



The Qualitative Investigation into Current Return-to-Activity Protocols, Persistent Effects, and the Perceived Feasibility of Exercise Interventions in Individuals Who have Sustained a Concussion

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Abstract

Individuals who sustain a concussion typically follow a return-to-activity protocol outlined in the Consensus Statement on Concussion in Sport. However, research indicates that many individuals are at an increased risk of musculoskeletal injury and physical disability in the months and years following a concussion. There is a possibility that current return-to-activity protocols do not adequately identify and rehabilitate biomechanical changes resulting from a concussion. Therefore, this study aims to qualitatively examine the current state of return-to-activity protocols among athletic trainers, investigate whether athletic trainers have observed athletes continuing to experience negative effects related to their concussion, and gain insight into the feasibility of a post-concussion exercise intervention. Ten athletic trainers participated in this study: six reported practicing at the collegiate level, and four reported practicing at the secondary school level. The qualitative data analysis revealed the following themes: 1) athletic trainers are staying updated with international concussion recommendations, 2) athletic trainers are increasing return-to-activity protocol compliance through a multifaceted approach, 3) athletic trainers report patient compliance frustrations as the leading challenges to the return-to-activity protocol, 4) athletic trainers focus on returning athletes to successfully completing activities of daily living, not just returning to competition, 5) athletic trainers are noting a variety of lingering negative effects, 6) athletic trainers recognize the importance of an individualized exercise intervention, and 7) athletic trainers anticipate similar setbacks from an exercise intervention as they currently have during return-to-activity progression. These findings indicate that athletic trainers are staying informed about international recommendations and believe that recommendations for individualized exercise interventions are necessary to reduce the risk of concussion-related musculoskeletal injuries and physical disabilities later in life.

KeyWords: Athletic Trainers; Evidence-Based Practice; Exercise; Interview; Traumatic Brain Injury

Introduction

Over 30 million cases of traumatic brain injuries are reported globally each year, with the United States accounting for three to four million of total cases [1, 2]. A mild traumatic brain injury (mTBI), also known as a concussion, is caused by a sudden blow or external force to the head that results in altered brain function physically, cognitively, and behaviorally [3]. Commonly associated signs and symptoms include headache, migraine, nausea, anxiety, depression, balance disturbances, and sleep disturbances [3]. Although many individuals recover from concussion with rest and a gradual return to activity [3], over half of patients diagnosed with a concussion experience prolonged symptoms even after medical clearance [1, 4]. Due to the individualization of concussion-related symptoms, a rigid guideline approach to concussion management may be challenging to target individual signs and symptoms [3].

Previous concussion protocols took a passive recovery approach; this involved patients resting until symptoms subsided, followed by a gradual return to activity [5]. The current *Concussion Statement on Concussion in Sport—6th Edition* has recommended introducing aerobic activity that can mildly increase symptoms in the early stages of the return-to-activity protocol [3, 6]. While the current standard of return-to-activity protocols does allow for aerobic physical activity, it still lacks the ability to identify and rehabilitate biomechanical alterations that may be placing individuals who sustained a concussion at a greater risk of musculoskeletal injury, dexterity limitations, and physical disability [3, 5, 7-11]. The modified Balance Error Scoring System (mBESS) loses its ability to detect balance errors after 72 hours following concussion [12]. The tandem gait test does have better sensitivity and specificity than the mBESS; however, it only uses time to complete as the outcome, with no scoring of biomechanical errors or alterations [13, 14].

It is reasonable to speculate that the current approach is what has potentially led to over half of patients experiencing prolonged concussion symptoms and could be why individuals are at a greater risk of musculoskeletal injury [4, 8]. It has been shown that

individuals who sustained a concussion are at a 45% increased risk of lower extremity musculoskeletal injury, and 50.6% developed osteoarthritis before age 55 years old [10]. While there are tests like the Buffalo Concussion Treadmill test to understand exercise tolerance after concussion, there is a lack of specific interventions to prevent concussion-related musculoskeletal injury and later in life physical disability [15].

Given this knowledge gap, we conducted a qualitative research study aimed at understanding athletic trainers' (ATs) insights on current return-to-activity protocols, exploring their perceptions of persistent concussion-related effects, and assessing the feasibility of an exercise intervention. Our primary research questions guiding this study are: 1) What is the current state of return-to-activity protocols in concussion recovery? 2) What lingering effects have ATs observed in patients with concussions? 3) What factors should be considered for a potential exercise intervention? Hypotheses are excluded to minimize researcher bias and maintain the inductive nature of qualitative analyses. This research is significant because the feedback gathered regarding a potential exercise intervention will lead to fewer patients experiencing lingering symptoms and will help prevent the historical tendency in rehabilitation medicine to conduct clinical trials prematurely [16].

Materials and Methods

Participants

Athletic trainers often work with concussed athletes and are integral to making decisions regarding patient care and return-to-activity protocols. This makes them the target population for this study. The specific inclusion criteria for ATs included the requirement to work with individuals who have sustained concussions, hold current licensure (or an equivalent state credential), possess the ability to read and write English fluently, consent to having the interview recorded, and be available to complete a one-hour interview.

Instrumentation

An interview guide for our research questions does not exist. Therefore, we created a semi-structured interview guide based on our primary research questions. A panel of six independent experts, four of whom were ATs who regularly treated individuals with concussion and two of whom who are athletic training educators with knowledge of qualitative methodology, reviewed the interview guide for content validity by assessing each question for relevance and clarity. The experts were asked to rate each question on relevance and clarity. Relevance was scored as 1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, and 4 = relevant. Clarity was scored as 1 = not clear, 2 = somewhat clear, 3 = quite clear, and 4 = very clear. Reviewers were asked to provide feedback on any questions that received a score of 1 or 2 in relevance or clarity. To calculate the content validity index, we counted the number of experts who rated a question as a 3 or 4 for relevance and divided that by the total number of experts [17, 18]. We repeated the procedures for clarity; 0.78 is considered an acceptable content validity index score [18]. For all questions that scored below 0.78, the research team reviewed the feedback and revised the questions. The expert panel was then asked to evaluate the interview guide again with the updated questions. This process continued until each question achieved a score of at least 0.78 in relevance and clarity. The questions included in the study were averaged and received scores of 0.96 for relevance and 0.91 for clarity. The final version of the interview guide can be found in Appendix A.

Procedures

Northern Illinois University Institutional Review Board approved all study-related procedures (HS24-0113). Athletic trainers were recruited to participate in the study through direct communication from members of the research team and referral from participants to the study. Potential participants were provided with a link to an online survey (Qualtrics, Provo, UT, USA), which described the study, participant tasks, overall purpose, risks and benefits, confidentiality

procedures, and their rights in participating in the study. Participant then provided their electronic consent to participate in the study. Participants who agreed to participate in the study scheduled a time to meet with a member of the research team via Zoom (Zoom Video Communications, Inc., San Jose, CA, USA). Participants completed the semi-structured interview based on the validated interview guide, as seen in Appendix A [18]. The semi-structured nature allowed the researcher who conducted the interview the flexibility to ask follow-up questions to glean robust answers. Each interview took 30 – 60 minutes to complete. Zoom recorded and transcribed the video transcript, participants then reviewed their transcript to verify their accuracy as a member check.

Statistical Analysis

We implemented a phenomenological approach to analyze the qualitative data through Colaizzi's method to limit research bias during the interview and interpretation [19]. Participant responses during the semi-structured interview were transcribed. To enhance the credibility and trustworthiness of the qualitative analysis, both member checking and data triangulation were employed. For triangulation, three research team members (JP, NEG, TAW) independently and systematically engaged with the interview transcripts by reading and re-reading them to ensure familiarity with the data. Each team member independently identified and extracted significant statements relevant to the investigated phenomenon from each transcript. To strengthen inter-rater reliability, the researchers independently analyzed the extracted statements and assigned qualitative meanings to them. Themes were then developed from these meanings through an iterative and comparative process. Following individual analyses, the research team met to discuss and compare their interpretations, resolve discrepancies through consensus, and refine the thematic framework collaboratively. These finalized themes are supported by representative participant statements, which are presented in the Results section below. Finally, the team compiled an exhaustive list of meanings and themes, which was jointly reviewed and summarized to ensure analytic consistency and depth.

Results

In total, 10 ATs participated in this study. Six reported practicing at the collegiate level, and four reported practicing at the secondary school level. The following themes emerged from the interviews guided by research questions.

Addressing Current Return-to-Activity Protocols

Our first research question addressed the current state of return-to-activity protocols in concussion recovery and yielded four themes. The first theme was that ATs are staying updated with international concussion recommendations. A female collegiate athletic trainer stated, "We have a five-step protocol. It doesn't mean five days. It just means five steps. Sometimes we're able to push it a little bit more or quicker." Another collegiate athletic trainer explained, "If they have what we consider mild symptoms and they can tolerate active rehabilitation (walking, easy bike, mental/cognitive [effort]), they're allowed to do that when their symptoms are mild, as long as nothing's exacerbating their symptoms." A female secondary school athletic trainer stated, "We do daily checks with a Sports Concussion Assessment Tool or a Sports Concussion Office Assessment Tool 6. We have a pre return to play, which is like the stage 0, 1, and 2. The return to play, starts at stages 3 and 4. In those initial phase [the patients] are allowed to start activity like light aerobic activity before they're symptom free."

The second theme was that ATs are increasing return-to-activity protocol compliance through a multifaceted approach. A male secondary school athletic trainer explained, "We have the support of coaches and nurses...the school nurses...help us make sure things are getting done." A male collegiate athletic trainer their institution uses "Baseline SCAT and baseline IMPACT. [...] Once they clear the IMPACT and [are] within normal limits of their symptoms score..."

they [can] complete the full return to play [under] our physician's guidance." A female collegiate athletic trainer further elaborated, "The coaches know what [the patients] are doing. Everyone is on the same page. We are communicating, but I think the biggest piece is education for [all parties]."

The third theme was that ATs report patient compliance frustrations as the leading challenges to the return-to-activity protocol. A female secondary school athletic trainer said, "I've also had challenges with kids having recurrent symptoms show up during their return to activity or somewhere during their return to play protocol." A female collegiate athletic trainer elaborated that "They [patients] are not necessarily going to go back to being 100, which I think is another big [aspect] with like concussions is that there's an assumption of oh, 'I'm going to be 100, or I'm going to be back to normal'. But for some people...they can have those long-term [symptoms] like headaches or concentration issues...there's a lot of things that can go long term that makes a new normal hard to grasp." A female collegiate athletic trainer went on to say, "I think one challenge is just getting honesty out of the patients to come to terms with experiencing symptoms in the middle of [the return to play protocol]. They are afraid that they are going to have a setback and not be able to go back to competition by the next game, or whatever their next event may be."

The fourth theme was that ATs focus on returning athletes to successfully completing activities of daily living, not just returning to competition. A male collegiate athletic trainer explained, "Whether or not they can get back to not only performing, but also the day to day life stuff, so that they do not have any lingering effects." A female collegiate athletic trainer then stated, "I would say a successful recovery from concussion is getting the patient back to their baseline scores and back to class and participating in sport without exactly exacerbating symptoms daily." A male collegiate athletic trainer also stated, "I would say returning to everyday activity is the big one that I try to stress with my athletes. They are here to play sports, but they are also human beings with lives and goals outside of their sports."

Lingering Effects After Concussion

Our second research question outlined the lingering effects of concussion. The overarching theme was how ATs are noting a variety of lingering negative effects. A female secondary school athletic trainer said, "If they've missed more than like a week to 10 days, their fitness level tends to be down and then trying to play, catch up and find their way back into the lineup can be probably the biggest setback I've seen." A different female collegiate athletic trainer elaborated that, "If their proprioception is still not great, they'll sprain their ankle when they're running down the trail. Or you see some quadriceps or hamstring strain is typically the biggest thing that I see." A male collegiate athletic trainer explained, "I would say coordination [remains altered] I have noticed some ball handling changes, or it takes time to get back to the ball handling skills they had before the concussion." A female collegiate athletic trainer also elaborated, "If the athlete's proprioception is still not great, they will sprain their ankle when they are running... or I have seen some sort of quadriceps or hamstring strain after concussion."

Feasibility of an Exercise Intervention

Our third research question gained insight into the feasibility of a post-concussion exercise intervention for individuals who sustain a concussion and yielded two themes. The first theme was that ATs recognize the importance of an individualized exercise intervention. A female secondary school athletic trainer explained that "No [intervention for] more than like 10 or 15 min a day depending on symptoms. That's the biggest thing for concussions is like, if it aggravates their symptoms, you can't push it." A female collegiate athletic trainer stated, "I feel like the biggest piece there [for vestibular components] is the duration as long as they're symptomatic in terms of overall treatment. Is it a week, or is it 2 weeks? It's until symptoms resolve." A male secondary school athletic trainer further elaborated,

"After a concussion, gradual always is going to be best. So, whether it's something that spans a week or a couple of weeks, just gradually increasing [intensity]. For example, I would have athletes just lift weights and adjust repetitions or add in advancements of activities to improve coordination."

The second theme was that ATs anticipate similar setbacks from an exercise intervention as they currently have during return-to-activity progression. A female collegiate athletic trainer stated, "An increase in symptoms, meaning they're probably going to be a little more hesitant to want to do the exercises sometimes, if they felt good before, and they're feeling worse after, they might question whether the exercises are necessary." A female secondary school athletic trainer explained, "I think cultural buy-in is a big one. Coach buy-in, athletes continuing to feel like they're missing participation. Feelings of being punished for having a concussion." A male secondary school athletic trainer elaborated, "I think maybe a sense of false hope that they are going to come back sooner than they thought, essentially if they experience an exacerbation in their symptoms."

Discussion

This study aimed to understand the current state of concussion return-to-activity protocols, examine the lingering effects of concussion, and investigate the feasibility of an exercise intervention to decrease post-concussion symptoms. We confirmed how ATs are staying current with current evidence-based practices for concussions. ATs identified several approaches regarding concussion management, and we identified prevalent themes.

ATs are employing evidence-based practices by following the recommendations from the latest International Concussion Consensus Statement, enabling athletes to initiate the protocol before they become asymptomatic [3]. The current state of return-to-activity protocols consist of a five- or six-step process, with the final step being full participation. In this study, collegiate athletic trainers reported using mild symptom exacerbation as a guideline for tolerating progression, including light aerobic activities such as biking.

Athletic trainers are enhancing compliance with return-to-activity protocols through a multifaceted approach that includes collaboration with physicians and school nurses, employing patient education, building rapport with patients, and implementing various diagnostic measures tests [3]. There are several individuals involved in a patient's support network, including the team physician, coaches, school nurse, parents, and teammates. It's important to include external personnel in management discussions, as they can influence the progression of protocols. This progression encompasses a focus on completed activities of daily living, not merely a return to competition. This approach to concussion management promotes patient-centered care by prioritizing athletes as individuals first [3].

The Sports Concussion Assessment Tool (SCAT) was used across our participants. There is still a discrepancy as some ATs utilize the fifth version, and others utilize the sixth. Released in June of 2023, the SCAT-6 is the most recent sports-related concussion assessment with several improved features [3]. First, there is an on-field coordination and ocular/motor screen section. Another new feature is that the patient does not read the symptom score paragraph out loud before reporting symptoms. During the off-field assessment, the SCAT-6 implements new motor control testing: the timed tandem gait test and the dual-task tandem gait test [3]. The single- and dual-task tandem gait tests have shown superior sensitivity and specificity compared to the mBESS alone [13, 14]. The specificity compared to the mBESS alone [13, 14]. The sixth Consensus Statement on Concussion in Sport highlights the urgent need for enhanced research into the determinants of recovery and the enduring neurodegenerative consequences associated with concussive events [3]. In our study, athletic trainers reported that their patients experience lingering signs and symptoms, one of which is changes to proprioception. This

indicates a need for diagnostic tests and rehabilitation protocols to identify and reduce these lingering effects, which may place individuals who have sustained a concussion at greater risk of musculoskeletal injuries, dexterity limitations, and disability.

Athletic trainers identified several key areas to consider in the feasibility of an exercise program following a concussion. They defined a successful outcome of an exercise intervention as one that improves faulty movement patterns resulting from a concussion and alleviates symptoms or reduces lingering effects post-concussion. Athletic trainers emphasize the importance of an individualized exercise intervention. They reported using symptoms on a case-by-case basis to advance patients through the intervention. Initially, frequency and duration should be light, while intensity may vary depending on symptom onset, which could be supplemented by vestibular or dual-task exercises [14, 20]. Vestibular rehabilitation has been shown to reduce symptoms and time to return to activity [20]. The use of dual-tasks or cognitive exercises enhances rehabilitation by allowing clinicians to measure patient abilities post-concussion, simulating sport requirements compared to single tasks [14]. However, ATs anticipate similar setbacks from an exercise intervention as they currently have during return-to-activity progression.

Limitations

This is the first study to qualitatively assess the current state of return-to-activity protocols, examine ATs' perceptions of lingering effects after concussion, and the feasibility of future exercise intervention after concussion. While ATs are at the frontlines of concussion care, input from other healthcare disciplines would benefit the development of an exercise intervention. This study found data saturation within 10 participants; however, repeating these measures to focus on specific settings (i.e., secondary school and college) would help inform more specific interventions that could be utilized at each setting.

Clinical Implications

The results of this study identify how ATs are integral to concussion management and care. This study shows the importance of staying up to date with research evidence and international recommendations. Athletic trainers should identify how to best adapt the evolving guidelines based upon the demands of their setting to improve patient care. Furthermore, this study qualitatively captured ATs experience with lingering effects after concussion. Previous work has only captured this quantitatively with research-grade equipment [13]. Athletic trainers can utilize this information to evaluate movement post-concussion and identify deficits for improvement through physical rehabilitation. Finally, the current research emphasizes the importance of individualized approaches in the current return-to-activity protocol and future exercise interventions. This information can be utilized by researchers and ATs to adapt physical rehabilitation and motor control principles to this population to identify and implement patient-centered concussion management plans and improve quality of life.

Future Research

The results of this study will be utilized as the foundation for future clinical trials. It is important that the feasibility was established prior to the clinical trial to prevent the historical tendency in rehabilitation medicine to conduct clinical trials prematurely [16]. The next steps will include establishing the efficacy of an exercise intervention to decrease the concussion-related risk of musculoskeletal injury risk, dexterity limitations, and physical disability. The proposed intervention would include a symptom-based progression incorporating vestibular rehabilitation, graduated aerobic activity, and dual-task protocols.

Conclusion

Athletic trainers are staying up to date with contemporary evidence-based international concussion guidelines. The current state of return-

to-activity protocols relies on patient education, interdisciplinary collaboration, and individualized symptom progression, along with identifying lingering effects. Considerations for a future exercise intervention involve a symptom-based progression incorporating vestibular rehabilitation, gradual aerobic activity, and dual-task protocols. Future research should include longitudinal interventional studies to establish the efficacy of utilizing an exercise intervention for post-concussion care to manage symptoms and result in better patient outcomes.

Competing Interests: The Authors have no competing interests to disclose.

List of Abbreviations

- Mild traumatic brain injury (mTBI)
- Modified Balance Error Scoring System (mBESS)

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Appendix A: Semi-Structured Interview Guide

Introduction

The interview will last 30-60 minutes. It will explore three main areas: the current state of return-to-activity protocols in concussion recovery, observed lingering effects of concussion, and aspects to consider for a potential exercise intervention that takes place after a patient is cleared to return to activity.

Thank you for providing us with your return to activity protocol. To begin, we would like to ask you some questions about it.

***Prompts and Probes**

1. Please describe your standard return-to-activity protocol following concussion.
2. What do you believe enables your current return-to-activity protocol?
3. What challenges, if any, do patients encounter during your current return-to-activity protocol?
4. Please describe any testing or measures you use to determine when an individual who sustained a no longer needs your care.
5. Please describe what would be considered a successful recovery from concussion?

Now, I would like to ask you about some potential lingering effects your patients may experience from concussion.

1. Please describe the setbacks, if any, your patients have experienced after being cleared to return to activity?
2. Describe for me what physical problems, such as musculoskeletal injuries, that your patients may have experienced after concussion, if any.
3. What treatment, if any, did your patients receive for these physical problems?

Lastly, I would like to ask you some questions about aspects you believe should be considered for an exercise intervention to be implemented in individuals who sustain a concussion.

***Exercise intervention definition: a series of exercises to correct movement alterations related to concussion.**

6. Please describe what exercises you believe would be beneficial to a concussion exercise intervention.
7. Please describe what frequency, intensity, and duration you believe a concussion exercise intervention should have.
8. Please describe what challenges you believe patients could face while engaging in a concussion exercise intervention.
9. Please describe what you believe would be considered a successful outcome of a concussion exercise intervention.
10. Please describe any anticipated setbacks you believe a patient may experience with a concussion exercise intervention.