 reps separated by 1 minute of rest in between sets twice a week for six weeks.[16] This study followed all 9 safety guidelines outlined below and no adverse events were reported.[16] Similarly, a RCT performed by Ferraz et al. studied patients with knee osteoarthritis followed similar protocols to the previous RCT, followed all 9 of the safety guidelines, and also found no adverse effects.[17] Another RCT performed by Hughes et al. compared BFRT with light exercise to high intensity resisted exercise alone on participants following ACL reconstruction and a non-injured control.[8] They followed 8 of the 9 recommended guidelines for BFRT as described in this review and had no adverse reactions.[8,10] Six RCT and four case series found no adverse effects from BFRT.[10] Eight of these studies followed 7 or more of the 9 guidelines. The studies performed by Bryk et al. and Gaunder et al. following 6 and 5 respectively.[18,19]

Participants in a total of 6 studies, 3 RCTs and 3 case studies, had common adverse effects. The RCT conducted by Ohta et al. in 2003 compared the use of BFRT with exercise to the same exercises without BFRT for participants with ACL reconstruction but only followed 6 of the 9 recommendations.[20] Discomfort and dull pain in the limb after 12 minutes of occlusion caused two participants to withdraw from the study.

Table 1. BFRT Recommended Guidelines[a]

Type	Guidelines
Cuff application	Around the limb proximal to the muscle(s) being trained
Cuff type	Wider for the leg (6-13.5 cm) and narrower for the arm (3-6 cm)
Occlusion Pressure	Upper Extremity: 40% to 50% of limb occlusion pressure[b] Lower Extremity: 50% to 80% of limb occlusion pressure[a,b]
Exercise stimulus	Aerobic: minor increase or maintenance of muscle mass and strength Low-load resistance: substantial increase in muscle mass and strength
Type of exercise	Single- and multi-joint exercises are beneficial
Exercise loads	~20-40% 1 rep max
Training volume	50-80 repetitions/exercise
Rest time	30-45 seconds; maintain occlusion
Training frequency	2-4 sessions/week with the addition of high-load resistance without BFRT for more active patients

Abbreviation: BFRT = Blood flow restriction training
[a]Guidelines adapted from Scott, Loenneke, Slattery, and Dascombe (2015).[14]
[b]Guideline adapted from Patterson, Hughes, Warmington, et al. (2019).[15]

They used a single pressure of 180 mmHg for all patients.[20] Likewise two studies, one with male subjects and one with female subjects, performed by Segal et al. examined the use of BFRT in patients with knee osteoarthritis. These studies used the same parameters outlined above by Tennent et al., however these studies used a standard 160-200 mmHG for all participants instead of a percentage of the individuals total limb occlusion pressure.[21,22] Each study had a single participant drop out due to inability to tolerate BFRT, but no other participants exhibited any adverse effect.[21,22] Utilizing a single pressure does not fall within the recommended guidelines of 50%-80% occlusion pressure.[10] The pressure applied to the limb must be calculated for each patient. Five of these studies followed 7 or more of the 9 guidelines, with the final study following 6 guidelines.

The final three case reports experienced rare adverse events. In two of the three cases with adverse events, it was stated that the individual had a preexisting condition. A case report by Noto et al. saw a patient develop Paget-Schroetter Syndrome when only 1 out of the 9 guidelines was followed.[23] However, the authors noted that this patient had a history of localized edema in the left clavicle.[10] The lack of guidelines followed, including occlusion of the upper extremity for long durations of 30 minutes to 1 hour, and preexisting condition are both factors that lead to the patient's development of Paget-Schroetter Syndrome.[10,23] A case report by Iverson et al. of a patient knee articular cartilage resection and microfracture and a case report by Krieger et al. of a patient with an ankle sprain, reported that the patient developed rhabdomyolysis after just a singular treatment.[24,25] In both cases, the authors concluded that this was a freak occurrence and both subjects made a full recovery and were able to continue BFRT training.[24,25] Additionally, the subject of the case report by Iversen et al. had a history of deep vein thrombosis after knee surgery.[10,24] Once this subject had been treated and recovered from rhabdomyolysis, they were able to return to the study and complete BFRT without any further complications. In the case by Krieger et al., the subject did not have any known preexisting conditions, but it should be noted that the exercise load is not specified.[25] Preexisting conditions should not be seen as an absolute contraindication for BFRT use and individuals with preexisting conditions are still able to experience the benefits of BFRT. To limit adverse events, future research should explore in depth safety precautions and guidelines, specifically for at-risk populations with specific factors or indicators, while continuing to explore mechanisms to improve clinician and patient adherence to the guidelines already outlined.[10]

This available research indicates that there is no greater risk for patients who use properly implemented BFRT than those who only use traditional therapeutic techniques. It is suggested that if the 9 guidelines are followed, the worst adverse effect that a patient would experience is mild discomfort and transient muscle pain. However, the use of BFRT is not completely devoid of risk and therefore only healthcare practitioners who wish to implement BFRT into their rehabilitation should be properly trained on the parameters and safety guidelines.[10]

CLINICAL BOTTOM LINE

Blood flow restriction therapy has been found to have little to no adverse effects on patients with knee related musculoskeletal disorders.[10] The risk of adverse effects is minimal when the 9 safety guidelines are followed as well as ensuring that the patient does not have a history of vascular disorders such as deep vein thrombosis.[10] In particular, BFRT can be particularly useful in rehabilitation of post-operative ACL reconstruction. Hughes and colleagues found that although muscle pain was higher for both the ACL reconstruction BFRT and the non-injured BFRT groups, knee pain was less than that of the ACL reconstruction without BFRT.[8] As discussed, BFRT can be a useful therapeutic intervention; however, certain parameters

should be followed during use. Most importantly, the athletic trainer must be trained by the accredited medical device manufacturer before using the BFRT device. The athletic trainer should choose the appropriately sized cuff for the patient to ensure that the BFRT device can function as intended. It is critical that cuff pressure be individualized to each patient as well as using cuffs that disperse the occlusion pressure around the circumference of the given extremity for not only safe, but effective implementation of BFRT. In addition to cuff size and cuff type, the guidelines of cuff application, limb occlusion pressure, exercise stimulus, type of exercise, exercise loads, training volume, rest, and training frequency should be followed in order to ensure safe implementation of BFRT.[10] Further research is needed to make definitive conclusions about the absolute safety in all patient populations and for other injuries such as upper extremities and low back pain.

Based on the findings in the guiding systematic review, athletic trainers should use caution when considering the use of cuffs for postoperative patients. First, they should be required to take the recommended training offered by the manufacturing company in order to be trained in cuff selection and application for the BFRT device. Next, clinical guidelines should be created for BFRT cuff use for low-load use during rehabilitation so that the proper protocols are followed including but not limited to individualized cuff pressure. Finally, athletic trainers should record observations and results for patient outcome analysis related to the efficiency of BFRT on a case-to-case basis to inform future clinical decision making.

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Validity of Selective Tissue Tests for Knee Pathologies: An Evidence-to-Practice Review

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ABSTRACT

The knee is the most commonly injured joint in sport, inherently meaning the knee is also the joint most frequently evaluated by healthcare providers. Clinicians evaluate and treat the knee as efficiently as possible to prevent long-term disability of the patient. Clinicians rely on physical examination tests such as McMurray's Test, Apley's Test, Joint Line Tenderness, Lachman Test, Anterior Drawer, Pivot Shift Test, and the Ottawa Knee Rules for initial diagnosis and initiation of care. These physical examination tests have varying levels of diagnostic accuracy and validity. Clinicians should know how definite they can be about a diagnosis from physical examination alone based on the tests' validity and reliability. The purpose of this evidence to practice review was to evaluate the validity of the individual and combinations of two or more selective tissue tests for the knee. The authors included systematic reviews and meta-analyses that reported on the diagnostic properties of one or more physical tests for one or more knee disorders. The 17 articles used were screened independently by two reviewers. Each article was appraised using the Assessment of the Methodological Quality of Systematic Reviews (AMSTAR) ranking system. Articles with the highest AMSTAR ranking for each injury and evaluated the sensitivity, specificity, positive likelihood ratio, negative likelihood ratio, and diagnostic odds ratio were used to make recommendations for validity. Physical examination tests of the knee included in the review were found to be most accurate when performed in combination with each other, as they had only low to moderate diagnostic properties. Physical examination tests for the meniscus, ACL, PCL, patellofemoral pain, and knee osteoarthritis are not valid to be used as individual diagnostic tests. The only exemption to this finding is the Lachman test; with a sensitivity of 85%, the Lachman test is suitable to rule out an ACL tear as a stand-alone test.

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SUMMARY

CLINICAL PROBLEM AND QUESTION

The knee is the most commonly injured joint in sport, and thus the joint most typically evaluated by clinicians.[1] It is important to address and intervene with injuries to the knee as soon as possible to prevent secondary injury and chronic damage to the joint, as knee disorders often cause a decrease in quality of life from loss of optimal function and development of osteoarthritis.[2] Healthcare providers will intervene by performing a myriad of physical examination tests to rule in or out pathologies for the patient. The physical examination is relied upon in many instances due to the significant costs incurred from clinical imaging and the time delay patients may experience while waiting for results and subsequent diagnosis.[3,4] However, while physical

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examination tests are supposed to give patients and clinicians a firm diagnosis, most of these tests have both low sensitivity and low specificity.[4] The clinician should be familiar with the validity (degree to which a test measures what it is intended to measure) and shortcoming of each selective tissue test they perform, and the shortcomings of certain diagnostic tests.[5] Because of the inconsistent results with many diagnostic physical evaluation tests, the purpose of the guiding systematic review was to evaluate the validity of individual and combinations of selective tissue tests for the knee.[5]

SUMMARY OF LITERATURE

The guiding systematic review's authors conducted a literature search using five databases: PubMed, Medline, CINAHL, Embase, and the Cochrane Database of Systematic Reviews. The authors used relevant, and MESH based keywords for articles published any time before January 2016 on all five databases to determine which systematic reviews and meta-analyses to include. To determine whether a study would be included in the guiding systematic review, the article, title, and abstract were all screened independently by two reviewers. Systematic reviews and meta-analyses that were included in the guiding systematic review had to meet the following inclusion criteria: (1) be a systematic review or meta-analysis, (2) report on the diagnostic properties of one or more physical tests for one or more knee disorders, and (3) be written in English or French.

Following the search using the criteria listed above, 17 systematic reviews and meta-analyses of the original 6,750 systematic reviews and meta-analyses initially identified were included. Of these 17 studies, 11 were meta-analyses while the other 6 were systematic reviews that did not include a meta-analysis. Overall, the systematic reviews and meta-analyses explored selective tissue tests for meniscus injuries (n=8), anterior cruciate ligament (ACL) injury (n=6), the combination of tests from ACL/PCL/meniscus injuries and cartilage defects (n=2), while other systematic reviews and meta-analyses explored a clinical prediction rule for knee fractures (n=2) and knee osteoarthritis (n=2). Each systematic review and meta-analyses were appraised using Assessment of the Methodological Quality of Systematic Reviews (AMSTAR) ranking system. The AMSTAR is a reliable tool that is used to assess the overall quality of the systematic reviews and meta-analyses. Each systematic review and meta-analyses were given an AMSTAR score out of 11 to assess the strength of evidence. A score of an 8 or higher is considered a high-quality systematic review/meta-analysis. A score between 5 and 7 is a moderate quality and a score less than 5 was considered low quality. The AMSTAR ranking for each study was averaged out and inter-rater agreement on each term was accounted for. From the 17 systematic reviews and meta-analyses, seven of them reached an AMSTAR score of 7 or higher.

SUMMARY OF OUTCOMES

The authors of this guiding systematic review extracted sensitivity (ability of a test to rule a diagnosis out), specificity (ability of a test to rule a diagnosis in), positive likelihood ratio (the odds of detecting an injury in a patient who has that injury), negative likelihood ratio (the odds of detecting an injury in a patient who does not have that injury) and provided diagnostic odds ratio (the measure of effectiveness of a diagnostic test) in each of the 17 articles.[4-6] The authors then assessed the data for each of the following selective tissue tests from the studies: McMurray's, Apley's, Joint Line Tenderness, Lachman, Anterior Drawer, Pivot Shift, and the Ottawa Knee Rules. The authors of the guiding systematic review used the highest quality systematic reviews and meta-analyses for each selective tissue test of the knee, based on the respective AMSTAR scores, to assess the sensitivity, specificity, and diagnostic odds ratios of each diagnostic selective tissue test. The

authors also reviewed the likelihood ratios to make recommendations on the validity of the selective tissue test, with ratio of 5 or higher indicating a positive likelihood ratio and 0.2 or lower indicating a negative likelihood ratio. If an injury is present, the test would prove to be positive, and if the injury is not present, the test will prove to be negative.

FINDINGS AND CLINICAL IMPLICATIONS

The authors of the guiding systematic review grouped their findings into six different knee pathologies through nine physical tests and one clinical diagnostic rule with two scenarios that can be found in Table 1. The first pathology was meniscus injuries, with eight systematic reviews and meta-analyses providing data on the selective tissue tests for this pathology. The AMSTAR assessment of the systematic reviews for the clinical tests had ratings between a 2 to an 8. The tests with the highest validity were the McMurray's Test, which had a sensitivity of 70.5% (95% CI: 67.4-73.4) and Joint Line Tenderness test had a specificity of 77.4% (95% CI: 75.6-79.1%).7 When determining likelihood ratios, the Joint Line Tenderness test provided the highest positive likelihood ratio (4.0; 95% CI: 2.1-7.5) and the lowest negative likelihood ratio (0.23; 95% CI: 0.12-0.44). Tests for meniscal injuries of the knee should not be performed individually due to their low diagnostic validity.[7]

Six systematic reviews and meta-analyses provided data on the diagnosis of an ACL injury, with AMSTAR scores ranging from 2 to 8. The selective tissue test with the highest sensitivity was the Lachman test with a sensitivity of 85% (95% CI: 83.0-87.0%).[8] The Lachman test also provided the highest positive likelihood ratio (10.2; 95% CI: 4.6-22.7) and the lowest negative likelihood ratio (0.20; 95% CI: 0.10-0.30) out of all other selective tissue tests performed in the systematic reviews and meta-analyses. The pivot shift test had the highest specificity with a score of 98% (95% CI: 96.0-99.0%).[8] For ACL injuries, the Lachman test has a high diagnostic value to help rule in and rule out the pathology and the pivot shift test is best suited to complement the Lachman test when needing to rule in the condition.

Two systematic reviews, one that included a meta-analysis, were evaluated to look at patellofemoral pain with AMSTAR scores of 6 and 7, respectively.[9,10] The active instability test, pain using stairs, Clarke's Sign, pain during prolonged sitting, and the patella tilt test were all assessed. When looking at likelihood ratios, no test has a significant clinical value to help include or exclude patellofemoral pain. It can be concluded that there are no individual tests recommended to diagnose patellofemoral pain and performing a combination of tests did not improve the positive likelihood ratio.

Only one systematic review was used to look at posterior cruciate ligament (PCL) injuries. The systematic review was given an AMSTAR score of a 7.[11] In the systematic review, 11 studies determined the posterior drawer test to be the most frequent test used to determine a PCL pathology. Based on poor likelihood ratios for the posterior drawer test and despite a high specificity ranging from 96% to 100% for the quadriceps active test, there was no sufficient evidence to help include or exclude a PCL injury with any selective tissue test.[11]

For knee fractures, the Ottawa Knee Rules was examined in two systematic reviews. The Ottawa Knee Rules are used to rule in knee fractures and to avoid unnecessary radiographs.[12] The two systematic reviews received AMSTAR scores of 2 and 7. For the higher scoring systematic review, the sensitivity for the Ottawa Knee Rules was 98.5% (95% CI: 93.2-100%), with a specificity of 48.6% (95% CI: 43.6-51.0%), and a negative likelihood ratio of 0.5 (95% CI: 0.02-0.23).12 The overall findings provide that the Ottawa Knee Rule can be used to help understand if a referral for radiographic imaging should be ordered or not. If one

Table 1. Summary of Diagnostic Validity of Selective Tissue Tests for the Knee

Pathology	Selective Tissue Test	Number of Studies	Sensitivity	Specificity	Diagnostic Odds Ratio
Meniscus	McMurray's	14	71%	71%	4.5
	Apley's	7	61%	70%	3.4
	Joint Line Tenderness	14	63%	77%	4.5
ACL	Lachman's	21	85%	**94%**	70
	Anterior Drawer	20	55%	**92%**	21
	Pivot Shift	15	24%	**98%**	12
Knee Fracture	Ottawa Knee Rules	6	**99%**	49%	.05 (-LR)
Patellofemoral Pain Syndrome	Clarke's Sign	4	39%	76%	N/A
PCL	Posterior Drawer	8	69%	N/A	N/A
Knee Osteoarthritis	American College of Rheumatology Criteria (3 criteria points)	2	**95%**	69%	N/A
	American College of Rheumatology Criteria (4 criteria points)	2	84%	89%	N/A

Items in bold are considered to have good diagnostic perform with a sensitivity or specificity above 90%.

criterion from the Ottawa Knee Rules is deemed positive, then the clinician should not rule out a fracture and referral for radiographic imaging is warranted.

Finally, knee osteoarthritis was examined in two systematic reviews. Each systematic review received a 1 and a 2 for an AMSTAR score.[4,13] The criteria of the American College of Rheumatology to diagnose knee osteoarthritis was examined in the systematic reviews. The criteria included age above 50 years, stiffness for more than 30 minutes, crepitus, bony tenderness, bony enlargement, and no palpable warmth. During an examination, if at least three criteria points are met, the sensitivity and specificity are 95.0% and 69.0%, respectively. When the fourth criteria point is found, the sensitivity and specificity are 84.0% and 89.0%, respectively.[13] Based on the results, it was concluded that the American College of Rheumatology criteria can be used to determine knee osteoarthritis, but magnetic resonance imaging is also necessary to confirm the diagnosis as the AMSTAR scores for the systematic reviews included were low.

CLINICAL BOTTOM LINE

Athletic trainers learn about and implement numerous selective tissue tests of the knee during their evaluation and assessment of patients experiencing orthopedic pain or limitations. The purpose of the selective tissue tests is to provide criteria to the athletic trainer to diagnose the patient. Unfortunately, the guiding systematic review sheds light on the fact that some of the common selective tissue tests used and deployed in patient care do not yield the information we believe they do. It is becoming clearer that the physical aspect of the evaluation process is not as valid when used as a singular test. The findings support the use of Lachman test as a valid selective tissue test for diagnosing or excluding an ACL tear, whether used individually or in conjunction with other tests. In addition, the findings support the use of some clinical prediction rules[14] such as the Ottawa Knee Rules to rule out a knee fracture and the American College of Rheumatology and European League Against Rheumatism (EULAR) Rules to diagnose knee osteoarthritis. However, there are no valid selective tissue tests to diagnose a meniscal injury.

The guiding systematic review suggests that clinicians are often using a combination of many physical tests, as well as a thorough history, to complete a full evaluation of the patient. While not specifically mentioned in the guiding systematic review, there is a clinical prediction rule for meniscal pathology which includes: 1) history of "locking" or "catching", 2) pain with forced hyperextension, 3) pain with maximum flexion, 4) positive result from McMurray's, and 5) joint line tenderness to palpation.15 We suggest that athletic trainers utilize this clinical prediction rule which has between a 90-99% specificity when 3 or more of the 5 criteria are present in the patient.[15] The high specificity takes the findings of the poor diagnostic validity for meniscal injuries and combines it with actionable items to implement when a one selective tissue test alone cannot diagnose the pathology.

The guiding systematic review states that aside from the Lachman test, Ottawa Knee Rules, and EULAR Rules, clinicians should not base their clinical diagnosis from a singular selective tissue test. In terms of ACL injuries, while the pivot shift test and the anterior drawer test had good diagnostic performance, the tests were still not as accurate as the Lachman test (see Table 1). This guiding systematic review assessed many recent systematic reviews and meta-analyses about the validity of physical examination tests for the knee and found that the AMSTAR rating for these was typically moderate. Due to the limited and low-quality research on the validity of knee physical tests on their own, it is best to combine a physical exam with a thorough history or use a combination of data known as clinical prediction rules. For example, a clinician should consider the subjective history such as asking if the patient felt a pop or if their knee feels unstable or like it is going to give way. It is also important to determine what type of pain the patient is feeling; sharp pain refers to skeletal injury, aching pain can indicate muscular trauma or tendinopathy, and throbbing pain can mean a ligamentous injury or inflammation in the joint. Overall, the clinical bottom line from the guiding systematic review is to consider using clinical decision-making tools, such as a clinical prediction rule, to diagnose musculoskeletal pathologies. These clinical prediction rules incorporate history, physical examination, and selective tissue tests to improve the diagnostic accuracy rather than a singular diagnostic test.

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Recommendation for Best Practices in the Management of Musculoskeletal Pain: An Evidence-To-Practice Review

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ABSTRACT

While musculoskeletal (MSK) pain conditions are some of the most common health issues faced internationally, the quality of patient care with MSK pain is lacking. Problems with MSK care include the overuse of imaging, surgery, opioids, and failure to educate patients. Improving the quality of care for MSK conditions is considered a priority for all involved healthcare clinicians. The 2019 guiding systematic review addressed the concerns of MSK management by identifying common recommendations for high-quality care through appraisals of clinical practice guidelines (CPGs). Data was extracted from four databases and included articles examining the most common sites of MSK pain in adults. Selected articles were appraised using the AGREE II instrument that provided scores to indicate the level of quality. Researchers in the guiding systematic review then classified the CPGs to determine consistent recommendations. The results from the guiding manuscript identified eleven common and consistent recommendations for MSK pain management that focused on a comprehensive approach to address the overall well-being of the individual to ensure patient-centered care. The recommendations should be incorporated into healthcare and clinical practices to give healthcare professionals patient-centered outcomes for MSK pain management and improve the quality of care.

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SUMMARY

CLINICAL PROBLEM AND QUESTION

Some of the leading causes of disability worldwide are musculoskeletal pain (MSK) conditions.[1] A lack of quality healthcare and a lack of universally agreed-upon treatment plans for these MSK conditions, are two primary reasons for the MSK related disability. A lack of quality healthcare results in the overuse of imaging,[2,3] unnecessary surgeries,[4,5] use of opioids.[6,7] and a failure to properly educate and advise patients about their conditions.[8] In order to combat quality of care issues and improve healthcare, clinicians can utilize clinical practice guidelines (CPGs), which are 'statements that include recommendations intended to optimize patient care that are informed by a systematic review of evidence and an assessment of the benefits and harms of alternative care options'.[9] Patient care that follows CPG recommendations typically results in improved patient outcomes and lower costs to the consumer, especially with the management of low back pain (LBP).[10,11] These CPGs can also help ease transitions between different healthcare in terms of treatment options and care plans. Unfortunately, there are also many shortcomings with CPGs, creating discourse and criticism in the literature. Criticisms include the use of various guidelines for the same conditions having

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inconsistent terminology, having too much or too little representation of certain conditions, and a lack of instruction for implementation into practice.[12] Despite criticisms, high quality CPGs may be effective methods for shaping how MSK conditions are treated in the healthcare system. MSK pain conditions in different body areas may share similarities in regard to mechanisms and clinical courses.[13,14] However, there is inconsistent evidence that CPGs share similarities for how best to treat MSK pain or that the recommendations can be applied across levels of healthcare. Therefore, the purpose of the reviewed study was to establish recommendations to better assess and manage MSK pain conditions based on available CPGs.

SUMMARY OF LITERATURE

The authors of the guiding systematic review conducted a literature search of four databases that included MEDLINE, CINAHL, Embase, Physiotherapy Evidence Database, and four unnamed guideline repositories to evaluate MSK pain CPGs. The search terms and methods used in this study are the same as a previously published study.[12] For a CPG to be included in the systematic review, it had to meet certain criteria including: 1) published no earlier than 2011, 2) focused on adults, 3) described pain development processes, and 4) had to be written in English. The guidelines that only focused on traumatic MSK pain, single modalities, specific disease processes, and those that required payment were excluded from the systematic review.

The authors' initial search resulted in 6,232 CPGs, and after screening those results using their inclusion criteria, 44 guidelines were remaining for further appraisal. Appraisal was completed by three independent investigators using the Appraisal of Guidelines for Research and Evaluation II (AGREE-II) instrument, which resulted in eleven CPGs that were considered high quality. The AGREE-II instrument was utilized as it is the most widely used tool to obtain overall rating scores and identify high-quality CPGs.[15,16] Of the eleven CPGs that were high-quality and used in the systematic review, four of them evaluated low back pain, four investigated osteoarthritis pain, two evaluated neck pain, and one evaluated shoulder pain. After the appraisal, the CPGs were synthesized in four steps: extracting the CPG recommendations, classifying these recommendations, creating a narrative summary, and identifying common recommendations among MSK conditions when possible. The authors were able to use the information from their extensive search and evaluation to produce the following outcomes and results.

SUMMARY OF OUTCOMES

The CPGs were classified according to "should do," "could do," "do not do," and "uncertain" guidelines to help identify consistent recommendations which are defined in **Table 1**. The guidelines that were assigned either "should do" or "do not do" classifications and did not have conflicting evidence were considered consistent recommendations. Following the appraisal and classification process, only 44 CPGs of the 6232 identified records met the inclusion criteria. The 44 included CPGs applied to various MSK conditions which are specified in **Figure 1**. From the 44 CPGs, 11 common and consistent recommendations were chosen to be applied across MSK pain conditions. The guiding systematic review suggested that these recommendations could guide healthcare providers with a clear and simple consensus of current MSK pain priorities and, as a result, may help address the variations in the quality-of-care patients receive.[2,17,8] One intervention not listed in the systematic review was a consensus for CPGs related to opioid prescription. This is due to conflicting recommendations and the potential for harm; however, the only consistent view was to urge caution and discouraged the use of opioids.

Figure 1. Number of appraised CPGs and their specific musculoskeletal conditions.

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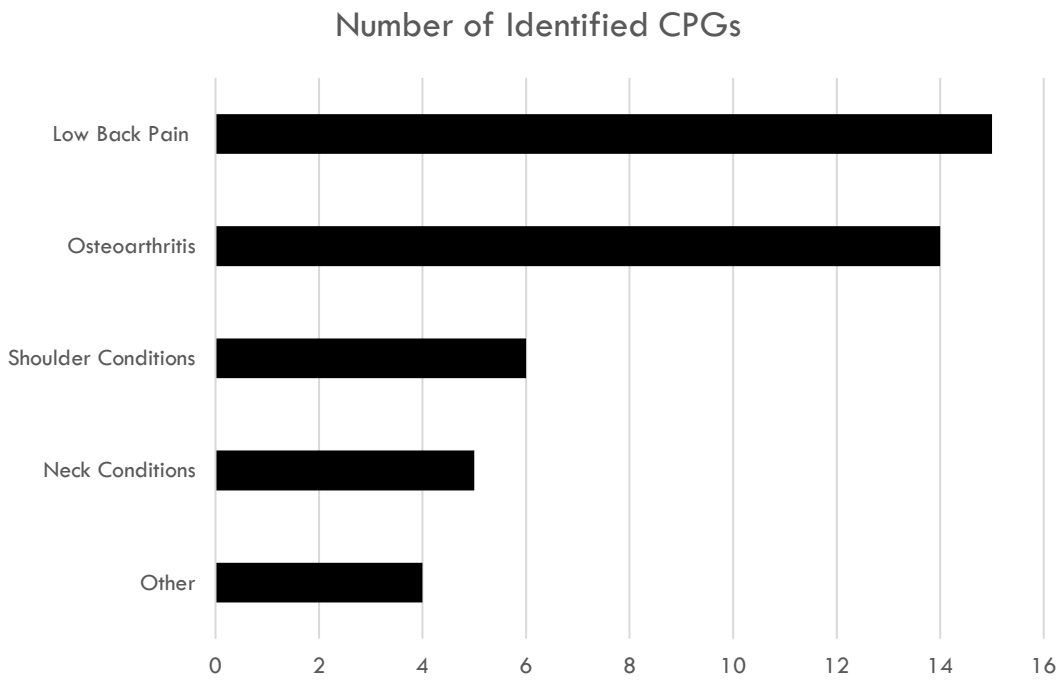

Table 1. Classification system the guiding systematic review used to determine consistent recommendations from relevant CPGs.

Classification	Definition
Should Do	Recommendations that could be applied in all circumstances of musculoskeletal pain unless contraindications are present. These 'should do' recommendations are based on strong evidence such as having high-quality evidence of positive clinical effects or that the benefits of following the recommendations outweigh the risks.
Could Do	Recommendations that could be applied in individual circumstances depending on the patient. These 'could do' recommendations are based on lesser quality studies with consistent evidence and where the benefits outweigh the harms.
Do Not Do	Recommendations with strong evidence of no benefits and/or the harms outweigh the benefits.
Uncertain	'Uncertain' classification was applied because of incomplete or inconsistent findings and could not give a recommendation for or against a clinical practice.

FINDINGS AND CLINICAL IMPLICATIONS

The appraisal and classification process in the guiding systematic review revealed 11 consistent recommendations for health care providers to incorporate into their practice. Recommendations are summarized in **Table 2**. The 11 recommendations may be used in a variety of ways to improve patient care. The reviewed article provided three examples of improvement. First, the recommendations may assist patients in making more informed decisions about their healthcare and help them recognize that some care they are receiving may be suboptimal. Second, the recommendations can guide clinicians in their decision making for the best course of action for their patients. Clinicians may also use them to identify areas where continued professional development is needed to improve their patient care. Third, with continued development of the recommendations, a set of indicators could be used as a benchmark of quality care or as minimum standards.

Limitations of the article were also addressed. The AGREE II instrument that scored the CPGs reflects processes and reporting of guidelines, not necessarily the quality of that content; therefore, high quality trials could have been excluded. Also, the investigators created their own criteria for appraising CPGs based on the AGREE II instrument which has the potential for bias. The study only reviewed CPGs in English, leaving out other relevant guidelines; however, the article is confident that, through their appraisal process, all relevant CPGs were included.

CLINICAL BOTTOM LINE

MSK pain can greatly impact the quality of life for affected individuals. Furthermore, variation in healthcare makes receiving care difficult for patients, as there are no common recommendations for the treatment of MSK conditions. The assessment and management of MSK conditions is the most effective way to improve the overall well-being of patients, and the lack in quality of care from the healthcare system is the largest problem faced by patients. The CPG recommendations were developed to address the shortcomings of the assessment and management of MSK pain conditions, and implementation of the recommendations may begin to fix this problem. After reviewing this article, all members of the healthcare team should utilize the recommendations put forth by the guiding systematic review to provide measurable, impactful care.

Athletic trainers are included in the healthcare team and are no exception when it comes to following the guidelines presented by the reviewed article. Athletic trainers have primary roles involving prevention, emergency care, assessment, and therapeutic interventions for illnesses and injuries, specifically with orthopedic and musculoskeletal care.[18] Athletic trainers also work with a variety of patients in various settings that can affect MSK health. One of the eleven recommendations suggests completing an inclusive exam which may include neurological screenings and mobility and strength testing, which all athletic trainers are already trained to do during patient evaluations. Athletic trainers already incorporate some of the CPG recommendations into practice by providing mobility, strength, and flexibility exercises and conservative management into rehabilitation therapy for their patients. However, even though this approach is already practiced, athletic trainers are still not perfect in their care. A study from 2016 indicated athletic trainers have knowledge about using evidence-based care, such as the CPG recommendations, in clinical settings, but less than 30% actually implemented evidence-based healthcare into practice.[19] Constant awareness, intentional implementation, and daily practice of the 11 recommendations is necessary to improve patient care in patients with MSK pain conditions.

Table 2. Recommendations and examples to improve patient care

Recommendation	Examples	Classification of Recommendations
Care should be patient centered	• Viewing the patient holistically • Viewing each patient as an individual • Allowing the patient to be involved with the decision-making process • Using effective communication • Base context on patient's preferences	Categorized as "should do" for osteoarthritis (4/4), low back pain (4/4), neck pain (2/2), and shoulder pain (1/1)
Practitioners should screen patients for serious pathological conditions	• Suspected infections, malignancy, fracture, inflammatory causes of pain, or neurological deficits • Serious conditions that present as MSK pain but are not (aortic aneurysm) • Gout • Other arthritis or malignancy (bone pain)	Categorized as "should do" for osteoarthritis (1/1), low back pain (3/3), neck pain (2/2), and shoulder pain (1/1)
Assess psychosocial factors which can be affected by their injuries/illnesses	• Emotions/moods such as depression and anxiety • Fear/kinesiophobia (irrational fear of physical movement due to injury or reinjury)	Categorized as "should do" for osteoarthritis (2/2), low back pain (4/4), neck pain (2/2), and shoulder pain (1/1)
Only use radiological imaging in specific situations	• Suspecting serious pathology • Conservative care is not working • Unexplained progression of signs and symptoms occurs • Imaging is likely to change management	Categorized as "do not do" routine use of radiological imaging for osteoarthritis (1/1), low back pain (4/4), and shoulder pain (1/1)
Assessments should be complete and all inclusive	• Physical exams • Neurological screening • Mobility • Muscle strength testing	Categorized as "should do" for osteoarthritis (2/2), low back pain (3/3), neck pain (1/1), and shoulder pain (1/1)
Use validated patient-oriented outcome measures to evaluate patient progress	• Patient self-rated recovery questions • Pain intensity measures • Functional capacity or activities of daily living • Quality of life questionnaires	Categorized as "should do" for osteoarthritis (2/2), low back pain (1/1), neck pain (1/1), and shoulder pain (1/1)
Educate patients about their conditions and the management options	• To encourage self-management of their conditions • Inform and reassure patients	Categorized as "should do" for osteoarthritis (3/3), low back pain (4/4), neck pain (2/2), and shoulder pain (1/1)

Management options should address physical activity and exercise	• Strengthening • Flexibility • Mobility exercises (range of motion and stretching) • Water-based exercises • Neuromuscular education	Categorized as "should do" for osteoarthritis (4/4), low back pain (2/4), neck pain (2/2), and shoulder pain (1/1) Categorized as "could do" for low back pain (2/4)

Use manual therapy only in combination with other evidence-based treatments	• Used with other management strategies like:
	  ○ Exercise
	  ○ Psychological therapy
	  ○ Information/education
	  ○ Activity advice
		Categorized as "should do" with other modalities for osteoarthritis (1/1), low back pain (4/4), and shoulder pain (1/1)

Offer non-surgical treatments before considering surgery unless "red flag" conditions are present	• Conservative treatment yields no progress or makes the conditions worse	Categorized as "should do" for osteoarthritis (1/1), low back pain (2/2), and shoulder pain (1/1)
Facilitate continuation or resumption of work after MSK injury	• Avoid inactivity • Gradually increase normal daily activity levels • Return to work and while continuing rehabilitation services • Communication between workers, employers, and health providers	Categorized as "should do" for osteoarthritis (1/1), low back pain (2/3), neck pain (1/1), and shoulder pain (1/1) Categorized as "could do" for low back pain (1/3)

Numbers provided in the classification of recommendation column refer back to the 11 CPGs (osteoarthritis=4, low back pain=4, neck pain=2, shoulder pain=1)

Athletic trainers also have a unique role in the healthcare team, as they practice in collaboration with other healthcare professionals, such as physicians, physical therapists, nurses, dietitians and pharmacists.[18] If all of the healthcare professionals follow the recommendations of the guiding systematic review, the transfer of patient care will be seamless, the overall quality of care will increase, and better outcomes can occur for the patient in the event of a patient transfer between collaborating healthcare professionals. This holds true for athletic trainers when they perform an initial evaluation but must refer the patient to a physician for further testing or a physical therapist for a more focused rehabilitation plan. Following the guidelines will allow for referrals to be smooth and will benefit the patient in the end. Healthcare services can also use the CPG recommendations as benchmarks or minimum standards for documentation, reporting, or clinical audit purposes. For example, athletic trainers may base performance evaluation criteria on the CPG recommendations to evaluate the staff's clinical performances and ensure patient-centered care is being practiced.

In conclusion, MSK pain conditions are common issues in various populations. Unfortunately, the treatment and management of MSK conditions can be inconsistent and suboptimal. Treatment options and plan of care for patients can be lost during the transition between different healthcare providers and professions. Improving

patient-oriented quality of care for MSK conditions also poses a challenge in healthcare; fortunately, the CPG recommendations provide simple and direct guidelines to implement into practice. The eleven recommendations can serve as an educational tool and reference for all healthcare professionals who provide care for MSK pain conditions, as well as a benchmark for comparing the quality of care between health services and minimum standards during reporting or clinical audits. The healthcare team, including athletic trainers, should be able to implement the eleven recommendations with ease which would in turn improve care for MSK patients. The recommendations can be applied with minimal or no resources as several of the recommendations require the clinician to be patient-centered in their exam and delivery of information. Examples of implementation without resources including assessing psychosocial factors, using validated outcome measures, and providing clear patient education.

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Creating and Implementing a COVID-19 Prevention and Response Program in the Performing Arts: A Clinician Expertise Commentary

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COMMENTARY

The novel coronavirus disease of 2019 (COVID-19) resulted in a worldwide pandemic that shut down various aspects of business, education, sport, recreation, and entertainment venues worldwide.[1,2] These public health measures particularly disrupted the performing arts sector, resulting in hardships such as performance hall closures, decreased revenue, limited opportunities to transition to online work, and unemployment.[3-5] Additionally, colleges and universities implemented protective protocols to promote student, faculty, and staff safety. Throughout the summer and fall of 2020 and into the spring of 2021, professional, collegiate, high school, recreational, and amateur sports leagues across the globe commenced operations and competitions after developing and implementing COVID-19 safety protocols.[2,6] This clinician expertise commentary presents how athletic trainers at one United States public university developed and implemented a COVID-19 safety protocol for its integrated performing arts academic campus during the 2020 – 2021 academic year.

FACILITY DESCRIPTION

The Southeast Missouri State University performing arts campus is separated geographically from the main university campus by approximately 3 miles and built to promote the constant interaction and creativity of the performing arts majors and faculty. The performing arts campus encompasses several interconnected buildings and complexes, including campus residential housing and living spaces for approximately 180 performing arts students, offices and studios for 30 faculty and staff, a dining hall, areas designed for classroom instruction and rehearsals, and public performance spaces for large and small-scale productions (190 to 950 audience members). The layout and daily operations of the performing arts campus contrasts with the design of the main University campus, where residence halls and living spaces, dining areas, classrooms, and faculty offices are separated across multiple buildings, and individuals rarely spend more than 2 hours in any one location. Compared to the main University campus, these differences present unique COVID-19 challenges. Most of the daily personnel traffic in the performing arts campus results from individuals who live in the buildings or spend 40+ hours of work functions inside a confined collaborative space. Additionally, the performing arts campus contains the Clinic for Health in the Arts (CHART Clinic), a joint venture between the university and a regional hospital system that provides two on-site athletic trainers throughout the day and during university-sponsored performances and shows. These athletic trainers work

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cooperatively with physicians and the performing arts faculty to provide health care that focuses on the prevention, evaluation, treatment, and rehabilitation of musculoskeletal and general medical conditions specific for undergraduate performing arts majors across various dance disciplines, theater, musical theater, and the university marching band.

LIVED EXPERIENCES AND SKILL DEVELOPMENT

During the summer of 2020, the CHART athletic trainers, collaborating physicians and hospital, and the performing arts faculty met to review University and county public health COVID-19 safety protocols to determine how best to implement these guidelines, specifically the performing arts campus. These meetings resulted in a multi-pronged approach based on county and Universityprotocols to mitigate the transmission of COVID-19 among the students, faculty, staff, and visitors while allowing the performing arts campus to operate and promote on-campus learning, social interactions, and inclusive creative thought. Additionally, these stakeholders agreed that the CHART athletic trainers would be the COVID-19 experts of the performing arts campus by implementing, creating, and adjusting policies and procedures as appropriate.

Before COVID-19, athletic trainers could not foresee that their job descriptions would include group and facility-level infection prevention protocols of a novel airborne virus. The CHART athletic trainers were previously trained and understood how to prevent the spread of skin infections,[7] influenza, and other communicable diseases. However, these policies and protocols were insufficient for managing COVID-19. Like all healthcare providers, the CHART athletic trainers rapidly adapted to develop COVID-19 specific prevention and mitigation protocols and implementation measures on a unique university academic campus and patient population that required guest access. This clinician expertise commentary describes the framework of creating, adjusting, and implementing a COVID-19 mitigation protocol for a university performing arts campus, the unique challenges that arose, and their solutions.

EDUCATION, PREVENTATIVE SANITATION, AND MINIMIZED GROUP GATHERINGS

The CHART athletic trainers instituted COVID-19 transmission prevention protocols recommended by the county health department and the University by mandating the wearing of face coverings, social distancing, and placing capacity limits on classrooms and facilities.[8] Wall signage, floor stickers, modeling, and electronic communication educated and promoted COVID-19 personal responsibility prevention methods. The only daily situations where removing a face-covering was allowed were when students were physically inside their primary residence and when faculty and staff were alone inside their offices. The University employed part-time workers to stock hand sanitizer, surface disinfectants, and facemasks throughout the rooms and traverse the public areas throughout the day to disinfect high-touch areas such as doorknobs, elevator buttons, and communal furniture. During weekly campus meetings and gatherings, the CHART athletic trainers educated the faculty, staff, and students about the importance of mask-wearing and disinfecting chairs, tables, desks, and shared equipment after classroom and academic sessions.

Faculty and staff meetings, media events, and community gatherings transitioned to online video platforms (e.g., Zoom) or otherwise restricted to prevent unnecessary congregation inside the performing arts campus. To promote safety within the 300 square foot CHART Clinic, all patients and providers minimally wore double-layer cloth facemask over their mouth and nose, enforced handwashing and hand sanitizer usage, and disinfected touched surfaces and equipment after each patient encounter. Only two patients were allowed physical entry into the CHART Clinic simultaneously, and the CHART athletic trainers screened each

patient for COVID-19 symptoms before allowing access (**Table 1**). These same screening and entry protocols occurred for all rehearsal and production situations where physical distancing could not be ensured. The CHART athletic trainers implemented an electronic appointment system for all non-emergency injury evaluations and treatment sessions to facilitate clinic safety and maximize capacity. Additionally, the CHART athletic trainers created a telehealth process to check in with patients and perform virtual COVID-19 symptom screening without requiring physical attendance in the CHART Clinic.

Table 1. Pre-Screen (before entering CHART Clinic)*

Current Symptoms	• Fever/Chills • Cough • Shortness of Breath/Difficulty Breathing • Fatigue • Muscle/Body Aches • Headache • Loss of Taste/Smell • Sore Throat • Congestion/Runny Nose • Nausea/Vomiting • Diarrhea
Exposures/Diagnosis in past 14 Days	• Been in contact with a confirmed COVID-19 patient • Visited an area with a high COVID-19 community transmission rate • Received a positive COVID-19 test/diagnosis
Body Core Temperature	• Obtained each patients' body core temperature. Any reading above 100.4°F (38°C) was considered a "yes."

*All patients were required to answer these questions utilizing the EMR system before entering the CHART Clinic for athletic training services. All questions required the patient to designate a yes/no response. Any "yes" response prompted further investigation and/or contact tracing by the CHART athletic trainers.

SYMPTOM MONITORING, REPORTING, AND CONTACT TRACING

Under the supervision of the CHART athletic trainers, the performing arts campus implemented the University's general COVID-19 symptom monitoring and reporting guidelines, which mandated that faculty, staff, and students self-report any symptoms of illness (e.g., fever, sore throat, or excessive tiredness) and interactions with a known or potential COVID-19 positive individual. All potential exposures and COVID-19 symptoms were reported to a centralized system and were investigated by the University's designed contract tracing personnel. Because of the performing arts campus's unique nature and off-campus location, the CHART athletic trainers advocated for and received approval from university administrators to become the lead individuals to identify and perform contact tracing activities for the performing arts students and report those findings to University personnel. The CHART athletic trainers sought this capability at the beginning of the fall 2020 semester because the university contact tracers were overwhelmed, requiring up to a week for some investigations. This extended timeline potentially jeopardized required student productions by enabling potential positive patients to spread COVID-19 or delayed the decision to adjust casting. With the CHART athletic trainers performing contact tracing for the 180 performing arts students, investigations and contact tracing required only 24-48 hours. Based on the contact tracing findings, rehearsal and production schedules could remain or be quickly altered. This independence further allowed the CHART athletic trainers to create

targeted policies for the unique needs of the performing arts campus and population. The CHART athletic trainers administered contract tracing for the performing arts campus students and transmitted the names to the Dean of Student's office, who maintained the list of quarantined and isolated students campus-wide and communicated findings to non-performing arts faculty. The performing arts campus was the only academic entity to have health care providers implement University policies, contract trace, or perform and track a daily symptom monitoring system.

ISOLATION AND QUARANTINE

The CHART athletic trainers operated and enforced the University isolation and quarantine protocols for the performing arts campus. Any dormitory-resident student who tested positive for COVID-19 or was identified through contact tracing as a potential positive was quarantined and isolated in their room with any roommate(s) per University, county, and CDC requirements for between 10 and 14 days.[8] The CHART athletic trainers informed the performing arts campus dining services, which coordinated meal deliveries for the duration of the isolation or quarantine. Off-campus residents had identical requirements, except no meal delivery service. All isolated and quarantined students attended their courses via video streaming and completed assignments through the online learning management platform. Quarantined and isolated students were required to maintain and track their symptoms and upload the results to the CHART Clinic online database daily. The CHART athletic trainers would visit the isolated and quarantined students via video chat to confirm symptoms and timelines for return.

TRANSITION OF EVIDENCE INTO PRACTICE AND UNIQUE CHALLENGES

The University canceled all fall 2020 athletic competitions. However, the performing arts campus could not discontinue student productions because participation was a required component of the academic degree programs for graduation and course credit. The prior sections described how the CHART athletic trainers were charged with implementing the general University COVID-19 protocols, received the authority to adjust University protocols, contact trace, and created a targeting symptom monitoring program. The subsequent sections contain specific instances where the CHART athletic trainers created and implemented enhanced COVID-19 mitigation policies during the 2020 – 2021 academic year that only affected the performing arts campus, students, and faculty because the general University COVID-19 protocols primarily discussed masking during social and academic gatherings, room capacity limitations, and surface disinfection.

VOCAL PERFORMANCE ALTERATIONS

The CHART athletic trainers and performing arts faculty worried that the forceful movement of air during the act of singing rehearsals and performances could potentially transmit COVID-19.[9,10] To decrease droplet and aerosol transmission risk during solo rehearsal, detailed voice coaching sessions transitioned to online video platforms (e.g., Zoom). Background vocal and group rehearsals occurred in smaller gatherings when video platforms were impractical. In the days immediately preceding the show performance, the production recorded passages of background vocal sessions in the recording studio to be played during the live performance. Prerecording of singing (lip-syncing) was limited to situations where multiple cast members must gather on-stage during the performance's aesthetics and narrative to eliminate the need for close group live singing and further reduce the risk of air droplet virus transmission. On-stage live solo vocals from the lead cast members or duets were allowed, with the singing individual(s) projecting their voice away from any other stage members (**Figure 1**). Finally, shared and non-personalized microphones during rehearsals

and performances were eliminated. Each performer had their assigned microphone and was responsible for its cleaning and maintenance. Microphones were stored in separate plastic bags when not actively used within the venues.

MASKS, COSTUMES, AND STAGE DESIGN ALTERATIONS

Figure 1. Example of a stage mask worn during performances and on-stage social distancing. Photo by: Kenneth L. Stilson

During the 2020 – 2021 academic year, the CHART athletic trainers used their position as the performing arts campus COVID-19 coordinators to work with the faculty and students to develop and alter on-stage personas and characters based on the wearing of transparent face masks during performances. The CHART athletic trainers educated and assisted the wardrobe and make-up designers who integrated masks into on-stage costumes that contributed to the character and story (**Figure 1**). Additionally, the CHART athletic trainers collaborated with the costume and stage design shops, performers, and faculty to create fewer costumes for each character and reduce on-stage physical background props and sets. The faculty, performers, and designers learned how to incorporate masks and fewer costumes and props that supported character portrayal while maintaining audience appreciation of the performance.

PERFORMANCE ALTERATIONS

Outside spectators were not allowed into the performance halls during the fall 2020 and the first half of the spring 2021 semester, and the performing arts campus implemented live-stream performances. The CHART athletic trainers worked with the performing arts faculty to identify alternative productions that would require fewer participants on stage and backstage to promote social distancing and reduce potential COVID-19 transmission. The CHART athletic trainers ensured the backstage area was limited to only essential cast members or production personnel on the official casting roster. The reduction of physical on-stage backgrounds reduced the need for some backstage personnel to change stage design between acts, and on-stage performers utilized fewer props. Electronically created and projected backgrounds and lighting effects replaced select physical stage backgrounds and props for the audience's appreciation of the storyline while serving as a modern way to create background and staging effects for the undergraduate students. The fewer number of costumes reduced quick costume changes during productions, the unnecessary congregation of multiple performers in enclosed backstage locations and made costume sanitation more effective between productions. The CHART athletic trainers implemented a daily symptom self-report screening process (**Table 2**) for any student assigned to a production throughout the 2020 – 2021 academic year to identify possible COVID-19 infections that could potentially alter or cease a production run. During the final months of the spring 2021 semester, the main performance hall was allowed to sell 10% of its available 950 seats for in-person viewing. Traditionally, the cast and faculty would have a meet-and-greet style interaction with the campus patrons and supporters after each production run.

Table 2. Daily Symptom Checklist for Production Participants*

Daily Symptom Checklist Questions	• Have you had any signs or symptoms of a fever in the past 24 hours (chills, sweats, felt feverish)? • Have you had a temperature above 100.4°F (38°C)? • Have you had any of the following signs and symptoms: cough, shortness of breath, sore throat, nasal congestions, body aches, loss of smell/taste, diarrhea, or vomiting? • In the last 48-hours, have you been in direct contact with anyone positive or presenting COVID-19 symptoms for longer than 15 minutes with no mask and within 6-feet? • If you have any "yes" responses, please explain how long the signs and symptoms have been present.
Body Core Temperature	• Obtained each patients' body core temperature before a rehearsal or performance. Any reading above 100.4°F (38°C) was considered a "yes."

*All participants in productions (cast and crew) were required to complete this online symptoms checklist at the beginning of each day during all rehearsals and production days. The results were reviewed by the CHART athletic trainers daily, and any positive symptoms required consultation with the CHART Clinic staff before arriving on site.

However, the CHART athletic trainers requested alterations to enforce and promote social distancing requirements to prevent COVID-19 infection between the community and the performing arts campus participants. **Table 3** describes other performance and rehearsal alterations. All 13 scheduled productions throughout the 2020 – 2021 academic year occurred without any incidence of COVID-19 traced to a production.

Table 3. Alterations to performances and rehearsals during the 2020-2021 academic year

Pre-recording music to be played during productions
Pre-recording group background vocals (lip-synching during performances)
Decreased dressing room admittance for non-essential personnel
Decreased backstage presence to only essential personnel
Limiting ensemble numbers (performers and stagehands) to the minimum needed
Decreased number of set-changes during performances/designing sets for entire performance
Less on-stage group performances
Cast members and stagehands learning more roles
Livestreaming events and productions online
Choosing and developing productions that would promote physical distancing
Integrating masks and physical distance into productions
Elimination of live orchestra during performances
Symptom screening before each performance and rehearsal

MARCHING BAND SPIT VALVES

One unexpected issue that arose during the fall 2020 semester was the ability of the marching band members to discharge the spit valves of their brass instruments (e.g., trumpets) safely during rehearsal. The

CHART athletic trainers worked with the marching band faculty to create a policy where the brass instrument performers had a designed area of the marching band rehearsal field to discharge their spit valve over indoor puppy pads to absorb the salvia and discard the potentially infected material into a receptacle safely. Additionally, the marching band developed alternative formations and patterns to promote proper social distancing during rehearsals and performances.

COVID-19 VACCINE EDUCATION AND TRACKING

Since the university administration designated the CHART athletic trainers as the COVID-19 experts for the performing arts campus, they were charged with vaccine education and tracking efforts. The CHART athletic trainers provided scientific material about the COVID-19 vaccine throughout the facility, distributed information about vaccine opportunities throughout the region, and discussed becoming vaccinated during weekly performing arts campus meetings and gatherings.[8] The CHART athletic trainers inserted documentation of all provided COVID-19 vaccination cards into the student's electronic medical record and adjusted the quarantine and isolation policy for fully vaccinated students according to evolving local and federal recommendations. Finally, when the University developed a campus-wide vaccination incentive for the students and staff, the CHART Clinic was 1 of 10 locations where students, faculty, and staff could provide their vaccination cards for entrance into incentive drawings and similar university vaccine drive efforts.

CONCLUSION

Athletic trainers can quickly become infectious disease experts, solve unique problems, and positively promote on-site athletic trainers' value to create and implement policies and procedures specific to the patients and populations in their care. This clinician expertise commentary demonstrated how a group of athletic trainers became COVID-19 experts and advocated for their autonomy to develop and implement policies and procedures specific to the performing arts patient population within an academic structure.

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Gamekeeper's Thumb with Stener Lesion in a High School Football Player: A Disablement Model Case Study

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ABSTRACT

This disablement model case study outlines a unique thumb pathology of a high school football player in his non-dominant hand and will detail the benefits of quick referrals for patient with extreme laxity and swelling around the 1st metacarpal. Initially, the patient presented with laxity of the 1st metacarpophalangeal joint and swelling along the 1st metacarpal. Radiographs showed floating bone fragments in the first metacarpophalangeal joint indicating Gamekeeper's Thumb, an acute injury to the 1st metacarpophalangeal ulnar collateral ligament, complicated by a Stener lesion, requiring surgical repair. The patient was scheduled for surgery in the following week and was casted for four weeks which posed many physical, occupational, and social problems. Many 1st metacarpal injuries may present similarly making it important to be familiar with the structure and function of the 1st metacarpal and metacarpophalangeal joint and concomitant injuries that may occur in the surrounding area. A Stener lesion is often missed due to the evaluator assuming that the injury is a basic 1st metacarpophalangeal ulnar collateral ligament sprain. The best way to rule in or out the involvement of a Stener lesion is by radiograph; therefore, it is in the best interest of the athlete to refer for a radiograph anytime a grade III ulnar collateral ligament sprain of the 1st metacarpophalangeal joint is suspected. Furthermore, the main purpose of this paper is to detail the importance of a quick referral when there is little to no ability to use the thumb and the effects the lack of movement can have on a young student-athlete.

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INTRODUCTION

Gamekeeper's Thumb, also known as Skier's Thumb, is an acute rupture of the ulnar collateral ligament (UCL) at the 1st metacarpophalangeal (MCP) joint of the hand and is a common injury among alpine skiers.[1] Repetitive valgus stresses, or forced hyperextension and abduction of the thumb, are the primary mechanisms of injury in the Gamekeeper's Thumb.[1] Gamekeeper's Thumb makes up 86% of all thumb injuries and occurs about 200,000 times a year globally.[1] The severity of the injury is characterized into three grades.[1] Grade I injuries occur when the UCL is stretched but still fully intact. A Grade II injury is a partial tear of the UCL, and a Grade III injury is the complete rupture of the UCL.[1] The UCL is composed of two ligaments, the Proper Collateral Ligament (PCL) and the Accessory Collateral Ligament (ACL), which are taught in different ranges of motion throughout the thumbs movement and helps ensure the stability of the 1st MCP joint on the ulnar surface.[1] The adductor pollicis muscle acts as the dynamic stabilizer of the thumb and attaches to the 1st proximal phalanx.[1] The UCL is most commonly injured at its distal attachment on the 1st proximal phalanx. A grade III injury to the UCL results in a bony avulsion fracture in about 20-30% of all similar pathologies.[2] The strong forces required to rupture this ligament can cause the ends of the UCL to retract and lay on the adductor pollicis, causing the UCL to become wedged in the MCP joint and hinder the joint's ability to be reduced or for the ligament to heal. This is known as a Stener lesion, which occurs in 64-87% of all grade III UCL injures.[2,3]

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In acute injuries to the 1st phalange, patients may present with mild swelling, discoloration, and tenderness to palpation along the 1st metacarpal and MCP joint.[2] Applying a valgus force to the MCP joint, looking for excessive laxity when compared bilaterally, can test the integrity of the ligament.[2] If excessive movement at the MCP joint is present upon evaluation, a radiograph is indicated. In Gamekeeper's Thumb, the radiograph will typically show avulsed bony fragments displaced one millimeter or more away from the distal attachment site of the UCL[1]. If no avulsed bone fragments are seen, but Gamekeeper's Thumb is still suspected, the patient should be referred for Magnetic Resonance Imaging, or a high-resolution ultrasound for further imaging of the affected area.[1] Treatment of the area varies depending on the grade of the injury and whether or not the UCL was displaced. A displaced (folding over of the ligament onto the adductor aponeurosis) UCL requires surgical intervention to repair the injury, whereas a non-displaced injury would need to be immobilized for four to six weeks.[1] The rate at which the patient is seen for their injury has a major effect on how favorable their outcome may be; the longer the patient waits from the time of initial injury, the less likely it is that they will regain full function of that joint.

PATIENT INFORMATION

The patient was a healthy 18-year-old, male, high school football player who was in the middle of his first preseason game of the season, when he caught an interception and fell straight on his right hand forcing his thumb into hyperextension and abduction (**Figure 1**). The patient had no previous injuries to his dominant right hand.

Figure 1. Patient positioning during fall.

Differential Diagnosis and Evaluation

The patient complained of 6/10 pain and swelling along the 1st metacarpal and 1st MCP joint. Upon evaluation, he presented with tenderness to palpation along the 1st metacarpal and 1st MCP joint, a 1/5 manual muscle test (MMT) of the opponens pollicis, and a positive valgus stress test for laxity of the UCL. The patient was treated with ice and asked to return the following day for re-evaluation. The next day, he presented with increased pain and swelling along the 1st metacarpal and 1st MCP joint. The differential diagnoses consisted of 1st MCP joint UCL sprain, 1st metacarpal fracture, 1st proximal phalanx fracture, or opponens pollicis strain.

Body Structure and Function

The patient was tender to palpation along the 1st metacarpal and 1st MCP joint and presented with edema surrounding the 1st metacarpal and the muscle belly of the opponens pollicis. Compared bilaterally, he presented with a 1/5 MMT for opponens pollicis, testing for 1st MCP joint opposition, and tested positive for 1st MCP joint valgus stress test for laxity of the UCL.

Activity and Participation

The patient was a starting linebacker and kicker for his high school football team, as well as an elite soccer player. He was in his senior year at the time of injury and a member of a two-time reigning state football championship team who was relying on him for a victory three years in a row. A year prior, the patient

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fractured the 3rd metacarpal on his opposite hand, benching him for most of the season. The patient stated that he was excited to get back to playing football this year and was hoping for an injury-free season. Sustaining an injury in the first preseason game of this season took a toll on the patient; he was worried that he would be letting his team down for the second year in a row, especially being the captain and leader of the team during his senior year. He also worried about how it would affect team morale and their ability to succeed in future games.

Environmental and Personal Factors

The patient had a previous history of a fracture in his left hand from an injury in football the previous year, which caused him to miss most of the season. Along with being upset about missing his senior year of high school football, the patient was also nervous on how this injury would affect his ability to do school work as he had injured his dominant hand. As a leader on the team and someone that people in the school looked up to, he felt as though he was letting people down as the hype of the new season was beginning. The preseason game was a tough loss for the team, and with the added stress of losing their starting linebacker he was unsure how people would react.

INTERVENTIONS

The injury occurred on the patient's dominant hand. Due to the increased swelling, pain, and loss of function after the initial evaluation and a history of trauma to the opposite hand, the patient was referred to a hand specialist for a second opinion and further imaging three days post-injury. Radiographs showed a rupture of the UCL with displaced bone fragments, indicating an avulsion from the proximal phalanx (i.e., Stener lesion), requiring surgical intervention. Surgery was scheduled for a week later, ten days post-injury. The surgery consisted of releasing the adductor aponeurosis and anchoring the avulsed UCL to its insertion with a Mitek suture by passing it through the ligament. Additional reinforcement was accomplished by repairing the aponeurosis. After the surgery, the patient was placed in a padded splint, with the thumb flexed and fully adducted, to keep his thumb immobile while swelling decreased before he was placed in a cast. A week after the surgery, the patient was placed in a hard cast for four weeks. Extra support around the thumb was applied within the cast to ensure that there was no movement and that the repaired ligament could heal; any excess movement of the thumb could result in failure of the surgery and loss of function in the thumb. While in the cast, the patient was able to participate in non-contact activities. As the team kicker and linebacker, the patient was still able to participate in football practice and games with a padded cast as the punter and place kicker. After four weeks, the patient was able to return to full contact as long as he wore a padded brace during games and practices. The patient returned to his starting position as linebacker and kicker for his high school football team with no additional rehabilitation.

OUTCOMES

Body Structure and Function

The patient had surgery on his hand within a week of the initial injury and was placed in a soft splint for one week and a hard cast for four weeks. The patient was right-handed; therefore, he was unable to use his dominant hand for five weeks. After the cast was removed, the patient tested 5/5 for the manual muscle tests for opponens pollicis, testing for opposition and had no laxity when the UCL was tested. The physician stated there was no need for rehabilitation, and the patient could return to normal activity as he saw fit. No patient-reported outcome measures were used during the patient's recovery. The patient denied having any pain but was nervous about re-injury upon returning to play and the potential to lose function of his thumb.

Therefore, the patient continued to wear the splint during activity for the remainder of the season. The splint was provided by the physician and padded by the athletic trainer for games and practices. The sports medicine staff at the school discussed the fear he was having and any underlying concerns he had about re-injury which also helped him overcome that fear.

Activity and Participation

The patient was removed from all contact participation in football practices and games but did not have to stop playing football altogether while he was recovering. Because of his position, he was able to participate in kick-off, field goal, and extra point attempts. In addition to playing football for his high school, he was also an elite soccer player for his high school. Realizing that he did not want to lose cardiovascular fitness during his off time from football, he focused on running to stay fit for both sports. Being able to stay interactive with the football team and focus on keeping up his fitness level was good for the mental health of this young player. He stated he enjoyed feeling like a part of the team on and off the field. Along with being beneficial to the patient, his hard work kept the spirits high for all of those still playing. Understanding that their teammate was working hard to get back and stay involved encouraged them to play hard and kept morale high until he was able to return to full participation.

Environmental and Personal Factors

Since writing was difficult, the school issued him a laptop to use to help complete his assignments in class and at home. Teachers also made accommodations, such as giving him more time to complete tests and assignments, to assist him. The school is competitive academically with high expectations for all students; missing a day of school can set the student far behind. The stress of having to miss a couple of days due to surgery and the inability to use his dominant hand was something the patient expressed worry about. After communicating with his teachers, he soon realized that they would not allow his injury to set him behind. He was able to stay up to date on all assignments and easily completed homework and notes with the use of the issued laptop.

DISCUSSION

Although a Gamekeeper's Thumb injury is common in some athletic events, this injury at this severity is not well known in the world of football causing athletic trainers in this role to be less familiar with the treatment. When treating a Gamekeeper's Thumb injury that has not been displaced, there is a possibility of a non-surgical option. When treating a Gamekeeper's Thumb injury in a non-surgical, more conservative method, the thumb is immobilized for 4-6 weeks in a plaster cast or splint in the position of slight flexion and ulnar deviation of the MCP joint with the 1st interphalangeal joint kept free for movement. When patients were asked if they preferred the cast or splint, most patients preferred the splint due to its superior comfort.[6]

Gamekeeper's Thumb complicated by a Stener lesion has likely occurred in this sport before; however, current literature reports minimal instances relating to football players. The treatment of this injury does not differ in that of a high school football player as opposed to a skier suffering from a similar injury. It is important, as athletic trainers, to identify the signs of a Gamekeeper's Thumb injuries and be able to take the appropriate steps in a timely manner. If a Stener lesion complicates the pathology, treatment and referral of the injury should be timely to avoid any further complications, such as weakness or loss of function.

An injury to the thumb that may seem insignificant at first glance can have a huge impact on a patient's life in athletics, the classroom, and daily life. Athletic trainers should be mindful of patient-centered care and take the time to identify interventions to assist making the injury and its complications less stressful.

CLINICAL BOTTOM LINE

The purpose of this case study is to inform health care professionals about a common injury such as the Gamekeeper's Thumb, with a not so common pathology like a Stener lesion, in an even less common patient population (high school football player). There is little documented evidence regarding Gamekeeper's Thumb in football players.[1,2] The prevalence of a Stener lesion in a Gamekeeper's Thumb is low compared to the amount of injuries that are seen yearly, about 60% of all Gamekeeper's thumb injuries among athletes and everyday people are considered to be a grade III injury.[1,2] The treatment of this type of injury is different than that of a typical Gamekeeper's Thumb injury and requires surgical intervention. Due to the in-depth evaluation of the patient by the athletic trainer the proper referral was made in a timely manner to catch this particular injury and help the patient regain all mobility of his thumb. Health care providers should be aware of this diagnosis and misdiagnosis of this injury could result in long-term complications in range of motion and strength.

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Exertional Heat Stroke in a Male High School Runner with Disordered Eating: A Disablement Model Case Study

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ABSTRACT

A 16-year-old male high school cross country athlete collapsed at the end of an afternoon 5K cross country meet. The patient was unable to stand, and after outwardly displaying confusion and agitation, his coaches sought assistance from the athletic trainers (ATs). The patient consumed one cup of water and a granola bar on the day of the meet. The ambient air temperature was 90°F with 69% humidity. Differential diagnoses included exertional heat stroke (EHS), exertional heat exhaustion, exertional collapse associated with sickle cell trait, heat syncope, dehydration, malnutrition, and hypoglycemia. Approximately 20 minutes passed between activation of the emergency action plan (EAP), initial collapse, and cold-water immersion. Assessment of rectal temperature did not occur until after submersion due to waiting for parental consent. The patient was removed from the water after 12 minutes with a rectal temperature of 100.5°F. He was transported to the hospital, received 2 liters of intravenous normal saline among multiple other tests, with no significant findings, and was released approximately 9 hours later. It was later learned that the athlete dealt with disordered eating. The patient was asked to complete a seven-day food and drink log and was provided nutrition guidance by the ATs. This patient's disordered eating habits could have contributed to the development of EHS. The ATs were unaware of his eating patterns until after the EHS event. Athletes need to be educated on how to properly fuel themselves for athletic competition in anticipation of adverse environmental conditions. If a patient is already prone to disordered eating, this individual will not have the proper intake of nutrients to sustain athletic competition, nor to sustain everyday living. Athletic trainers should be aware of all potential medical concerns in their patients, including those not often discussed, to accurately diagnose conditions and avoid any potential sequelae.

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INTRODUCTION

Exertional heat stroke (EHS) is the most severe exertional heat illness (EHI) characterized by a core body temperature exceeding 105°F, the presence of central nervous system (CNS) dysfunction, and multiple organ system failure.[1-5] When the metabolic heat produced by muscle during activity outpaces body heat transfer to the surroundings, the core temperature rises to levels that disrupt organ function, unless correctly recognized and treated in a timely manner.[2,5] Care should begin within 30 minutes of initial collapse to include cooling from the neck down.[6] Relevant to this case study, high school boys' cross country has been found to have an EHI incidence rate at 0.52 per 10,000 athlete-exposures per cross country season, during competition, and 0.50 per 10,000 athlete-exposures in practice, the second-highest EHI rate following boys' American football.[8] Exertional heat stroke is one of the leading causes of sudden death during activity.[1,2]

Risk factors for EHS include lack of heat acclimatization, cardiovascular dysfunction, fever, illness, dehydration, and hypokalemia, among others.[2] Some of these factors can also be directly associated with eating disorders.[5] Eating disorders can be determined by using questionnaires such as the Eating Disorder Examination (EDE). This questionnaire includes questions related to eating disorder (ED) risk. These questions are specific to sport and are related to being diagnosed.[6] If an individual is not consuming enough nutrients, it can result in low energy availability, health risks, and ultimately affects bone mineral density.[5] Disordered

eating behaviors are similar to eating disorders, but they do not meet the criteria for diagnosis.[7] Relevant risk factors pertaining to this case include that the patient struggled with disordered eating (DE).[7] If not addressed appropriately or in a timely manner, DE can result in physiological and psychological effects. Some of these include inadequate energy availability, decreased bone mineral density, and for females specifically, menstrual disorders and the female athlete triad.[6] In athletes who completed the EDE-12 questionnaire, body dissatisfaction, drive for thinness, and body mass index were found to contribute to their DE habits.[8] In males specifically, body dissatisfaction has been found to be linked to muscularity and weight concerns.[6] In this case, the patient's family was previously aware of his nutritional habits; however, the ATs at his school were not.

PATIENT INFORMATION

The patient in this case study is a 16-year-old male high school cross country athlete that collapsed at the conclusion of an afternoon 5K cross country meet. At the time of the incident, the patient was in the 11th grade and had been participating on the cross-country team since middle school. There was no documented family history of heart disease, diabetes, ED, or mental health disorders. He had no previous history of ED, injury, or other illness. On the day of the meet, which started at 4 pm, the patient had only consumed one cup of water and one granola bar. At the time of the collapse, the ambient air temperature was 90°F with 69% humidity, which is in the dangerous percentile and increases the risk of EHI.[9] These measures were not determined until after the collapse occurred.

Differential Diagnosis and Evaluation

The differential diagnoses were EHS, exertional heat exhaustion, exertional collapse associated with sickle cell trait, heat syncope, dehydration, malnutrition, and hypoglycemia.[2] When the patient first collapsed at the finish line, the ATs decided for the patient to drink water and sit down since he was conscious, alert, and oriented. Due to the patient's fatigue, he was assisted to the team tent by his coaches and teammates. The patient's presentation drastically changed after arrival at the team tent, which is when the coaches called the ATs for assistance. The most notable changes included signs of CNS dysfunction (confusion, inability to form speech, unaware of date, place, time, personality change/aggression), feeling of extreme overheating of the body that could not be cooled with water, and extreme fatigue (inability to walk or stand). The patient was transported from the team tent to the athletic training facility where cold water immersion and a rectal thermometer were available. At this time, emergency medical services were called. Since the patient was a minor, the AT's policy was to get parental consent prior to the use of rectal thermometry and immediately initiated cold water immersion. The patient's parents were not at the race and were called to receive permission to utilize the device. After the patient was immersed for 12 minutes and showed obvious signs of improved CNS function, the ATs removed him from the cold-water immersion tub and assessed his rectal temperature after receiving parental consent. At this time, his rectal temperature was 100.5°F, and it was determined that the patient was now able to be safely transported. Emergency medical services then transported him to the hospital, where he received further evaluation and care.

Body Structure and Function

The body function most affected was his CNS, as shown through his delirium. When talking to the patient after the event, he recalls that he felt an out-of-body experience. The patient expressed that he knew something was wrong, but he did not know what was going on. The best practice, or gold standard, of immediate treatment for EHS is the assessment of rectal temperature and cold-water immersion.[1,3]

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Activity and Participation

At nine months since the event, there are no documented long-term negative effects on the patient's health as a result of his EHS event. The incident made the ATs aware of the patient's DE behaviors. Additionally, the patient expressed that it made him realize the drastic effects that his DE can have on his body, and he began to change his eating habits. This event shows clinicians that DE presents in males as well as females. He has worked with his parents to improve his DE. The patient took time off from running to help his body heal. It is important to note that DE is not an overnight fix and takes months and sometimes years to get to a healthy place.

Environmental and Personal Factors

The patient expressed that the nature of the sport of cross country and associated physical appearance standards, the overwhelming media push to "look skinny," and the myth shared throughout his high school that you should not eat too much as an athlete, were all factors that led up to his DE. He shared that his teammates' support had a huge hand in the difference between him having a successful and unsuccessful recovery. Parental involvement was a key factor in his recovery process, as well, due to their constant support without judgment. This patient, in particular, expressed that the encouragement that he received from his teammates and family is what helped him face his DE and get on a path to recovery and healing.

INTERVENTIONS

Due to the patient's personality changes and aggressive behavior, indicative of CNS dysfunction, the ATs initiated the emergency action plan, which was to call emergency medical services and immerse the patient in cold water. The cold tub was not located at the cross-country course, and the patient had to be transported to the athletic training facility for cold-water immersion, resulting in approximately 20 minutes passing between initial collapse and cold-water immersion. The patient had partial consciousness and was unaware of the events happening during the cold-water immersion. After 12 minutes of cold-water immersion, the patient's cognitive function improved, so he was removed from the water, and his rectal temperature was assessed. At that time, his core temperature (100.5°F) was determined to be safe for transportation by emergency medical services, who arrived shortly after his immersion. At the hospital, he received two liters of intravenous normal saline and was administered multiple tests, including an electrocardiogram and blood panel, with no significant findings. He was released approximately 9 hours after arriving at the emergency department following the resolution of symptoms.

The patient followed up with his AT the following day, who had since been informed of possible DE by a concerned peer. The patient was asked to complete a 7-day food and drink log and was provided nutrition guidance where he logged everything he ate and drank each day. In the mornings, he reported to the athletic training facility prior to school to review what he ate prior to practice the night before and to report his breakfast intake prior to school for the day. He also reported to the athletic training facility at the end of each day, where the log was reviewed. If he did not consume adequate calories based on the recommended daily intake values, he was not permitted to practice.[10,11] On the days that he was not in school, he contacted the head AT to report his documented intake electronically.

OUTCOMES

The only quantitative data, or validated outcome measures that were taken, were taken during the initial incidence. Based upon conversation, his body has returned to normal function, and he is now able to

participate in full activity. In addition to completing the 7-day food log and daily check-ins with the AT, the patient's return to play included an evaluation of the nutrients that he took in every day and if that fulfilled his requirements to participate in sport. If he did not meet this threshold, he was not allowed to practice that day. His running mileage was also greatly lowered. He began his return to play with biking and walking in the athletic training facility, to progressing to walking with a friend and a mile of light running. After 7 days, he had built up enough nutrient intake as well as mileage increase to return to full practice. Due to concerns over the patient running alone, it was decided to have a friend run with the patient during his return-to-play in case another situation occurred while they were out on the course. The patient has continued to address his DE behavior, but the family has kept the continued process personal.

DISCUSSION

Certain aspects of this case that are important to note, such as the delay in assessing rectal temperature to confirm an EHS diagnosis, wet-bulb globe temperature (WBGT), which had not been used prior to or during the event, and the lack of immediate on-site access to cold water immersion. Rectal thermometry is the gold standard of care to assess core body temperature during a heat illness event.[9,11-14] Methods such as oral or temporal temperature assessment are inaccurate.[15] However, recent literature still demonstrates that most secondary school ATs do not assess a rectal temperature during suspected cases of EHS.[9,11-14] Less than half of surveyed ATs reported that they were comfortable using a rectal thermometer to assess for EHS.[15] In this situation, the ATs wanted to protect themselves in case the parents did not give consent. However, rectal thermometry is the standard of care for athletic training for heat-related illness emergencies, as stated by the NATA,[2] and therefore, it is the required practice of care, regardless of parental consent or the patient being a minor.[1,2] Barriers to implementing the use of rectal thermometers have been found to be lack of training with equipment, misunderstandings of use and cost, and the possibility of legal issues.[16] There are also extrinsic factors that negatively impact ATs use of rectal thermometry. For example, in some cases, school administrators may express concerns with the use of rectal thermometry on minors. This has especially been noted by ATs that work in private school settings.[4] Recommendations to overcome these barriers include proper education of these devices explaining the importance of understanding the efficacy of the temperature measurement compared to other tools.[17] Ultimately, it is the AT's responsibility to ensure meetings with administrators are held prior to such events so that all individuals are on the same page when it comes to emergency action plans and protocols. In this case, the ATs had not gotten prior permission from the parents to utilize this standard of care. This should be explained to parents prior to sport participation, and a form signed that gives the ATs the right to care for their student-athletes using rectal temperature if the parents are not present at the time of the incident.[2] There is a heat stroke treatment authorization form that is created by the NATA that clearly lists out the proper evidence and the definitions of the AT's scope of practice that parents and guardians can sign at the beginning of every season.[18]

The day of the patient's EHS event was one of the hottest days within the first few weeks of the cross-country season. The team was only a few weeks into regulated practices and had not gone through a low to high increase in practice mileage/intensity or regulated acclimatization period during those weeks, nor did they have any regulated summer practices. This day, in particular, was too hot for participation in sports (90°F and 69% humidity) based on the ambient temperature and relative humidity.[3] According to the heat stress risk temperature and humidity graph,[19] if the relative humidity is between 50-60% ambient temperature should not exceed 86-90°F for safe sport participation.[16] However, there were no modifications to the competition based on the extreme environmental conditions. Ideally, a WBGT device should have been utilized, and the event delayed or postponed until the conditions were more favorable; however, a WBGT reading was not utilized prior to that day's events.[3] WBGT is preferred to ambient temperature and radiant

heat alone due to differences in weather effects within various regions of the country.[2] WBGT is calculated by completing a mathematical equation including wet-bulb temperature, black-globe temperature, and dry-bulb temperature.[2] Lastly, the facilities where the cold tub was located, were a 5 to 8-minute walk from the finish line and team tents. Precious time was lost during the commute from the team's tents to the place where the cold tub was utilized. Since the patient was being carried, this also added to the time that he could have been in the cold tub. Rectal thermometry and cold-water immersion were utilized within the 30-minute recommendation after the start of treatment, supported by the NATA position statement for standard of care for EHS.[2,19]

CLINICAL BOTTOM LINE

It is important for ATs to ensure they are up to date on the standard of care that is expected of the profession. Emergency action plans for situations like this should be implemented and practiced prior to an event occurring. ATs should be in contact with emergency personnel to make sure that the standard of care is continued during and after transportation to a hospital. EHS can be avoided if prevention and recognition are practiced correctly. Individuals presenting with EHS must be cared for within a short amount of time to prevent serious injury or death. It is the AT's responsibility to ensure all important personnel are trained and ready for any emergencies that may occur.[2] With the proper training, pre-participation examinations, and weather precautions in place, EHS can be avoided and potentially completely prevented.

This case is important due to the rise of EHS in both the high school and college athlete populations.[10] Rectal thermometry has been the gold standard of practice since 2002, yet many ATs still do not feel comfortable performing it if they did not learn this in their schooling.[1,12] Since this information was published 18 years ago, this standard of care should be fully accepted and administered across the athletic training world. Athletic trainers are responsible for learning and implementing new athletic training competencies into their practice, even after obtaining their initial certification.[20] State, regional, and national conferences should provide opportunities for ATs to learn and practice these skills to help facilitate implementation to practice.

ATs should be aware of other factors that could affect and increase risk of EHS. In this scenario, disordered eating was a factor that led to the patient's EHS. Other factors of this EHS event included lack of supplies, AT preparation, and difficulty accessing emergency equipment. It is important for athletes to have a basic understanding of proper nutrition guidelines for their sport participation and how environmental conditions may further compound.[8,21] Outdoor sport athletes need to be especially careful due to potential exposure to adverse environmental conditions.[4] It is suspected that the patient's DE had a key effect on his dehydration and lack of nutrients to be able to successfully compete in his race.

The authors recommend three important take-a-ways from the experience. One of the most important things that an AT can do with their staff is to review and practice their EAPs, annually.[2,4,5,16,19] This plan includes instructions on what to do in case of an emergency, and more specifically, a heat related illness event. Rectal thermometry should be available to all ATs at every level, even including secondary schools. [1,2,4,16,17] There are certain forms and parameters that can be navigated to gain permission from parents in regard to minors. ATs should consider screening athletes for nutritional concerns prior to sport participation through pre-participation exams (PPEs) and throughout the season utilizing validated risk assessments, such as the EDE-Q and EDE-12 questionnaires.[6,8] ATs should be aware of all potential medical concerns in their patients, identified through PPEs, to properly refer to physicians or specialists and diagnose conditions to avoid any potential sequelae. If ATs adopt the regular use of EAPs, rectal temperature, and PPEs in their practice,

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incident rates of fatal heat related illnesses should drastically decrease due to the awareness gained through these three avenues.

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Quality Improvement: Implementation of Individualized Concussion Patient Education and Rehabilitation Treatment Plans

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ABSTRACT

Concussion is a significant health issue at all levels of sports participation. At Saint Luke's Health System (SLHS) in Kansas City, Missouri, the sports medicine and concussion team discovered an issue with dissemination of patient education for concussion rehabilitation plans. A quality improvement project was launched in August 2019 to develop concussion educational rehabilitation plans, incorporating cluster symptoms into concussion profiles and improving communication during follow-up care. The project promoted improvement of patient understanding of individualized rehabilitation plans and effective communication for the treatment management team. Three cycles of a Plan-Do-Study-Act (PDSA) quality improvement project were completed over 6 months. The physicians and athletic trainers reviewed literature and treatment plan recommendations for patients. Comparison of pre-PDSA and post-PDSA adherence to charting standards was performed. Before this project, patients had insufficient documentation of the education they were receiving. Additional implementations included education, Patient Health Questionnaire (PHQ-9) score, graded symptom scale (GSS) score, and changes to the documentation template. Eighty patients (46 male, 34 female) were included in the 6-month project. Of pre-PDSA (control) concussion patients, 71% (n=29) were male football players. After the PDSA cycles were completed, only 18% (n=7) of patients were football players. The season had no effect between the number of patients included pre-PDSA or PDSA cycles 1-3. For PDSA cycle 1, the pre-PDSA goal was surpassed, and 100% of new concussion patients received concussion education during their initial visit. During the 3-month data collection period for that cycle, only 10.5% (2/19) of follow-up patients received a concussion information packet during their visit. After completion of PDSA cycle 2, 100% of patients received education pamphlets; initially, only 85% received pamphlets. Finally, PDSA cycle 3 successfully implemented the use of the new concussion template system-wide and the addition of concussion symptom profiles for patient education and individualized treatment planning.

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CURRENT MODEL

The original process for concussion rehabilitation at SLHS in Kansas City, Missouri, involved an initial clinical examination consisting of a physical examination, ImPACT test, Balance Error Scoring System test, and symptom score. Patients were then provided with academic supports, concussion education, and a signed Missouri State High School Activities Association or Kansas State High School Athletic Association concussion form for the school, which allowed the patient to begin the return-to-play progression with the athletic trainer once free of symptoms. If there were referrals to other providers for therapy, patient education was limited. The main therapies considered were vestibular/oculomotor (after 7 days), manual therapy for the cervical spine (if the patient had cervical pain), and neuropsychological evaluation for patients with persistent symptoms that did not resolve using alternative treatment plans.

The primary issue addressed in this quality improvement project was the lack of individualized concussion rehabilitation treatment plans and patient education for these plans. Initially, the concussion rehabilitation treatment process at SLHS was limited, referring patients for a few therapy techniques while neglecting others. Typical treatment recommendations for patients were rest followed by a progression back to sport that gradually increased exertion.[1] The primary method used to assess patient status was a self-reported

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symptom questionnaire.[2] The Post-Concussion Symptom Scale was used for tracking symptoms throughout the recovery phase and has been reported as a useful tool for assessing concussions;[3,4] however, it was only used to determine when symptoms resolved rather than to direct therapy. As concussion treatment evidence continues to emerge, we felt we should be constantly innovating new ideas and processes throughout our sports medicine program. Recent evidence has identified presentations of SRC that have been termed profiles[5] or subtypes.[6] Various taxonomies have been developed that categorize symptoms in a somewhat different manner; but many include similar constructs, such as cognitive, emotional, vestibular, and ocular.[7] Furthermore, sleep and cervicogenic injury have been implicated as modifiers for any concussion profile.[6] We identified a gap in patient care from the resting phase through return to sport beyond the progression of exertion.

Secondarily, there was limited communication with the patient and parents about the necessary steps required after initial evaluation. Patients did not take home any written information about their current rehabilitation plan. If a patient needed a specific therapy, the specialized office would call to schedule the therapy. The physician educated the patient and the parents in the office; but once they left the clinic, it was assumed they understood the next steps of the rehabilitation plan. The majority of the time the patients would call and ask additional questions because they forgot when they should begin therapy or when they could start their return-to-play progression.

Therefore, the two primary aims of this quality improvement project were to (1) establish symptom profiles as part of each patient's individualized treatment plan and (2) improve patient and parent education and understanding of concussion treatments and return to play. To identify changes that addressed the project aims, information from the comprehensive physical examination at the initial visit, adjunct assessments, and the symptom scale was used to assign a symptom profile to each patient. Ideally, the symptom profile would result in an appropriate individualized approach to the concussion treatment and management plan. A second change required using the information from the symptom profile assignment to better educate patients and parents about the next steps in their care and expectations for the recovery process. Measurable outcomes for this project included improving the percentage of patients assigned a concussion symptom profile and providing patient educational materials at the initial visit.

PLAN-DO-STUDY-ACT (PDSA) CYCLES

Baseline Evaluation

Pre-PDSA (baseline) data were analyzed from August-September 2019 and included data from every concussion patient seen by SLHS sports medicine department during that period. An assessment of the treatment and rehabilitation plans that patients received was also performed. Three PDSA cycles were then used to establish necessary changes for improvements to patients' concussion education, communication of rehabilitation and treatment plans, and electronic medical record (EMR) template changes for staff to ensure assignment of a concussion symptom profile. A summary of the sports patients participated in during the 6-month project is presented in **Figure 1**.

To complete the three PDSA cycles during the project, there was a 6-week delay, where no data were collected. Before the PDSA cycle 1 data collection period, 41 patients were identified as meeting inclusion criteria. However, 2 cases were excluded because the concussion was caused by a motor vehicle accident and the patient was not attending school.

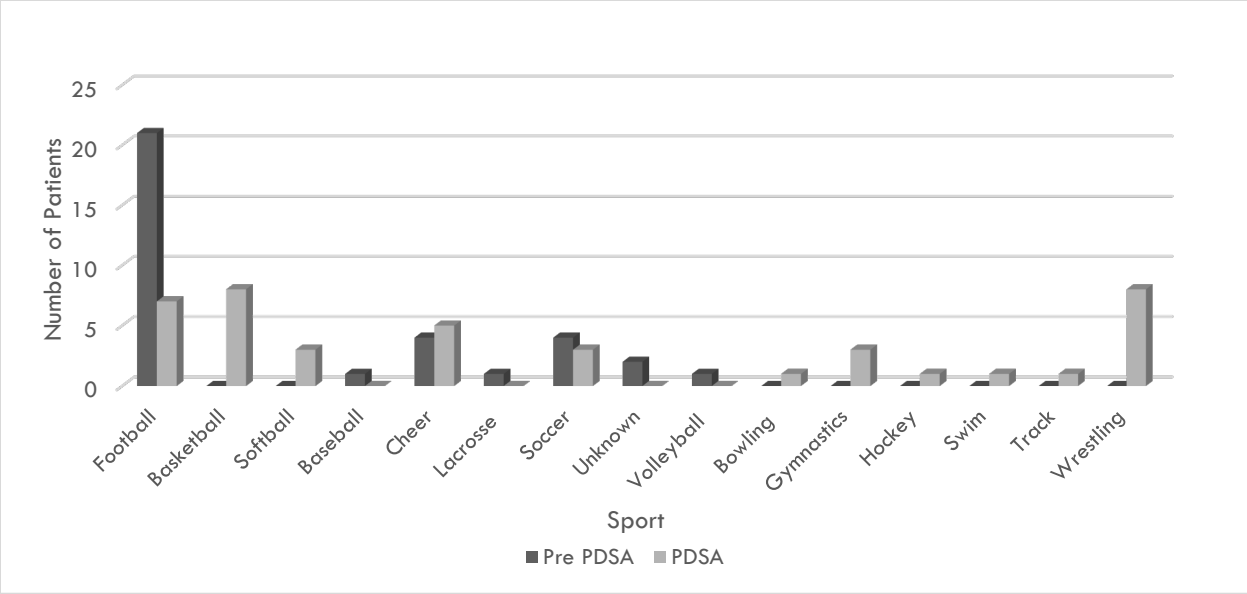

Figure 1. Patient demographics per their sport. Blue: Pre PDSA1 Aug-Sept 2019 controlled data patients. Orange: PDSA2 Dec-Feb 2020 patient's data.

In 15% (n=6/41) of pre-PDSA cases, it was unclear whether the patient received any concussion education material because that information was not documented in the EMR. For the other 85% of cases, it was clearly documented that the patient received concussion education.

PDSA Cycle 1

The first PDSA cycle focused on improvements in the use of concussion symptom scores through the development of concussion symptom profiles and modifications to the EMR.

Plan: To implement concussion symptom profiles based on concussion symptom scores and physical examination findings for each patient, the clinical athletic trainer was responsible for obtaining the physical findings and categorizing patients into profiles after each examination. After the profiles were established, the implementation process took less than 5 minutes. Resources needed for PDSA cycle 1 included an up-to-date concussion literature review, EMR training, and instruction from the information technology team to change the templates. This cycle was expected to require a month to plan because of constraints related to scheduling with others.

Do: Five concussion symptom profiles were established to drive treatment plans. The concussion symptom profiles were discussed among the entire sports medicine team and informed by the concussion symptom cluster of the GSS. After the 5 symptom profiles were established, changes were made to the EMR template (**Table 1**) to create symptom profile groups within the documentation; the previous EMR template included only a total symptom severity score. Thus, PDSA cycle 1 resulted in changes to the entire healthcare EMR system that were not limited to the sports medicine physicians. More specifically, the templates were changed

so, the exact symptoms that patients were experiencing reflected their symptom profile. One unexpected finding was the placement of a symptom in the correct profile when the symptom could be categorized in multiple profiles. For example, headache could arise from lack of sleep but is still a physical symptom.

Study: Following this EMR change, we compared data from concussion patients evaluated during the current football season with those from the prior season (before individual plans were developed based on the symptom profile).

Act: Based on the patient concussion symptom profiles, the sports medicine staff at SLHS developed and delivered individualized concussion treatment and rehabilitation plans, and concussion education for at least 90% of all new concussion patients during a 3-month period.

Table 1. EMR template changes incorporating concussion symptom profiles.

Review of symptoms (ROS)
Physical Symptoms
Headache (yes/no)
Neck Pain (yes/no)
Radicular Symptoms (yes/no)
Vision Complaints (yes/no)
Sound Complaints (yes/no)
Mood Symptoms
Sad/Depressed (yes/no)
Irritable/Angry (yes/no)
Anxious/Fearful? (yes/no)
PHQ-9 Modified for Teens Score (0-30)
Sleep Symptoms
Hard to get sleep? (yes/no)
Sleeping more than usual? (yes/no)
Cognitive Symptoms
Missing school/work (yes/no)
Confusion/memory problems (yes/no)
Distracted/attention problems (yes/no)
Feeling foggy/slowed down/groggy (yes/no)
Normal school grades
Vestibular
Dizziness (yes/no)
Balance issues (yes/no)
Car sickness (yes/no)
Nausea/vomiting (yes/no)
Physical Education
Alert and oriented
Answers questions appropriately

According to PDSA cycle 1 data, in 66% (n=14) of pre-PDSA cases, patients received recommendations for academic supports during their visit with the physician. However, 50% of patients who did not receive temporary academic adjustments were follow-up patients with a symptom score of 0 who were ready to be cleared for return to play. Changes between the proposed process map to the post-PDSA cycle process are presented in **Figure 2**.

PDSA Cycle 2

The second PDSA cycle was directed specifically toward staff communication and education training and how to effectively educate patients and parents about the individualized concussion rehabilitation and treatment plans. The addition of patient-reported outcomes (PROs) facilitated communication among the staff and improved visualization of patients' documented outcomes.

Plan: To build new concussion templates within the EMR, the sports medicine staff met weekly before clinic. These weekly meetings were needed to discuss the new templates and answer any questions about them. Saint Luke's medical liaisons were part of the implementation process to ensure all concussion specialist physicians had access to the templates. The concussion templates were available for use across the entire health system for any provider who wanted to use the template. In addition to educating the staff about concussion template changes, finalizing the patient education pamphlets was included in the weekly meetings.

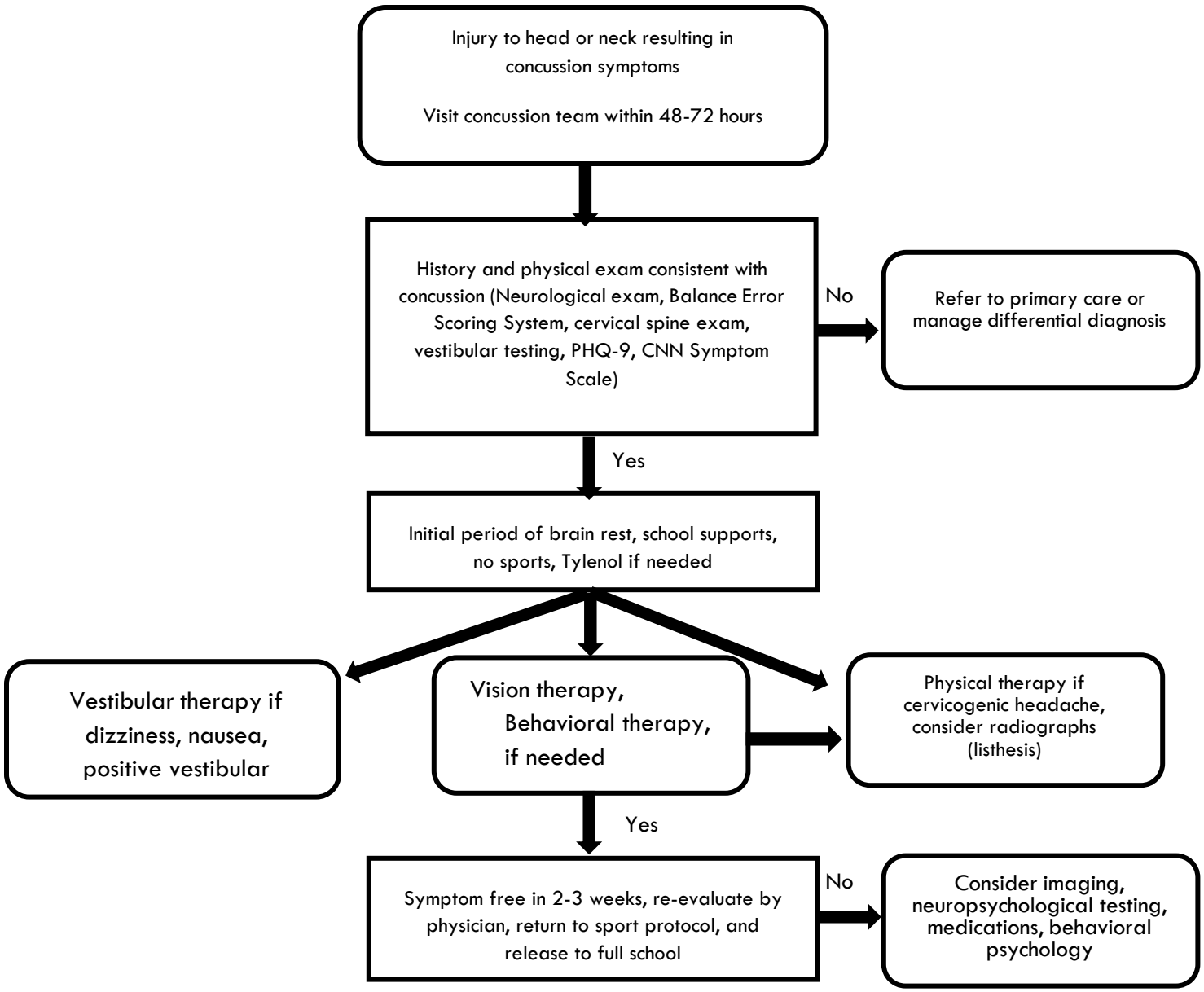

Figure 2. Changes between the proposed process map to the post-PDSA cycle process

Do: Communication and staff education were used to ensure everyone understood and used the templates the same way. The previous concussion template did not include symptom profiles and only included the patient's graded symptom scale (GSS) total score. Improvements to the EMR template may have affected an observed increase in the number of documented patient PROs. An unexpected finding of this cycle was a lack of GSS scores for follow-up patients, which had been previously recorded. Staff were also unaware of how to document information in the EMR because of lack of training before PDSA cycle 2.

Study: Notable changes were made to the EMR templates and patient education pamphlet. A staff meeting that included all members of the sports medicine and orthopedics team was conducted for staff education and training purposes. Topics discussed during the meeting included wording changes, where to find the new PROs, how to interrupt the PRO results, and the process for neurocognitive testing. The patient education pamphlet also included a change in patient instructions increasing the amount of time allowed for the brain to rest (48-72 hours) before beginning light exercise, the PROs given to the patient (GSS score, Patient Health Questionnaire [PHQ-9], and the number of times the patient completed neurocognitive testing (baseline, after injury, before return to play, and after clearance for a new baseline).

Act: **Table 2** presents data for this cycle (December 2019-February 2020). Improvements were made to the concussion education material the patient received and, subsequently, to the rehabilitation and treatment plans. New PRO measures, including the PHQ-9, were also added. Before PDSA cycle 2, 85% of patients received patient education; however, this number increased to 100% after the PDSA cycle 2.

Table 2. Change in the percentage of patients with documented outcome measures prior to and following PDSA Cycle 2.

Outcome Variable	Pre-PDSA2	Post-PDSA2
Patient education	85	100
GSS	86	95
PHQ-9	0	80

PDSA Cycle 3

The third PDSA cycle was structured to implement all the concussion education changes in the updated pamphlet that the patients and parents received.

Plan: Individualized plans were highlighted on the concussion education handout for each patient. The concussion symptom profiles were listed using the American Medical Society for Sports Medicine overlapping symptom profiles, which is an emerging concept to facilitate individualized management after sport-related concussion.[5-7]

Study: Marketing reviewed the size, color, and number of pages of the pamphlet before it was sent to production for printing.

Do: Information was condensed in order to make the handout smaller. Further, all pictures were removed from the original concussion education handout to limit the number of pages.

Act: Results for PDSA cycle 3 indicated the pre-PDSA goal was surpassed and 100% of new concussion patients received concussion education during their initial visit. During the 3-month PDSA cycle 1 data collection period, only 10.5% (2/19) of follow-up patients received a concussion information packet during their follow-up visit. Both of those follow-up patients were still experiencing symptoms. The new education handouts started being used after completion of PDSA cycle 3.

LESSONS AND LIMITATIONS

While we successfully made improvements during this quality improvement project, several lessons were learned during the process, some of which were specific to our situation and some of which may benefit others interested in a quality improvement initiative at their institution. The first lesson learned was to extract data from the same season, same sport, and same time of year for better comparisons. Because of time constraints on the project, we were limited in this ability. However, we were fortunate that the population of pre-PDSA concussion patients during football season was similar to the population of post-PDSA concussion patients during the winter sports season.

The second lesson learned was to involve other hospital system departments, such as marketing, before making specific pamphlet changes to ensure all formatting requirements of the organization were followed appropriately. The revision of the education pamphlet in PDSA cycle 3 was completed by department clinicians without consulting the hospital system's marketing department. In hindsight, the sports medicine department should have focused solely on updating the content and then working collaboratively with marketing to ensure compliance with hospital branding, thus decreasing the number of edits required before printing.

There are plans to continue this quality improvement project with a fourth PDSA cycle to facilitate to improve the nationwide implementation of the new SRC symptom profile and individualized concussion rehabilitation and treatment plans throughout the EMRs of this healthcare system. The EMR template changes can be shared system-wide and could also be used by providers in other healthcare networks that use the same EMR. Further, using the same template may decrease documentation errors and result in better patient care. It may also decrease the amount of time it takes clinicians to review previous patient records before follow-up appointments. Financial savings may be another benefit resulting from decreases in documentation errors and the amount of time spent on documentation.

Although this project focused solely on a single hospital department, the changes made and lessons learned can be applied to concussion protocols of other institutions. A similar concussion template could be used in other settings, such as industrial, performing arts, military, hospital, secondary school, or collegiate settings. The development of similar educational materials to improve patient understanding of other elements of concussion treatment and rehabilitation plans can also be replicated by other institutions.

The evaluation and management of concussion has changed markedly in the past several years, and with our increased understanding of the effectiveness of active rehabilitation and treatment plans, we can expect these changes to continue. Active and targeted rehabilitation strategies, such as vestibular and oculomotor rehabilitation and pharmacological interventions, have emerging evidence supporting their use.[8] The use of quality improvement processes to evaluate the concussion protocols of an institution or individual clinician is an important way to ensure contemporary practice and the provision of evidence-informed patient care. Further, continuously evaluating aspects of concussion management using PDSA cycles can help clinicians effect small changes over short periods to ease implementation burden. For this particular project, our focus was on simple changes to the educational materials provided to patients regarding their treatment plans; however, quality improvement strategies have also been used for the treatment of concussion to improve management of academic considerations[9] and to ensure patients are provided education about driving.[10] To evaluate potential gaps in protocols, clinicians should review their concussion protocols annually and when

updated consensus or position statements are published. A quality improvement process can then be initiated for implementation of those changes.

CONCLUSION

From a team approach perspective, miscommunication and lack of documentation for a patients with concussion may be detrimental to patient care. Since concussion patients are often treated by more than one healthcare professional, it is imperative that all healthcare professionals communicate with each other about the patient's rehabilitation and treatment plan and, perhaps more importantly, that patients understand their follow-up care plans. This quality improvement project showed that modifications to the EMR to capture symptom clusters and assign symptom profiles and that revision of patient educational materials were effective improvements for concussion care.

Utilizing a multidisciplinary approach and having effective communication among athletic trainers, coaches, and parents will ensure the patient's concussion rehabilitation and treatment plans are implemented as prescribed. For athletic trainers in states that allow them to treat concussions on their own, symptom concussion profiles can be used to drive the treatment plans for each individual patient. Further, the concussion symptom profiles, and individualized treatment approach allow the patient to visualize their plan and helps them create short-term goals for each therapy session. Importantly, these goals can be shared and viewed by other healthcare professionals on the patient's treatment team. Using concussion symptom profiles as a part of the SRC treatment plan can also guide athletic trainers when deciding whether it is appropriate to refer patients to specialty providers. Ultimately, a quality improvement approach is ideal because it allows clinicians to evaluate their protocols in relation to best practice documents and emerging evidence and to implement small changes for evaluation of outcomes in their specific setting.

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