Clarifying the Role of the Strength and Conditioning Coach in Athlete Rehabilitation

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Declaration

Form MAS8:
Declaration of Thesis Being Own Work

Otago Polytechnic

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I, Andrew Stewart Lloyd Armstrong
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Abstract

Strength and conditioning (S&C) coaches are assumed as performance professionals, but S&C may be utilised in athlete rehabilitation. Some S&C coaches collaborate with physiotherapists in athlete rehabilitation. The role of S&C coaches in athlete rehabilitation has been poorly documented. Therefore, this thesis aimed to clarify the role of S&C coaches in athlete rehabilitation using current literature and the perspectives of physiotherapists and S&C coaches.

Firstly, a narrative literature review on the roles involved in athlete rehabilitation helped to theorise a role for S&C coaches. Current literature highlights a gap in performance training at the end of athlete rehabilitation that S&C coaches could fill.

Secondly, semi-structured interviews were conducted in New Zealand (NZ) with four physiotherapists, four S&C coaches and one S&C coach with a physiotherapy background. A thematic analysis of the interview data identified thirteen themes that were analysed in four categories. These themes in their respective categories were: Current role (teamwork with the rehabilitation team, level of involvement, and physical roles), proposed role (teamwork with the rehabilitation team, level of involvement, and physical roles), variables (rehabilitation team structure, governance, relationships in the rehabilitation team, and the athlete), and significance (positive and negative).

The theorised role from the literature is similar to the current perceived role of S&C coaches in athlete rehabilitation. Most S&C coaches seem to have a small role in the end stages of athlete rehabilitation and take over from physiotherapists to provide performance training. Participants thought that S&C coaches should have a much greater role than this. Participants thought that S&C coaches can provide

performance context throughout the athlete rehabilitation process, but poor communication and collaboration with health professionals reduces their role. Participants thought S&C coaches should be minimally involved following a health professional's diagnosis. Their involvement should then increase as athlete function improves and the physiotherapist's role decreases. Their most significant involvement would be in performance training. Participants agreed that the S&C coach's role should be flexible and account for the context of rehabilitation and their own personal skillset.

Acknowledgements

First, I offer my gratitude to all individuals who participated in this research and shared their experiences and insight into the role of strength and conditioning coaches in athlete rehabilitation.

I would like to thank I would like to thank the Institute of Sport, Exercise & Health at Otago Polytechnic and my primary supervisor Simon Body for allowing me to enter the field of research and pursue a topic that I feel strongly about. I am thankful for the time you have been able to give me. Our conversations over the last year have spanned much further than the topic of strength and conditioning in rehabilitation. You have helped me mould my ideas in both research but also practically in physiotherapy and performance training.

I would also like to thank my secondary supervisor Dr. Codi Ramsey. Your guidance, both as course coordinator and my secondary supervisor has taught me how to be a researcher and a writer. You helped me take my aggrandised ideas and turn them into a realistic research topic.

I would also like to thank Matt Carrington at Recovery Room physiotherapy, and Brent Matehaere and the Otago Nuggets for the supporting me to continue working as a physiotherapist while studying. It has been a great opportunity to work with a professional basketball team and be a part of a rehabilitation team with excellent communication and collaboration.

That said, I would like to thank Mike Spencer, Strength and Conditioning coach of the Otago Nuggets and owner of Valley Strength and Conditioning. You and your staff were the first to highlight to me the role of Strength and Conditioning coaches in rehabilitation. Through this I have seen the benefits that S&C coaches can provide to

rehabilitating athletes and some of the barriers that they come across in providing this role. Without this, I may not have started this research.

I would like to thank my partner, Emily. Your support has helped me juggle work, life, and study. You are my best friend and at many times my personal therapist. Thank you for being you and helping me stay me.

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Table of Contents

Table of Figures

Table of Tables

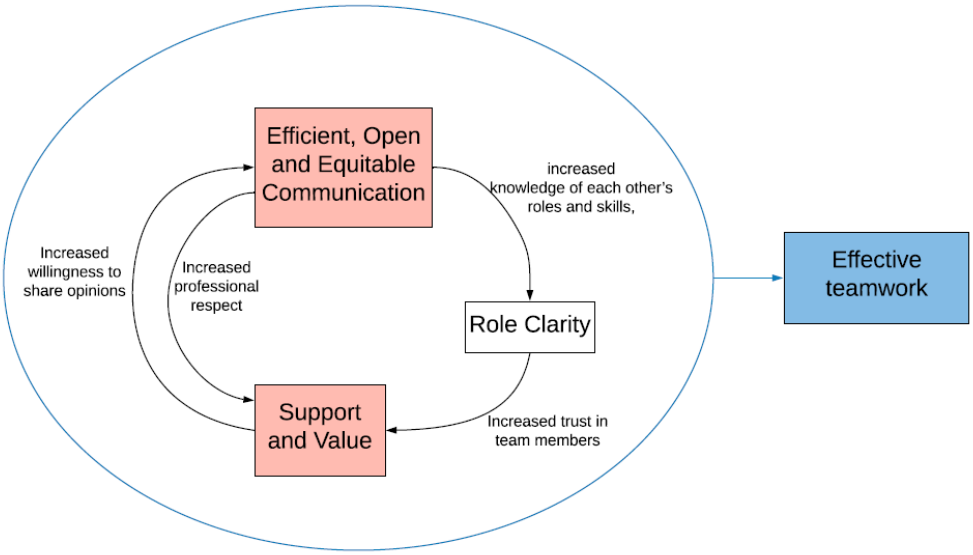
Chapter 1: Introduction

Role Clarity

Role clarity is a key determinant of communication quality in an interprofessional healthcare team (Almost et al., 2016; Atwal, 2002; Sims et al., 2015b; World Health Organisation, 2011) and is perceived by health professionals as important for collaboration (M. L. Jones, 2005; Suter et al., 2009). 'Role clarity' was identified in series of four articles by Sims et al. as a context that influences multiple mechanisms (i.e. support and value, collaboration and coordination and role blurring) in teamwork and improved as a result of 'efficient, open and equitable communication' between members of the team (Hewitt et al., 2014, 2015; Sims et al., 2015a, 2015b). Role clarity is, therefore, a key component in a feedback loop of mechanisms that result in effective teamwork (Figure 1).

Figure 1

The role clarity teamwork loop



(adapted from Sims et al., 2014, 2015)

In a sports setting, Strength and Conditioning (S&C) coaches and physiotherapists along with other healthcare professionals (e.g. physicians or athletic trainers) and performance trainers (e.g. the head coach) often make up the 'team behind the team', aiming to ensure athletes are prepared to play and return to sport (RTS) after injury, respectively. On paper, segregating the roles of the S&C coach and physiotherapist may seem straightforward. However, both professional groups often possess required and supplementary skills that enhance athlete training before and/or after injury. Conversely, some scenarios may be outside the scope of the S&C coach or physiotherapist, requiring input from the other. This means that physiotherapists and S&C coaches could work side by side, rather than consecutively, during athlete training and rehabilitation to enhance the athlete health outcome.

Physiotherapists have a defined role in performance enhancement (Bulley et al., 2004; Physiotherapy Board of New Zealand, 2018), but the scope of strength and conditioning is ill-defined in the area of rehabilitation, so it is hard to say how the S&C coach should be involved in rehabilitation. Currently, it is generally agreed that S&C coaches have a role in injury prevention (Talpey & Siesmaa, 2017; Triplett et al., 2017) and engagement with athletes and health professionals in the late stage of rehabilitation (ASCA, 2016; Bomgardner, 2001; Kleiner et al., 1996; Sousa, 2019). Similar to S&C coaches, physiotherapists provide a whole range of services such as injury prevention, acute intervention, rehabilitation, performance enhancement, and promotion of a safe, active lifestyle (Bulley et al., 2004). A few of these roles, such a performance training, overlap with the roles of an S&C coach (Triplett et al., 2017), so the role sharing during performance training can be determined. However, the

dearth of information on the S&C coaches' role in rehabilitation makes it is hard to decide which, when and how roles should be shared during rehabilitation.

Communication may act as a barrier to collaboration between physiotherapists and S&C coaches. Physiotherapists are trained in interprofessional communication and collaboration with other healthcare professionals, but they may not think communicate health information to S&C coaches unless the patient asks them, or they are in a high-performance sports team. This lack of communication may restrict the athlete's continuity of care (Sims et al., 2015b).

Improving the clarity of S&C coach's roles in athlete rehabilitation could enhance collaboration and communication between the healthcare team and the sport performance team leading to greater continuity of care (Almost et al., 2016; Atwal, 2002; M. L. Jones, 2005; Sims et al., 2015b; Suter et al., 2009; World Health Organisation, 2011).

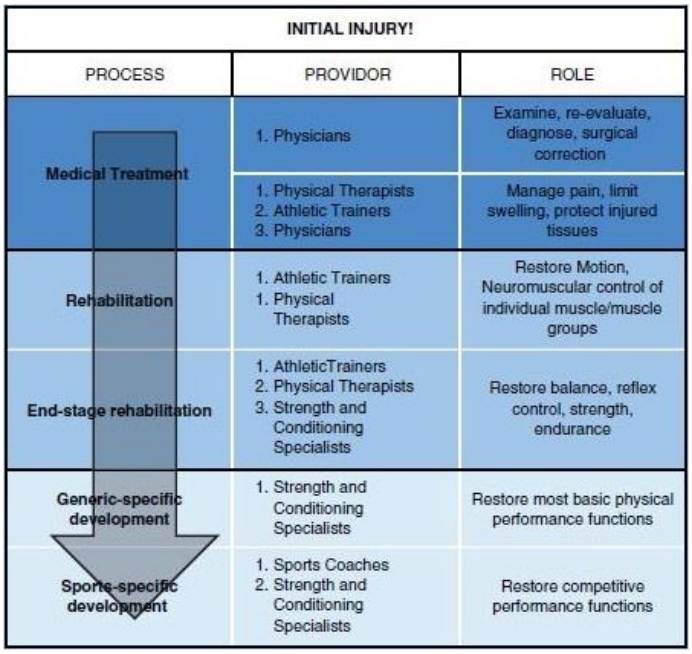
The Link between Medical and Performance Rehabilitation

The transition from medical to performance rehabilitation could be improved if there was more clarity in the role of the S&C coach. This would result in improved teamwork and better patient outcomes (Almost et al., 2016; Epstein, 2014; Sims et al., 2015b; Suter et al., 2009).

The S&C coach and physiotherapist provide a vital link between the medical and performance stages of athlete rehabilitation. In NZ, the physiotherapist acts as the final point of contact for athletes in healthcare before progressing to performance rehabilitation, where the S&C coach is often the primary facilitator.

Figure 2

The process of care for an athlete who is returning to play, with different providers and roles

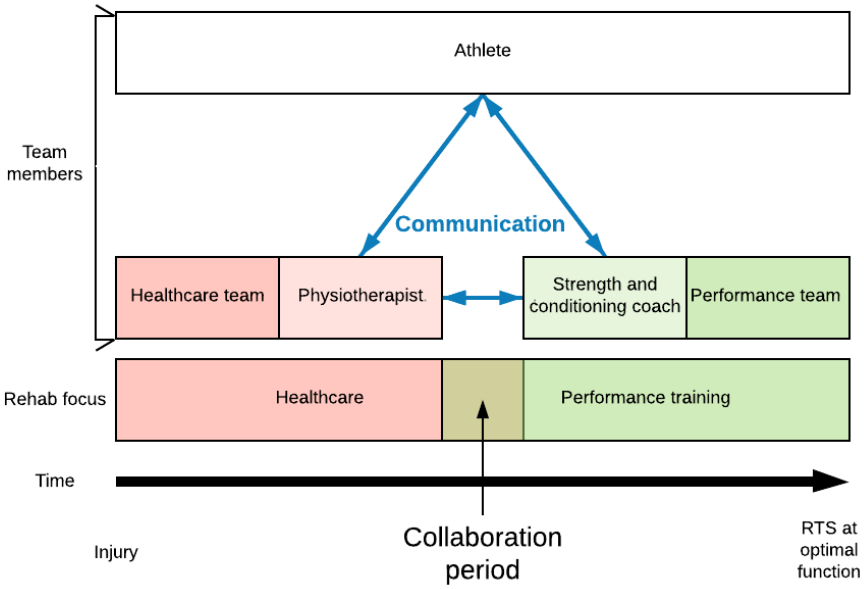


(W. Kraemer et al., 2009)

Good communication between these two professional groups and the athlete would lead to a period of collaboration where rehabilitation roles are shared or allocated to either group (see Figure 3). Coach-practitioner communication is not always ideal, and this may lead to poor patient outcomes (Ekstrand et al., 2019; Podlog & Eklund, 2007). Communication seems to be poorer between physiotherapists and S&C coaches than communication within the medical team (Ekstrand et al., 2019). This could weaken the link between the medical and performance stages of athlete rehabilitation and disrupt the continuity of care (Kripalani et al., 2007; Price & Lau, 2013).

Figure 3

The collaboration period of athlete rehabilitation



Theoretically, the athlete should be progressively phased into performance-related training and sport-specific training as they become more medically fit (Figure 2; W. Kraemer et al., 2009). S&C coaches are well prepared to take care of the athlete's physical and psychological needs in the later stages of rehabilitation (Judge et al., 2012; Kleiner et al., 1996; W. Kraemer et al., 2009; Rees & Hardy, 2000; Robbins & Rosenfeld, 2001; Wittwer, 1997). However, if communication and role clarity are poor, then the transition from healthcare to performance rehabilitation will be impaired, leading to suboptimal rehabilitation, delayed RTS and injury recurrence (Brandon & Lamboni, 1996; Ekstrand et al., 2019).

Clearly defined roles of the S&C coach in athlete rehabilitation are needed to improve the working relationships between physiotherapists and S&C coaches (Mafuba et al., 2015; Sims et al., 2015b). Insight into the perspectives of physiotherapists and S&C coaches on the role of the S&C coach in the rehabilitation process will help improve teamwork by improving role clarity (Almost et al., 2016; Atwal, 2002; Sims et al., 2015b; World Health Organisation, 2011). Consequently, the link in the recovery process and communication between the healthcare and performance teams will be strengthened.

Thesis Layout

Chapter 2: Literature Review

The literature review of this thesis is split into two parts: a literature review and a hypothesis section (piece). The literature review explores the role of the rehabilitation team in athlete rehabilitation. The hypothesis section explores articles that describe the roles of sports rehabilitation team members to highlight areas that S&C coaches can work in athlete rehabilitation.

Chapter 3: The Perceived Role of the S&C Coach

This section of the thesis studies the perspectives of both S&C coaches and physiotherapists on the role of S&C coaches in athlete rehabilitation by conducting semi-structured interviews. These interviews addressed four key topics:

1. The S&C coach’s current role in athlete rehabilitation
2. A proposed role for S&C coaches in future
3. The variables that affect the role
4. The significance of the role

Chapter 4: Discussion

The discussion chapter summarises and clarifies the role of an S&C coach. In the discussion section, the information from the literature review is compared with the perspectives of both S&C coaches and physiotherapists from chapter 3. The challenges that S&C coaches may face while starting to work in athletic rehabilitation and how they may operate practically is also discussed in this section.

Format

Chapter three of this thesis has been published in the NZ Journal of Physiotherapy (NZJP). As such, the thesis has been formatted to be consistent with the style of this journal.

Ethical Considerations

An ethics application was completed in with consideration to the “World Medical Association declaration of Helsinki: Ethical principles for medical research involving human subjects” (2013). This was approved by the Otago Polytechnic Research Ethics committee (Appendix A: Ethics Approval

Chapter 2: Literature Review

The S&C coach's knowledge and skills may benefit the medical rehabilitation team, but only a few studies have explored the role of a S&C coach in athletic rehabilitation. S&C coaches use performance training to enhance the physical capabilities of athletes and help them meet performance goals in their sport (ASCA, 2020; Hartshorn et al., 2016; Triplett et al., 2017). In NZ, most healthcare professionals do not study performance training, and therefore, many injured athletes are rehabilitated in medical terms (medical rehabilitation) but may not have been restored to their pre-injury level of sports performance (performance rehabilitation). This may expose them to injury recurrence (Freckleton & Pizzari, 2013; Gabbett & Domrow, 2005; Whittaker et al., 2015). S&C coaches can provide performance training to injured athletes and help link medical and performance rehabilitation if they are included in athlete rehabilitation teams. To understand the role of the S&C coach in athlete rehabilitation, the current literature on athlete rehabilitation and the S&C coach must be explored.

Systematic Literature Search

Initially, a systematic search of the literature was conducted with the assistance of a subject librarian on the databases: PubMed, Scopus, CINAHL, SPORTDiscus and PEDro. The databases were searched using the following search terms and Boolean operators: ("strength and conditioning" AND "athlete" AND "rehab*"). The search resulted in 127 articles across the five databases and 87 articles upon removing duplicates. Articles were included if they contained information on the roles of strength and conditioning coaches in any athlete rehabilitation setting. Of the articles screened in the search, a narrative review of the athlete recovery process in the

United States of America (USA) by W. Kraemer et al. (2009) was the only study that suggested a model for the S&C coach and other professional's roles in athlete rehabilitation.

The model of athlete rehabilitation in the USA suggested by W. Kraemer et al. (2009) may be adapted to suit athlete rehabilitation in NZ. However, there are subtle differences between the roles of health professionals in NZ and the USA. A key difference is that NZ does not have athletic trainers and physical therapist differ somewhat to physiotherapists. Therefore, physiotherapists in NZ perform many of the roles that both physical therapists and athletic trainers do in the USA. Practising physiotherapists in NZ may not have the same background in sports as athletic trainers in USA and may not perform some of the sport-specific roles of an athletic trainer. Therefore, to highlight these differences, North American and Canadian based practitioners will be referred to as 'physical therapists' and NZ based practitioners will be referred to as 'physiotherapists'.

W. Kraemer et al. (2009) suggests a stepwise format for rehabilitation (Figure 2). The S&C coach, physical therapist, and athletic trainer work together in end-stage rehabilitation and then the athlete is handed over to the strength and conditioning coach for performance rehabilitation before RTS. The article provides a theoretical framework for the role of the strength and conditioning coach in athlete rehabilitation, but it does not go into depth on the benefits of a healthcare team or the roles of each provider in an athlete rehabilitation team. Each team member's roles must be clearly understood in an effective rehabilitation team (Almost et al., 2016; Atwal, 2002; S. Nancarrow, 2004).

Physiotherapists and S&C coaches could combine to share the roles of an athletic trainer. S&C coaches in NZ share the same scope of practice as S&C coaches in the USA. They have excellent knowledge of sports performance but little medical knowledge. Physiotherapists can attend to the medical rehabilitation and S&C coaches could provide performance rehabilitation. This would make the transition from medical to performance rehabilitation smoother.

Aims of the Review

The following section will review existing literature on the role of an S&C coach with three aims:

Aim 1: Review the importance of the healthcare team in athletic rehabilitation

Aim 2: Review the roles of a doctor, physiotherapist and athletic trainer in athletic rehabilitation

Aim 3: Review the role of an S&C coach in athletic rehabilitation and develop a theoretical description of their role in athletic rehabilitation.

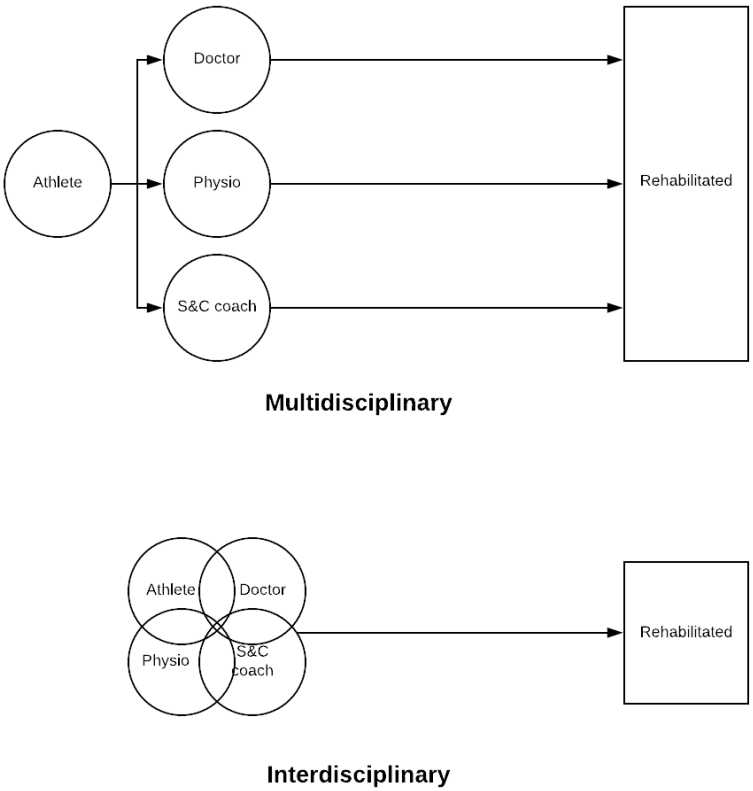
Teamwork in Athlete Rehabilitation

Teamwork is the range of behavioural processes utilised by team members to combine their resources towards a common goal (LePine et al., 2008; Marks et al., 2001; Rousseau et al., 2006). A realist series of 4 articles by Hewitt et al. (Hewitt et al., 2014, 2015; Sims et al., 2015b, 2015a) describes 13 key mechanisms of teamwork: Support and value, collaboration and coordination, pooling of resources, individual learning, role blurring, efficient, open and equitable communication, tactical communication, shared responsibility and influence, team behavioural norms, shared purpose, critical reflection, innovation and leadership.

Healthcare teams are comprised of two or more health providers (e.g. doctors, nurses, physiotherapists, occupational therapists) and may also include other people involved in a patient's healthcare (e.g. the patient, family, administrative staff, health service managers; Chamberlain-Salaun et al., 2013). Multidisciplinary – working in series or parallel, often in separate clinics, with clear and separate roles – or interdisciplinary – working in close proximity, collaborating as one collective unit. Team members such as nurses, physiotherapists, chiropractors, surgeons and general practitioners (GP) work together to improve the health outcome for a common patient (Chamberlain-Salaun et al., 2013; Körner, 2010; Figure 2).

Figure 4

Interdisciplinary and multidisciplinary healthcare teams



Why are Healthcare Teams Important?

Healthcare teams have been shown to benefit the team members (healthcare providers and their patients (Hewitt et al., 2014, 2015; Sims et al., 2015a, 2015b). Healthcare teams may benefit healthcare providers by providing the opportunity for professional development and improving the working environment (Hewitt et al., 2014, 2015; Sims et al., 2015a, 2015b). Patients may benefit from healthcare teams through improved health outcomes and safety (Manser, 2009; Reader et al., 2009; Salas et al., 2007; Schmutz & Manser, 2013). As a result of teamwork, continuity of care develops, which is beneficial to healthcare providers and their patients (Baggs & Schmitt, 1997; Baxter & Brumfitt, 2008; Kvarnström, 2008; Oishi et al., 2003; Shaw et al., 2008; Wertheimer et al., 2008).

Multidisciplinary Teams

In the context of athlete rehabilitation, a multidisciplinary healthcare team would generally be found in community settings. In community settings, the team members work in different clinics and provide their own separate care working towards the common goal of the athlete's optimal health and RTS. One example of this may be that an athlete is seen by a doctor who diagnoses triages and supplies the athlete with medication. The doctor would contact a physiotherapist through email or phone, and then the physiotherapist would treat the athlete with manual therapy and exercise before passing the athlete over to the performance team before RTS. In this scenario, mechanisms such as 'efficient, open and equitable communication' and 'collaboration' will difficult due to proximity, and this may negatively affect other elements of teamwork such as role clarity, pooling of resources and shared responsibility and influence (Hewitt et al., 2015; Sims et al., 2015b). Therefore,

multidisciplinary team members must develop systems, like communication pathways, for effective teamwork.

Interdisciplinary Teams

Interdisciplinary team members work in close proximity, and so they can communicate and collaborate more easily than multidisciplinary teams (Chamberlain-Salaun et al., 2013; Körner, 2010). Interdisciplinary teams are more common in professional sports settings where all of the healthcare and performance team members work with the athlete in one location. For example, the sports doctor and physiotherapist will be on-site, watching trainings and games and engaging with the S&C and skills coaches. The healthcare and performance members engage in team meetings regularly to discuss players rehabilitation and performance plans. Rehabilitation pathways are less sequential as the athlete engages with all of the professionals at once and receives care based on their needs. Therefore, athletes may engage in some performance rehabilitation at the same time as medical rehabilitation, which will ensure a smooth transition to sport once the athlete is medically fit.

Athlete Rehabilitation Teams

The importance of team-based healthcare is recognised globally; however, there is minimal evidence for teamwork concepts in athlete rehabilitation (Australian Commission on Safety and Quality in Health Care, 2017; Ministry of Health NZ, 2016; United States Department of Health and Human Services, 2019; World Health Organisation, 2010, 2011). Healthcare providers and their patients both receive a range of benefits from effective teamwork, including professional development opportunities and an improved working environment for healthcare providers (Hewitt

et al., 2014, 2015; Sims et al., 2015b, 2015a), improved safety and healthcare outcomes for patients (Manser, 2009; Reader et al., 2009; Salas et al., 2007; Schmutz & Manser, 2013), and better continuity of care, which benefits healthcare providers and their patients (Baggs & Schmitt, 1997; Baxter & Brumfitt, 2008; Kvarnström, 2008; Oishi et al., 2003; Shaw et al., 2008; Wertheimer et al., 2008). This has been demonstrated through a plethora of studies on healthcare teams in a range of settings (e.g. cancer, stroke, mental health, acute care, inpatient and community), but none are specific to athlete rehabilitation (Harris et al., 2013; Hewitt et al., 2014; Sims et al., 2015b, 2015a).

Given the wealth of knowledge on healthcare teams, some areas of research can be generalised to athlete rehabilitation. For example, Clarke (2010) interviewed members of a stroke unit rehabilitation team on teamwork processes. Clarke et al. found that one key element of good interdisciplinary teamwork was 'opportunistic dialogue', whereby open and consistent communication facilitated collective decisions and goals. Opportunistic dialogue required team members to engage in team learning, developing an understanding of each other's roles and creating an inclusive team culture. In this setting co-location of team members helped create the environment for opportunistic dialogue as communication was unplanned. Similarly, professionals in the elite athlete environment are often co-located, making opportunities for opportunistic dialogue more accessible. If these professionals do not have a good understanding of each other's roles and knowledge base, then unplanned communication will be more difficult. In addition, Price & Lau (2013) have shown that provider connectedness is important for continuity of care with family doctors in a community setting. Doctors and physiotherapists must have a good relationship to ensure an injured patient continues to receive rehabilitation through

physiotherapy. Therefore, in a sport setting, the physiotherapist and S&C coach must also have a good relationship for an injured athlete to continue to receive rehabilitation through S&C. If these professionals are not co-located, they may have to make an effort to meet each other in person to understand each other's roles and develop their relationship. Teamwork principles are therefore applied somewhat differently depending on the team setting, but they all aim for the common goal of improving patient outcomes.

Athlete Safety

A lack of teamwork in athlete rehabilitation teams could put athletes at risk of injury recurrence. Patient safety is a key principle of healthcare provision and is prioritised by the WHO (WHO, 2017). Teamwork has been shown to both decrease risk of adverse events and increase patient and caregiver awareness of safety issues (Auerbach et al., 2012; Manser, 2009). In addition, teamwork may enhance patient perceptions of the overall care process, including teamwork, communication and discharge planning (Auerbach et al., 2012). Safety improvements may be as simple as having more people involved in documentation and checklist completion. Porter, Narimasu, Mulroy, & Koehler (2014) showed that, in a surgical setting, if checklists were completed by the whole team, completion was 97% as opposed to 54% by the surgeon alone. These kinds of checks are completed in sport setting informally to make sure athletes are fit to play. If the coaching staff aware of these checks, they may also be able to help make sure the athlete is safe to play. Surgery is perhaps one of the most dramatic settings for a safety error to occur, and a team-based approach to checklist completion places responsibility for errors on the whole team, which may reduce the risk of errors occurring (Fong et al., 2009; Lee, 2010). In a hospital setting the consequences of a mistake could understandably be severe. In

the right sports context, a mistake could be equally dangerous. For example, great care needs to be taken when returning an athlete recovering from a head or neck injury to a contact sport. Teamwork in these settings is crucial.

If athlete rehabilitation teams (i.e. healthcare and performance teams) collaborated on safety protocols, perhaps the risk of adverse events would reduce. For example, if communication between physiotherapists and S&C coaches is inadequate, then performance rehabilitation may begin before an injured athlete is medically fit to do so, exposing them to a risk of a recurrent injury. Better communication between the physiotherapist and S&C coach will ensure that guidelines and protocols are put in place so that the athlete must be medically cleared before performing certain exercises.

A study by Auerbach et al. (2012) introduced health professional safety teams into inpatient general medical units in three hospitals. As each team developed greater patient engagement, their patients felt that doctors and nurses treated them with greater courtesy and respect, listened carefully, and they were better able to understand the information provided to them. Perhaps the improvement in the patients' perceptions of healthcare is due to the more holistic approach that can be supplied by multiple providers working together. Team members, as opposed to individual providers, often value understanding more than just the illness or injury but knowing the patients as people. They can therefore create patient-specific goals based on individual circumstances, thus shifting focus from specific mechanical improvements to more functional improvements and a biopsychosocial model of care (Clarke, 2010; Engel, 1980). In this study, the researchers found that patients and providers were more aware of safety issues within the healthcare team. This increased patient's view that errors may have occurred, but these errors may not

have been identified if both patients and providers were not aware of them. In time, as these errors are addressed, overall safety should improve. This study shows introducing a focus of safety and teamwork could significantly improve outcomes for athletes and their healthcare providers and risk of adverse events.

Simply having a team involved in healthcare is not enough to improve patient safety. In fact, teams with poorer teamwork qualities may have an increased risk of adverse events (Manojlovich & DeCicco, 2007; Manser, 2009), and patients are more likely to perceive that safety errors have occurred (Auerbach et al., 2012). If the physiotherapist and S&C coach took a team-based approach to athlete rehabilitation but had little respect for one another or the safety protocols that have been created, they are unlikely to abide by these protocols. The physiotherapist may disregard the need for performance rehabilitation and allow the athlete to RTS too early, or the S&C coach may engage the athlete in performance rehabilitation too early. In both scenarios the athlete will not be physically prepared for the stresses of exercise and they will be more at risk of injury. If the S&C coach and physiotherapist clearly understand each other's roles they will value each other's role in the team and collaborate on safety protocols (Hewitt et al., 2014), decreasing the athlete's risk of injury recurrence.

Athlete Well-Being

The athlete's mental health, as well as their physical health must be protected during their rehabilitation process. Injured athletes, particularly those with severe injuries and long durations of rehabilitation are more at risk for mental health disorders (Kerr et al., 2021; Kiliç et al., 2018)**.** A key concept in mental healthcare is maintaining continuity of contact (Haggerty et al., 2003). It has been suggested that improved continuity of care may help to the patient's mental state during their rehabilitation

process (Belling et al., 2011; Haggerty et al., 2003)**.** A team approach to athlete rehabilitation can ensure that the athlete has this continuity of care (Haggerty et al., 2003; Kripalani et al., 2007; Price & Lau, 2013). The athlete rehabilitation team can provide the athlete with social support throughout their rehabilitation, providing them with immediate and long-term goals (Haggerty et al., 2003; Lu & Hsu, 2013). This improves the athlete's well-being (Lu & Hsu, 2013) which also improve their chances of a successful return to sport (Ivarsson et al., 2017; Kiliç et al., 2018). A key thing to note here is that this social support does not have to come from the healthcare team. Social support can come from peers, family and the performance team (i.e. coaches and S&C coaches) as well (Lu & Hsu, 2013). Therefore, involving these people into the athlete's rehabilitation process can help to reduce the chances of the athlete developing mental health disorders.

Role Clarity in Healthcare Teams

Improving role clarity in a team may also lead to improved patient outcomes as it leads to better coordination (Duner, 2013; Sims et al., 2015b) and continuity of care (Belling et al., 2011; Freeman et al., 2000; S. Nancarrow, 2004; Willard & Luker, 2007). Roles can be shared amongst the team if these roles are better understood, which aids in the development of interdisciplinary teams (Brown et al., 2000; S. Nancarrow, 2004; Sims et al., 2015b). If a physiotherapist understands the skillset of an S&C coach and vice versa, they may collaborate to ensure that some tasks in athlete rehabilitation are shared. For example, they may both engage in exercise therapy as they both have skills in this area. The physiotherapist must understand the limitations of the S&C coach's knowledge of pathology, and the S&C coach must understand the limitations of physio's knowledge of performance-related exercise prescription. to provide the athlete with the highest quality rehabilitation. If other

professionals (e.g. doctor, head coach, psychologist, nutritionist) also understand each other's roles, an interdisciplinary team may develop. A well-developed interdisciplinary team often results in better patient outcomes and perceptions of care (Baggs et al., 1999; Higginson & Evans, 2010; Kaissi et al., 2003; Wheelan et al., 2003).

Each team members role must be communicated clearly and understood by all members of the team to avoid conflicts on role boundaries (Fear & de Renzie-Brett, 2007; Morrow et al., 2005; Wittenberg-Lyles & Oliver, 2007). If teams pool their resources, continuity of care is developed by improving the team members' knowledge, skills and problem solving and blurring role boundaries so that treatment plans can be more seamlessly integrated (Baggs & Schmitt, 1997; Baxter & Brumfitt, 2008; Kvarnström, 2008; Oishi et al., 2003; Shaw et al., 2008; Wertheimer et al., 2008). Leadership within teams can help to facilitate communication within the team and a shared vision or purpose (Long, 1996; McCallin & Bamford, 2007). A shared purpose creates clearly defined objectives and a mutual commitment to these objectives (Atter, 2008; Edmans, 2001; Freeman et al., 2000; Piquette et al., 2009; Shaw et al., 2008), thereby shaping a self-organising system of healthcare. This not only provides continuity of care but a "circle of care", whereby the patient is directed through their own personalised path to rehabilitation (Haggerty et al., 2003; Price & Lau, 2013). This means the client is always treated by the most experienced member of the healthcare team. If S&C coaches were considered as part of this circle of care, then they could train athletes for RTS earlier, with less risk of injuring them. For example, if an injured athlete engages in performance training throughout a long rehabilitation, they may maintain or improve skills and fitness in their sport. Therefore, they are more likely to be at the required level of performance and fitness

needed to RTS when they are medically fit. This would mean less time at the endo of rehabilitation retraining performance. In addition, maintaining their fitness in other areas (e.g. upper body strength and cardiovascular fitness when you have a lower limb injury) could reduce risk of further injury on their RTS by keeping their loads high enough to avoid acute spikes (Gabbett, 2016). The better we can understand the roles of healthcare providers in rehabilitation teams, the more likely the athlete is to gain this level of care.

Professional Roles in the Athlete Rehabilitation Process: Where Does the Strength and Conditioning Coach Fit in?

Due to the paucity of information on the role of S&C coaches in athlete rehabilitation, this chapter aims to suggest a role based on available literature. Firstly, it will summarise the roles of well-understood healthcare professionals in athlete rehabilitation and identify gaps in this process. Then, it will utilise information already documented in the S&C coach's scope to identify areas where they may be of use in rehabilitation.

Role of the Doctor

The terms "medical practitioner" or "medical doctor" in commonwealth English countries or "physician" in the USA and Canada are umbrella terms that refer to professionals that practice medicine (World Health Organisation, 2008). More commonly, these professionals are simply known as "doctors". When considering the role of the doctor in the athlete rehabilitation process, a distinction must be made between the GP and sports medicine physician (SMP). Their scope of practice differs because SMPs have more training and experience in the sports setting compared to GPs.

General Practitioners

The role of the GP has historically been seen as the first point of contact for patients of all conditions (Foster et al., 2012). Thirty to forty per cent of people who experience musculoskeletal disorders will consult their GP first (Hagen et al., 2000; Picavet & Schouten, 2003). Some of these people will be injured athletes. GP's approaches to musculoskeletal disorders can be categorised as multimodal, low action, and psycho-social/non-opioid (Phelan et al., 2009). More often, GPs will refer for diagnostic tests, refer to medical specialists or physiotherapy, prescribe medication, take no action at all or undergo 'watchful waiting' (Bassols et al., 2002; Feleus et al., 2008, 2009). GPs can identify red flags, address multimorbidity, and refer to the most suitable secondary provider (Foster et al., 2012). There is no evidence to suggest that they are better than secondary providers at identifying red flags, and they are similarly accurate in providing diagnoses (Patel et al., 2011).

Most of the GP's role in management of musculoskeletal disorders can now be performed by secondary providers such as physiotherapists or chiropractors (Foster et al., 2012; Holdsworth & Webster, 2004). In recent years medical students have had more musculoskeletal training than their predecessors (Hose et al., 2017); however, overall, GPs feel, and objectively are, inadequately trained to diagnose and treat musculoskeletal disorders (Day et al., 2007; Day & Yeh, 2008; Matheny et al., 2000; Roberts, 2002; Skelley et al., 2012; Stott et al., 2011), especially sports-related injuries (Jaques & Loosemore, 2012; Pandya & Marino, 2018). For this reason, self-referral to physiotherapy has been well established in many countries (APTA, 2019; Galley, 1977; Holdsworth & Webster, 2004), and some doctors will upskill in the area of sports-related disorders through sports medicine training.

Sports Medicine Physicians

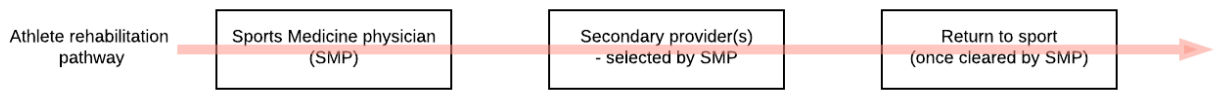
SMPs have more training and experience with sports-related injuries in comparison to GPs. Their scope of practice differs because of their specialisation. SMPs will train for three to four years following their graduation from medical school (Asif et al., 2017; Macleod, 2000; Pigozzi, 2009). The competencies in their training will cover: multiple inpatient and outpatient care settings (e.g. acute management, cardiology, radiology, rehabilitation, orthopaedics, neurology etc.), a variety of sport settings, pre-participation examination, exercise prescription, procedure training (e.g. injections) and interpersonal communication (Hardt & Santos, 2020). In the past, the SMP's role in athlete rehabilitation was seen purely as a legal requirement. SMPs would be there to request imaging, dispense and inject analgesia as required and prescribe medications (Dijkstra & Pollock, 2014). Now SMPs require a thorough understanding of the requirements and demands of the athlete's sport as well as their sport-specific goals to operate effectively (Dijkstra & Pollock, 2014; Hardt & Santos, 2020). SMPs have a broad role in the field of sports healthcare, working to prevent and treat both musculoskeletal and non-musculoskeletal disorders in athletes and active people (Asif et al., 2017; Pigozzi, 2009). SMPs advocate not only for rehabilitation in terms of medical measures (e.g. muscle strength, joint range of motion) but for optimal performance in the sport (Dijkstra & Pollock, 2014).

SMPs are key members of the athletes' team; they must communicate regularly and build relationships with the athlete and performance and medical teams (Fletcher et al., 2017; Ljungqvist et al., 2009; Shrier, 2015). The SMP can be thought of as the athlete rehabilitation coordinator (Figure 2). SMPs provide comprehensive care to athletes, including preparticipation assessments, acute injury management, return to play decisions, facilitation and promotion of exercise as medicine (Asif et al., 2017;

Dijkstra & Pollock, 2014; Hardt & Santos, 2020) and diagnosis of injuries using manual tests and/or imaging (Asif et al., 2017; Callender, 2018; Hardt & Santos, 2020; Macleod, 2000). Following an athletes sports injury, SMPs plan rehabilitation and initiate injury management (Asif et al., 2017; Callender, 2018; Dijkstra & Pollock, 2014; Hardt & Santos, 2020). Once a prognosis and a rehabilitation plan have been determined, the SMP communicates this to the athlete, relevant medical (e.g. physiotherapists, athletic trainers, chiropractors) and performance staff (e.g. strength and conditioning coach, head coach, physiologist). This information includes the nature of the injury, possible injury management, the ideal rehabilitation team pathway and the expected timeframe to return to play (Ljungqvist et al., 2009; Shrier, 2015). They regularly communicate and coordinate with the athlete and staff as the athlete moves along the rehabilitation continuum (Dijkstra et al., 2014; Dijkstra & Pollock, 2014) and is ultimately responsible for clearing the athlete for sport (Callender, 2018; FIMS, 2020). SMPs that are contracted to a sports team are generally expected to observe games and make side-line decisions on immediate return to play (Callender, 2018; Hardt & Santos, 2020).

Figure 5

Sports medicine physicians in the athlete rehabilitation pathway



The level of involvement doctors have in athlete rehabilitation is dependent on their knowledge, skills and experience in sport (Foster et al., 2012; Hardt & Santos, 2020; Hose et al., 2017). Overall, GPs and SMPs have a role at the beginning of the rehabilitation process (Asif et al., 2017; Dijkstra & Pollock, 2014; Foster et al., 2012;

Hardt & Santos, 2020). SMPs have better training and experience than GPs so they can diagnose, engage the athlete in acute management and coordinate the rehabilitation team. GPs may make a preliminary diagnosis, but unless they have received adequate musculoskeletal and sports injury training, they should refer athletes to SMPs or secondary providers.

Coordination with Physiotherapists

SMPs can provide valuable skills in rehabilitation planning and coordination (Asif et al., 2017; Callender, 2018; Dijkstra & Pollock, 2014; Hardt & Santos, 2020), but this role may also be taken on by the physiotherapist (Physiotherapy Board of New Zealand, 2018). The level of athlete, severity of injury, access to care and personal choice determines how much involvement the SMP may have in the athlete's rehabilitation (Barton & Grant, 2006; Dijkstra & Pollock, 2014; Erwin et al., 2020). For example, amateur athletes may not have direct access to an SMP or be able to afford to see them. These athletes and their sports clubs may choose to go directly to a secondary provider such as a physiotherapist. In this instance, the secondary provider must have the skills required to perform the same role in diagnosis, acute management, and rehabilitation planning.

So, if the doctor's role can be undertaken by the physiotherapist, then why is their role necessary? In the case of GPs, they are generally not necessary and first-contact with physiotherapists is associated with better patient outcomes (Nordeman et al., 2006; Sephton et al., 2010), patient satisfaction (Butler & Johnson, 2008; Sephton et al., 2010) and cost-effectiveness (Denninger et al., 2018; Holdsworth et al., 2007). SMPs, however, have more knowledge, skills and experience in sports-related healthcare than GPs, have more training in sports medicine than most physiotherapists and may be able to provide a different perspective to

physiotherapists (Asif et al., 2017; Hardt & Santos, 2020; Macleod, 2000; Pigozzi, 2009). In addition, SMPs are better qualified to manage athletes with multimorbidity, including non-musculoskeletal health conditions, and they are legally required for some imaging requests, prescribing medication and medical procedures (Dijkstra & Pollock, 2014; Hardt & Santos, 2020; Ministry of Health NZ, 2020). An example may be that the physiotherapist makes a provisional diagnosis but then refers to an SMP for diagnostic imaging. The two would then collaborate on a diagnosis, prognosis and plan the rehabilitation together. The physiotherapist provides exercise-based rehabilitation, and the SMP prescribes medication and suggests RTS guidelines. Diagnosis, acute management and coordinating athlete rehabilitation are all roles that can be assumed by the SMP and physiotherapist so they must coordinate their approaches to rehabilitation for the benefit of the patient. Perhaps this coordinated effort in the early stages of rehabilitation may be mirrored by the relationship between physiotherapists and S&C coaches in the late stages of rehabilitation?

Role of the Physiotherapist

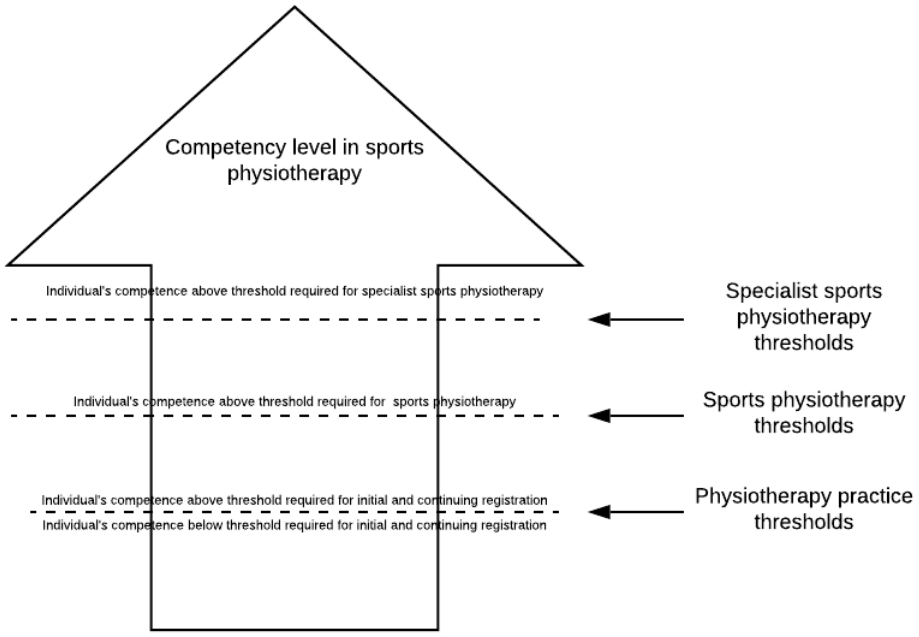
Physiotherapy is a profession that applies scientific knowledge and clinical reasoning to assess, diagnose and manage human function (Physiotherapy Board of New Zealand, 2018; World Confederation for Physical Therapy, 2011). Physiotherapists are required to utilise knowledge of core biomedical sciences to perform this role (Physiotherapy Board of New Zealand, 2018). The role of the physiotherapist may also involve health management, research, policy making, educating and consulting on issues of public health and safety (Physiotherapy Board of New Zealand, 2018; World Confederation for Physical Therapy, 2011). There are a wide range of clinical settings for physiotherapists, including: respiratory wards, intensive care units, neurological wards, musculoskeletal outpatients, orthopaedics, paediatrics,

ergonomics and sports physiotherapy (Physiotherapy Board of New Zealand, 2018; World Confederation for Physical Therapy, 2011).

Sports physiotherapists differ from other physiotherapists similarly to how SMPs differ from GPs. The difference is that many physiotherapists engage in sports physiotherapy without additional qualifications or specialisation. Therefore, a distinction has been made between a ‘general physiotherapist’, ‘sports physiotherapist’ and a ‘specialist sports physiotherapist’. A general physiotherapist may have minimal knowledge and engagement in sports-related physiotherapy treatment (the physiotherapy equivalent of a GP) and a sports physiotherapist should have more knowledge and engagement in sports. A specialist sports physiotherapist is a Physiotherapy Board of NZ (PBNZ) registered specialist in the field of sports physiotherapy (the physiotherapy equivalent of an SMP; Figure 3). Physiotherapists do not have to have specific qualifications in order to engage in sports physiotherapy; however, to use the term “specialist”, they must register with the PBNZ (Physiotherapy Board of New Zealand, 2018, 2020b). Work at a master’s level is required for specialisation in sports physiotherapy, and physiotherapists are assessed based on their clinical, academic and leadership competencies in the field of sports physiotherapy (Bulley et al., 2004; Physiotherapy Board of New Zealand, 2020b).

Figure 6

Competence thresholds for physiotherapists, sports physiotherapists and specialist sports physiotherapists



General Physiotherapists

General physiotherapists have some role in diagnosis, acute injury management and rehabilitation in medical terms (i.e. range of motion, strength, stability, pain, and inflammation). General physiotherapists may work with athletes, but athletes are not their primary patient population. The musculoskeletal demands of the majority of their patients are lower than the athlete population so general physiotherapists usually have a lesser role in RTS rehabilitation. In the initial stage of injury, general physiotherapists share the role of diagnosis with doctors (and other secondary providers). As long as the injury does not require medical intervention (e.g. surgery or medication), general physiotherapists help the patient to manage pain, protect injured tissues and encourage an optimal healing response in the affected area. The physiotherapist then aims to guide the patient through the optimal path to restore

their movement capabilities. On the injury-specific level, general physiotherapists aim to restore the range of motion, stability and strength of the injured tissue. Once able, general physiotherapists work with the patient to restore the patient's overall balance, strength, endurance and reflex control with the goal of returning the ability to perform all activities of daily living that were lost as a result of injury. This is be achieved through manual therapy, exercise prescription, education, advice and goal setting in collaboration with the patient. Physiotherapists are encouraged to work within their own personal scope when selecting treatment interventions. Although the law may allow a service to be provided, the physiotherapist must personally have the knowledge, skills, and abilities to perform that service (L. Anderson et al., 2015; Bulley et al., 2004; Physiotherapy Board of New Zealand, 2018).

General physiotherapists can expand their scope of practice through professional and personal development (L. Anderson et al., 2015; Bulley et al., 2004; Health & Care Professions Council, 2014; Physiotherapy Board of New Zealand, 2018). Those general physiotherapists that expand their knowledge and skills in sports (sports physiotherapists) will have a greater role in athlete rehabilitation and will be expected to coordinate the athlete's rehabilitation from diagnosis to RTS (L. Anderson et al., 2015; Mulligan et al., 2013; Physiotherapy Board of New Zealand, 2018).

Sports Physiotherapists

Sports physiotherapy is an area in which physiotherapists are involved in the prevention and rehabilitation of sport and exercise-related injuries (L. Anderson et al., 2015; Sport and Exercise Physiotherapy New Zealand, 2020). Sports

physiotherapists work with a range of athletes, including recreational, social or club level athletes and more experienced sports physiotherapists may work in elite sporting environments (Sport and Exercise Physiotherapy New Zealand, 2020). Sports physiotherapists work in a variety of settings, from in-clinic to on-field, sometimes travelling with sports teams for competitions (L. Anderson et al., 2015; Bulley et al., 2004). Sports physiotherapists engage in the promotion of physical activity, advice, rehabilitation, and training interventions, with the aim of preventing injury, restoring optimal performance, and contributing to performance enhancement in athletes.

Sports physiotherapists may share some roles with S&C coaches because of their role in performance enhancement. Strength and conditioning principles must be integrated into the athlete's rehabilitation in order for the athlete to return to optimal functioning in their sport (Bedoya et al., 2015; Therese Eisner et al., 2014; Villa Della et al., 2012). Some sports physiotherapists may completely train the athlete in the rehabilitation programme, while others may collaborate with an S&C coach during the final stages of the rehabilitation programme. Each option has its advantages and disadvantages and should be decided based on the experience of the S&C coach and sports physiotherapist and what is most suitable for the athlete. Sports physiotherapists can continue to expand their scope to have a greater role in athlete rehabilitation. This can be achieved through practical experience, educational courses, post graduate qualifications, or sports specialisation.

A sports physiotherapist's knowledge in specific sports will also affect their involvement in athlete rehabilitation (L. Anderson et al., 2015; Bulley et al., 2004; Health & Care Professions Council, 2014; Physiotherapy Board of New Zealand, 2018). Physiotherapists with greater knowledge of the athlete, their sport and their

personal goals in that sport will have more involvement in the athlete's RTS process. Individualised and sport-specific rehabilitation is important for the functional recovery of the athlete, especially as the athlete gets closer to returning to sport (Dhillon et al., 2017). For example, a physiotherapist that has spent some time personally as a professional swimmer and has worked as a physiotherapist for many years with swimmers will understand the strength and stability requirements specific to swimming and tailor rehabilitation towards swimmers more than a physiotherapist that only has knowledge of rugby. However, a rugby physiotherapist will have a greater role in a swimmer's rehabilitation than a physiotherapist that has no interest or experience in sports at all.

The Grey Area

The amount of experience in sports and performance rehabilitation that a physiotherapist may have is quite variable and is not always made clear to the athlete or performance team. In more elite sporting environments, highly competent sports physiotherapists, including specialist sports physiotherapists, are expected to actively engage in the performance enhancement of athletes (Grant et al., 2014). Therefore, highly competent sports physiotherapists may share or assume some of the performance roles of a strength and conditioning coach in athlete rehabilitation. Specialising in sports physiotherapy gives an indication of competency, but as most sports physiotherapists do not specialise, they are often simply referred to as physiotherapists. Therefore, athletes cannot easily distinguish between general physiotherapists or sports physiotherapists and may not even know that there is a difference.

Therefore, this transition period between healthcare and performance is often seen as a 'grey area' (Figure 7) in athlete rehabilitation because the roles of

physiotherapists and S&C coaches are poorly coordinated. An average physiotherapist's knowledge of performance training is often unclear. Therefore, it is hard to determine the physiotherapist's role in performance rehabilitation. Still, there is even less clarity on the S&C coach's role in rehabilitation. S&C coaches may be able to assist physiotherapists in performance rehabilitation, but many physiotherapists unaware of the S&C coach's role. This may be due to the relative recency of the S&C profession and lack of documentation on the S&C coach's role in athlete rehabilitation. Regardless, rehabilitating athletes may suffer because of this confusion surrounding the 'grey area', and either do not smoothly transition to performance rehabilitation or do not receive any performance rehabilitation at all during their rehabilitation.

Figure 7

The grey area

Perhaps NZ can look to other countries, such as the USA, that arguably address this 'grey area' better. Physical therapy in the USA has a similar scope of practice to physiotherapy in NZ (American Physical Therapy Association, 2019; Physiotherapy Board of New Zealand, 2018), but to work in an athletic setting, they must obtain additional qualifications (American Board of Physical Therapy Specialties, 2020; Mulligan et al., 2013; NATA, 2014; Smith, 2012). New graduate physical therapists or licensed physical therapists with general orthopaedic experience are not qualified to provide acute emergency medical care, and in some states, it is illegal to provide

side-line treatment (Smith, 2012). Some physical therapists may see an athletic population in a clinic, but in order to have side-line involvement with athlete's and have the skills to rehabilitate athletes in the 'grey area', they must have qualifications in emergency care and sports. Physical therapists can specialise in sports to get more involved in athlete rehabilitation, but gaining qualifications as an athletic trainer is the most accepted approach.

Role of the Athletic Trainer

Athletic training is not an accepted title in NZ, but it seems to have an important role in the transition between healthcare and performance in the USA and Canada. Understanding the role of athletic trainers may provide some insight into the roles required in the 'grey area' (W. Kraemer et al., 2009). Athletic trainers are healthcare professionals who provide performance-based healthcare mostly to athletes (NATA, 2014). Their role in athlete rehabilitation complements the role of the physical therapists.

Athletic training is a separate profession from physical therapy but has similar roles to sports certified specialist physical therapists in athlete rehabilitation. They cover five key domains: injury/illness prevention and wellness protection, clinical evaluation and diagnosis, immediate and emergency care, treatment and rehabilitation, and organisational and professional health and wellbeing (American Physical Therapy Association, 1987; Board of Certification, 2010; Hortz, 2017). Athletic trainers are considered to be the 'front-line professional' in injury prevention in the USA and Canada (Board of Certification, 2010). Although athletic trainers provide medical services to all types of people, some states will not reimburse them for outpatient services (NATA, n.d.), so they often work exclusively within the athletic environment (e.g. at games or practices). They are therefore on-site and can take pre-

participation screenings, identify risks, and provide regular preventative services (American Physical Therapy Association, 1987; Board of Certification, 2010). If an injury does occur, athletic trainers can make a diagnosis either in an on-field setting or in an athletic training facility (Board of Certification, 2010). Rehabilitation is decided with the consultation of the athlete's physician in order to return the athlete to sport (Board of Certification, 2010; Hortz, 2017). Overall athletic trainers provide these services while adhering to their organisational and professional practice standards (Board of Certification, 2010).

The key benefit of the athletic trainer is that they usually work within a sports environment with athletic individuals, whereas physical therapists usually work in clinics with a wide range of individuals (American Physical Therapy Association, 1987, 2019; Board of Certification, 2010). Athletic trainers have a key role in the performance enhancement of athletes and are can therefore be considered as healthcare providers that are part of the performance team (Board of Certification, 2010; Suprak, 2004; Werner, 2010). As opposed to physical therapists, athletic trainers are regularly and actively engaged in maintaining the health of injured and healthy athletes (American Physical Therapy Association, 1987; Board of Certification, 2010). This gives them a unique perspective in the delivery of healthcare as they will be much more attuned to the athlete's performance needs. Athletic trainers can therefore provide healthcare in the 'grey area' of athlete rehabilitation. Their role boundaries merge with physical therapists and strength and conditioning coaches (W. Kraemer et al., 2009; Suprak, 2004), which will theoretically improve continuity of care (Freeman et al., 2000; S. Nancarrow, 2004; Willard & Luker, 2007).

Sharing Roles with Physical Therapists

While the overlap of roles between physical therapists and athletic trainers has led to some collaboration of care (Lindley & Dunn, 2018; Ward & Albohm, 2009), which could arguably lead to improved outcomes for patients (Baggs et al., 1999; Sims et al., 2015b), it has also led to some tension between the two professional bodies (Ward & Albohm, 2009). Kraemer, Keeley, Martin, Breitbach, & Martin (2019) found that over 40% of athletic trainers believed that a physical therapist should not be involved in multidisciplinary rehabilitation teams and suggested that that rehabilitation can be directed by physicians and athletic trainers without the need for a physical therapist. The model proposed by W. Kraemer et al. (2009) is contrary to this belief. A master's thesis by Parizon & Snyder (1994) recognised conflict in the roles but indicated that physical therapists have an overall positive view of athletic trainers in the rehab team. No recent studies have been conducted to support this evidence. This study concluded that the main conflict between physical therapists and athletic trainers is due to not recognising their own limitations and this may be improved by understanding each other's professional training and role. This seems to hold true today as reducing role ambiguity is key to mitigating conflict among healthcare teams (Almost et al., 2016; E. Kraemer et al., 2019). If improving role clarity between athletic trainers and physical therapists can reduce conflict and promote collaboration it can be postulated that improved role clarity between S&C coaches and physiotherapists in NZ can achieve the same result.

The Gap in Athlete Rehabilitation

Exploring the roles of the doctor and the physiotherapist has revealed a gap in the end stages of rehabilitation, where the athlete requires performance rehabilitation that health professionals cannot provide. In the USA and Canada, athletic trainers

can act as a bridge between medical and performance rehabilitation, but in NZ, there is no such role. Therefore, physiotherapists and S&C coaches must collaborate and communicate more closely to fulfil this role. Therefore, the S&C coaches' theoretical role will be to provide performance rehabilitation in the end stages of athlete rehabilitation in collaboration with physiotherapists.

Theoretical Role of the Strength and Conditioning Coach

S&C coaches are professionals that train athletes to develop their physical capabilities and enhance athletic performance (ASCA, 2020; Hartshorn et al., 2016; Triplett et al., 2017). There are no specific qualifications that an S&C coach is obligated to obtain in NZ, nor is there a governing body. In the last year the NZ S&C Accreditation (NZSCA) has been set up under the umbrella of Sport and Exercise Science NZ (SESNZ). This is a good step towards governance. For now, S&C coaches should at least follow an internationally recognised scope of practice (ASCA, 2020; NSCA, 2020; Triplett et al., 2017; UKSCA, 2020). . The National Strength and Conditioning Association (NSCA) in the US, often regarded as the worldwide authority on strength and conditioning, states that:

"Certified Strength and Conditioning Specialists are professionals who apply foundational knowledge in a practical setting to assess, motivate, educate, and train athletes for the primary goal of improving sport performance. They conduct general physical and sport-specific testing sessions, design and implement safe and effective strength training and conditioning programmes, and provide guidance for athletes in nutrition and injury prevention. Recognising their area of expertise is separate and distinct from the medical, dietetic, athletic training, and sport coaching fields." (Triplett et al., 2017)

An S&C coach has the knowledge and experience to provide performance rehabilitation for injured athletes and can help them maintain their fitness throughout the rehabilitation process (Bomgardner, 2001; Kleiner et al., 1996). The medical team alone may not have sufficient training or be as attuned to the athlete's needs for returning to their sport (Walsh et al., 1999). Therefore, theoretically, the athlete should be progressively phased into S&C and sport-specific training as they become more medically fit (Figure 1; Kraemer et al., 2009).

The medical rehabilitation team can help the athlete rehabilitate in terms of pain and daily function early in rehabilitation, while S&C coaches are well prepared to take care of the athlete's physical and psychological needs in the later stages of rehabilitation (Judge et al., 2012; Kleiner et al., 1996; W. Kraemer et al., 2009; Rees & Hardy, 2000; Robbins & Rosenfeld, 2001; Wittwer, 1997). Physiotherapist for example could track the athlete's progress in terms of pain on a visual analogue scale and progress their function while ensuring not to aggravate this. Physiotherapist may use active assisted exercises, gravity eliminated, restricted range of motion strength training or isometric exercise to achieve this. In the late stages of rehabilitation, S&C coaches have a range of knowledge and skills that may transfer, including: Exercise science (e.g., Anatomy, Exercise Physiology, Biomechanics, Sport Psychology)**,** programme design, exercise training, testing and evaluation (e.g. of strength, power, flexibility and stability), and injury prevention (ASCA, 2020; Hartshorn et al., 2016; Triplett et al., 2017). They will be most useful when pain and function has improved enough such that they can progress the athlete based on performance measures such as workloads, repetition maximum tests or power tests. Providing this level of care in late rehabilitation his will enhance

continuity of care and ensure that the athlete receives physical rehabilitation and social support throughout their return to sport journey.

Exercise Science

Exercise science, the study of human movement, is the main base of knowledge that S&C coaches apply, and it is integral to the rehabilitation of athletes. S&C coaches' knowledge of exercise science helps them determine the appropriate workload for the athlete and design programmes that are specific to the athlete and the sport. S&C coaches have similar basic knowledge of anatomy and physiology to physiotherapists (e.g. musculoskeletal, neuromuscular, neuroendocrine and cardiopulmonary); however, they will study this in the context of exercise and sport. S&C coaches are not expected to have knowledge of tissue injury or healing (ASCA, 2020; Triplett et al., 2017), so they will need guidance from healthcare professionals on injury timeframes to understand when to apply their knowledge of exercise science. Nevertheless, S&C coaches' knowledge in the performance context could allow them to improve the movement potential (e.g. strength, stability and mobility) of athletes in their sport more than healthcare alone. S&C coaches have a good understanding of sport and exercise biomechanics, bioenergetics, physiological adaptations to exercise, techniques to manipulate physiological adaptations and how different athletes will respond to exercise (Triplett et al., 2017).

Programme Design

S&C coaches are well suited to programming the end stages of an athlete's rehabilitation programme because they understand how to develop an exercise programme to suit the athlete's performance goals (ASCA, 2020; Triplett et al.,

2017). Skills in exercise planning and periodisation are key to athletic performance and rehabilitation (Dhillon et al., 2017; Harries et al., 2015; Hoover et al., 2016; Issurin, 2010; Reiman & Lorenz, 2011). For example, a volleyball player who is in the end stages of meniscus tear rehabilitation is likely to need power training and dynamic stability training to restore peak jumping ability and maximum function in volleyball. After consulting with medical professionals, the S&C coach can programme in exercises to target these traits and any others that need development. This may include a periodised programme beginning with static stability (e.g. one-leg stance) and strength training (e.g. squats, split squats), progressing into dynamic stability (e.g. skater bounds) and power-based activities (e.g. Olympic lifts or weighted squat jumps) and eventually working towards plyometrics and sport-specific stability training (e.g. self passes against a wall). The S&C coach will plan this in advance and constantly monitor and evaluate the effects of the training programme to determine the exercise volume, intensity, type, work-rest ratio and progressions.

Testing and Evaluation

S&C coaches assess athletes' physical performance regularly through physical performance tests (PPTs) as a gauge of the athletes' progress in training, trends in performance, workloads and risk of injuries (Cates & Cavanaugh, 2009; Timoteo et al., 2021). PPTs assess the movements required for sport in a controlled environment, providing quantitative and qualitative data. This data gives the S&C coach a good understanding of an injured athlete's pre-injury function. It is well understood that PPTs must be performed, and athletes should return to pre-injury function before RTS (Abrams et al., 2014; Cates & Cavanaugh, 2009; Maestroni et al., 2020; Manske & Reiman, 2013). S&C coaches can compare the PPTs they have

assessed preinjury to PPTs in rehabilitation to determine the training required to return function as well as the athlete's readiness for RTS.

Exercise Training

Exercise is the primary tool utilised by strength and conditioning coaches to improve athlete performance (Triplett et al., 2017) but exercise is also an integral part of the athlete rehabilitation process (Kristensen & Franklyn-Miller, 2012; Reiman & Lorenz, 2011; Taylor et al., 2007; Zech et al., 2009). S&C coaches are experts in exercise prescription and use a range of exercise forms to train an athlete's physical abilities, including: Strength, power, stability, flexibility and aerobic training (Triplett et al., 2017).

Resistance and power training are valid tools for developing an athlete's strength in the rehabilitation of acute or chronic injuries (Hill & Leiszler, 2011; Kristensen & Franklyn-Miller, 2012; Maestroni et al., 2020; Rimando et al., 2015; Taylor et al., 2007). While physiotherapists have some training in resistance training, the S&C coach specialises in this area. S&C coaches provide a unique perspective on the ideal programme for athletes in their individual sports. Ability to maintain muscle power decreases following an injury (Maestroni et al., 2020), which directly affects athletic performances such as jumping, sprinting, changing direction, pushing, pulling, throwing and kicking (Haff & Nimphius, 2012; Issurin, 2013; Young, 2006). In the late stages of rehabilitation, adaptation from power training may help protect previously injured tissues. This adaptation increases the athlete's ability to coordinate movements and absorb and produce power, making the structure more robust. Power-based techniques are highly technical training modalities that should be individualised to each athlete (Haff & Nimphius, 2012; Issurin, 2013; Young,

2006), so skilled professionals such as S&C coaches or experienced sports physiotherapists should programme this.

S&C coaches should train aerobic fitness as soon as the athlete has been medically cleared to do so. Aerobic fitness strongly correlated with injury risk in athletic populations (Lisman et al., 2017; Tomes et al., 2020). Aerobic fitness may not necessarily reduce risk of specific injuries such as groin or hamstring injuries (Freckleton & Pizzari, 2013; Whittaker et al., 2015). However, it is important to maintain or progress during rehabilitation to reduce the effects of fatigue on motor control, balance and gait (Barbieri et al., 2013; Johnston et al., 1998; Zech et al., 2012) which may lead to elevated risk of injury. Aerobic training is often missed by the medical teams that apply more traditional biomedical models of rehabilitation because they address the injury but fail to address deficits that occur as a result of the injury (Farre & Rapley, 2017; Sanders et al., 2013). The S&C coach has a good understanding of how to develop cardiovascular fitness while controlling injury risk (Baechle & Earle, 2008; Gabbett, 2016; Timoteo et al., 2021).

Stretching and stability training are often included in rehabilitation, but without the guidance of an S&C coach, they may not cater the exercises specific to the athlete's sport. Stretching of tight muscles is required to improve the available joint range of motion (Kallerud & Gleeson, 2013; Medeiros et al., 2016) and stability and Balance training are important to improve stability following an injury and reduce the risk of injury recurrence (Lauersen et al., 2014; Leppänen et al., 2013; Zech et al., 2009). In addition, stability must be maintained whenever training in new ranges of motion. Sport-specific proprioception and balance training can be used by S&C coaches to rehabilitate injuries and reduce the risk of injury recurrence (R. Kraemer & Knobloch,

2009). S&C coaches knowledgeable in the athlete's sport can programme the stretching and stability protocols to benefit the athlete's performance.

Injury Prevention

Assessment of sports injury risk and strategies to reduce injury risk is well documented in S&C coaches' scope (ASCA, 2020; Hartshorn et al., 2016; Talpey & Siesmaa, 2017; Triplett et al., 2017) and should be applied to rehabilitation. Knowledge of injury history is important for injury prevention because history of previous injury is a risk factor for further injury (M. B. Clausen et al., 2016; Fulton et al., 2014). A key goal for an injured athlete should be to reduce the risk of further injury.

S&C coaches are encouraged to address "the three E's of injury prevention": Education, engineering and enforcement (Talpey & Siesmaa, 2017). Educational strategies aim to empower the athlete and coach by helping them understand injury prevention strategies. Engineering strategies encourage the design and use of protective equipment such as mouthguards to prevent impact-related injuries and workload and fatigue tracking technology to reduce risk of overuse-related injury. Enforcement strategies are policies, rules or practices that aim to reduce the occurrence of injury. For example, to minimise the risk of injury in a gym for a rugby player that has sustained a shoulder dislocation, the S&C coach may teach the proper shoulder press technique (education). They may also encourage the athlete to wear a shoulder brace when appropriate (engineering). The S&C coach could also enforce gym rules, such as limiting overhead lifting loads, to reduce recurrence of their injury (enforcement). In an on-field training scenario, the S&C coach may educate the athlete and coach on specific tackling techniques (education), using a

shoulder brace when training (engineering) and make shoulder taping compulsory to reduce risk or shoulder dislocation (enforcement).

Boundaries of the S&C Coach's Role in Athlete Rehabilitation

Athlete rehabilitation is only beneficial from a multidisciplinary approach if all team members understand the limitations of their roles. The ASCA's S&C scope of practice explicitly states that S&C coaches do not diagnose injury or illness, prescribe medications, or treat injuries through manual therapy or manual corrective joint manipulation. These roles must be undertaken by a qualified medical professional. For example, a physician or physiotherapist may diagnose a musculoskeletal condition. In NZ, only authorised medical providers (e.g. physicians, dentists) can prescribe medicine for the condition they are treating (Ministry of Health NZ, 2017), and generally, only secondary providers treat injuries with manual or manipulative therapy.

Taking these boundaries into account, the model suggested by W. Kraemer et al. (2009) could apply to athlete rehabilitation in NZ. Physiotherapists seem to undertake many of the roles of athletic trainers in NZ, and S&C coaches could take on the roles that physiotherapists are not trained for. Sports physiotherapists are better equipped to provide end-stage rehabilitation for athletes, but all physiotherapists will be able to engage in generic early rehabilitation. S&C coaches are more skilled in performance enhancement, so they can collaborate with the physiotherapist in the end stages of rehabilitation as the athlete's short-term goals shift towards returning to sport. They can then take over to provide generic specific and sport-specific performance rehabilitation to ensure the athlete returns to maximum functioning in their sport.

Conclusion

This literature review found that healthcare teams are an important component of providing holistic healthcare that benefits health providers and their patients, including athletes. It also summarised the roles of a doctor, physiotherapist and athletic trainer in athlete rehabilitation and identified the ‘grey area’ of athlete rehabilitation between medical and performance rehabilitation. Of the currently available literature, there is little information explicitly stating S&C coaches’ roles in athlete rehabilitation or the transition from medical to performance rehabilitation. Based on the literature explored on common health provider’s scopes of practice, the role of the S&C coach has been hypothesised to start in end-stage rehabilitation and increase as the athlete’s goals shift towards performance in sport. In addition, S&C coaches can only be involved in athlete rehabilitation in NZ if the medical rehabilitation team and performance rehabilitation team strongly collaborate. This can be achieved by improving physiotherapists’ and S&C coaches’ understanding of each other’s roles in athlete rehabilitation (Mafuba, Kupara, Cozens, & Kudita, 2015; Sims et al., 2015b). Greater insight is needed into the role of the S&C coach in athlete rehabilitation and the ‘grey area’ of athlete rehabilitation. The perspectives of physiotherapists and S&C coaches in NZ help to provide this insight in chapter three.

Chapter 3: The Perceived Role of the Strength and Conditioning Coach in Athlete Rehabilitation

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Abstract

Strength and conditioning coaches may collaborate with physiotherapists in athlete rehabilitation, but their role has not been documented. Therefore, this study aimed to clarify their role through the perspectives of physiotherapists and strength and conditioning coaches. The researchers conducted semi-structured interviews in NZ with four physiotherapists and five strength and conditioning coaches, including one that was previously a physiotherapist. Thematic analysis identified thirteen themes analysed in four categories: Current role (teamwork with the rehabilitation team, level of involvement and physical roles), proposed role (teamwork with the rehabilitation team, level of involvement and physical roles), variables (rehabilitation team structure, governance, relationships in the rehabilitation team and the athlete), and significance (positive and negative). Currently, most S&C coaches have a small role in providing performance rehabilitation at the end of rehabilitation. Participants thought they should be involved earlier, but poor communication and collaboration with health professionals reduce their role. They proposed that S&C coaches should be somewhat involved following a health professional's diagnosis, increasing their involvement as athlete function improves and the physiotherapist's role decreases.

Participants agreed that this role should be flexible and account for each clinical context.

Key words: Physical Conditioning, Human; Physical Therapists; Professional Role; Return to Sport; Sports Medicine.

Introduction

Despite their roles in injury prevention and health promotion, S&C coaches are traditionally thought of as performance professionals, not health professionals (Triplett et al., 2017). S&C coaches generally work with healthy athletes to prepare them for the physical demands of their sport. They incorporate specific exercises into their training programmes to minimise the risk of injury (prehabilitation; Meir et al., 2007). If an athlete is injured, health professionals such as physiotherapists will rehabilitate them.

Physiotherapists can help athletes rehabilitate in medical terms (i.e., range of motion, pain, inflammation, neuromuscular control, muscle, and tissue strength; Bulley et al., 2004; Kraemer et al., 2009; Physiotherapy Board of New Zealand, 2018). Still, those without sport-specific or S&C knowledge will struggle to rehabilitate athletes in performance terms (sport-specific strength, power, agility, endurance, and coordination). Therefore, many athletes do not rehabilitate to their pre-injury level of function. S&C coaches may help injured athletes return to their previous level of performance and reduce the risk of reinjury (Bedoya et al., 2015; Sommerfield et al., 2020; Wong et al., 2010).

In some elite sport settings, S&C coaches collaborate with physiotherapists in an athlete's rehabilitation to smoothly integrate the athlete back into sport. Still, the role of these S&C coaches is not well documented. If health professionals and athletes are unaware of this role, S&C coaches cannot help rehabilitating athletes. Kraemer et al. (2009) has suggested a framework for this role in the USA. They indicate that S&C coaches be involved in the end stages of rehabilitation and performance rehabilitation before returning to sport. Others have advised how to integrate S&C principles (e.g., periodisation, maximal strength training, power training, and sport-

specific training) into rehabilitation (Lorenz et al., 2010; Maestroni et al., 2020; Reiman & Lorenz, 2011). However, no studies have explored whether S&C coaches perform these roles in practice.

Defining S&C coaches' roles in athlete rehabilitation may improve their involvement in rehabilitation teams. Role clarity can enhance trust among health professionals, leading to improved support and value of each other's roles and communication (Sims et al., 2015b). Therefore, this study aimed to explore the perspectives of physiotherapists and S&C coaches in NZ on the role of S&C coaches in athlete rehabilitation.

Methods

This qualitative study used individual semi-structured interviews (Holloway & Galvin, 2016) to identify S&C coach and physiotherapist perceptions of the role of S&C coaches in athlete rehabilitation. The 32-item Consolidated criteria for Reporting Qualitative research (COREQ) checklist was used to report this study (Tong et al., 2007). Ethical approval (Appendix A) was granted for this study (Otago Polytechnic Research Ethics Committee review panel - reference number 840).

The primary researcher conducted all interviews with the physiotherapists and S&C coaches in this study and independently transcribed and coded each interview. The other researchers provided quality checking of the writing, methodology, and thematic analysis in this study.

The primary researcher had a professional relationship with two of the physiotherapists and one S&C coach before this study. The primary researcher informed participants about his background and current study aims before beginning the interviews with the clinicians.

Study Design

Theoretical Approach

A six-step inductive approach outlined by Braun & Clarke (2006) guided the analysis of this study. This approach allowed for flexible yet recursive analysis of the data to develop themes that accurately portray the participants' insights (Braun & Clarke, 2006, 2013).

Participants

Participants were selected from a sampling survey (Appendix B) completed by physiotherapists and S&C coaches in NZ. The survey was spread using chain referral (snowball) sampling (Mack et al., 2005). This technique aimed to maximise the study population, find participants that may not be easily accessible to researchers, and improve the external validity of the findings.

The sampling survey included participants if they: were a resident or citizen of NZ or Australia; registered as a physiotherapist with PBNZ and holds a current Annual Practicing Certificate (APC), or was registered and had an APC at the time of athlete interaction; were an S&C coach as defined in the NSCA Strength and Conditioning Professional Standards and Guidelines (Triplett et al., 2017); were of legal age to consent (Medical Council of New Zealand, 2019); Worked with an 'Athlete' (that meets adapted criteria proposed by Araújo & Scharhag, (2016) to include community sports athletes) within their care as a physiotherapist or S&C coach that has been 'moderately disabled' by an injury based on a score of 2 higher on 'the Bull five-point scale of disability' (Bull, 1978).

The sampling survey excluded participants if they: were unable to provide informed consent; did not speak fluent English, or speech was impaired such that interview

data could not be obtained, and they were unable to provide an interpreter; could not attend an interview and did not have access to adequate software for online interviewing; had an acute or chronic condition that would limit the ability of the subject to participate in the study.

The data gathered from the sampling survey was not included in the thematic analysis. However, it helped provide talking points for the interviews and demographic information, including age, sex, qualifications, and experience in their field and athlete rehabilitation. This information allowed for subgroup analysis if themes and categories were consistent among participants with similar demographics.

Two physiotherapists that were also S&C coaches, 47 physiotherapists, and 19 S&C coaches completed the survey. Of the 68 people that completed the sampling survey, 37 consented to be interviewed. Purposive sampling was used to recruit interviewees from the pool of volunteers (Battaglia, 2008; Onwuegbuzie & Leech, 2007).

One S&C coach with a background as a physiotherapist, four physiotherapists, and four S&C coaches across NZ were interviewed using a web-based video platform (ZOOM Video Communications Inc., San Jose, California). Audio and video were recorded for each interview and stored in a secure file. All interviews were between 60 and 95 min and no interview was repeated. Written and verbal informed consent was gained before starting the interviews. Verbal consent to proceed past 60 min was gained from all participants because the information sheet (Appendix D) had advised them that the interviews would last up to 60 min.

Data Collection

The primary researcher interviewed all participants using a single set of semi-structured, open-ended questions. These questions developed over several weeks through discussion with the two supervising researchers. Two pilot interviews were completed with the supervising researchers before the first interview. These interviews helped to identify key questions that should be addressed and refine the interview skills of the primary researcher. The questions in the interviews aimed to address the research question: "what is the role of S&C coaches in athlete rehabilitation?" by addressing four topics:

1. The current role
2. The proposed role
3. The variables that affect the role
4. The significance of the role

The interview questions addressed ideas surrounding these secondary research questions, but they were not directly asked in the interviews. The interview questions were adapted during the interview to increase the depth and vitality of the interview data. The final analysis was completed from the interview data alone. Audio recordings from the interviews were transcribed verbatim by the primary researcher.

Table 1

Participant characteristics

I.D.	Participant Type	Interview length	Sex	Age (range years)	Level of athletes					Years working with athletes	Main sport
					L.	A.R.	P.R.	A.N.	P.N.		
SC1	S&C coach	01:28:31	M	21-30	✓	✓				5	Rugby
P1	Physiotherapist	01:16:03	M	31-40	✓	✓	✓	✓		8	Volleyball
P2	Physiotherapist	01:01:09	M	41-50	✓			✓		5	Mixed
SC2	S&C coach	01:31:54	M	21-30	✓	✓	✓	✓	✓	5	Kayaking
P3	Physiotherapist	01:28:17	M	31-40	✓		✓		✓	9	Rugby
SC/P	S&C coach/ physiotherapist	01:21:17	M	31-40			✓		✓	7	Cricket
SC3	S&C coach	01:10:26	M	21-30		✓	✓		✓	5	Football
P4	Physiotherapist	01:32:31	F	21-30	✓	✓				5	Mixed
SC4	S&C coach	01:22:14	F	51-60	✓	✓	✓	✓	✓	40	Basketball

Note: L, Local; A.R., Amateur Regional; P.R., Professional Regional; Amateur National; P.N., Professional National.

Data Analysis

The Primary researcher conducted and transcribed the interviews and read all of the transcripts multiple times to familiarise himself with the data. A data-driven approach to coding was taken for the transcripts (Braun & Clarke, 2013). The primary researcher assigned codes to text segments to accurately portray what participants communicated in the interview. The primary researcher categorised the codes into four groups relating to the research topics: Current role, proposed role, variables, or significance. Within each of these groups, the codes were recorded in a Microsoft excel (2016) spreadsheet and categorised into subthemes, then candidate themes.

The candidate themes were reviewed at the level of the codes and data to ensure that they accurately reflected the interview content. Cross-checking and discussion between the researchers helped confirm these themes. All participants were sent a summary of the results and asked to comment to ensure that the results accurately reflected their perceptions. The data was determined to be saturated when no new subthemes emerged from the ninth interview.

Findings

Participants

Two females and seven males participated in this study (Table 1). Four were S&C coaches, four were physiotherapists, and one was an S&C coach with a background in physiotherapy. All had five or more years working with athletes and had experience with injured athletes. Participants worked with athletes in a range of sports and levels of competition. This included physiotherapists and S&C coaches employed as part of a sports team's staff and independent, community-level physiotherapists and S&C coaches

Themes

Thirteen themes relating to the role of the S&C coach in athlete rehabilitation were identified in four categories (Table 2).

Table 2

Categories and Themes

Current Role	**Proposed Role**	**Variables**	**Significance**
Teamwork with the rehabilitation team	Teamwork with the rehabilitation team	Rehabilitation team structure	Positive
Level of involvement	Level of involvement	Governance	
Physical roles	Physical roles	Relationships in the rehabilitation	Negative
	Understanding your own role	The Athlete	

In general, participants perceived that S&C coaches do not have enough teamwork, involvement, or roles in athlete rehabilitation. They expressed that the role of the S&C coach in athlete rehabilitation is not concrete. Multiple variables must be considered to avoid barriers and optimise the S&C coach's role. However, all saw the role of the S&C coach in athlete rehabilitation as significant and positive.

Current Role

Three main themes relating to the current role of the S&C coach in athlete rehabilitation were identified from the data: Level of involvement, physical roles, and teamwork (Table 2). Participants felt that the S&C coach's current role, including involvement, physical roles, and teamwork, depends on the factors discussed in the variables theme. The results of this thematic analysis helped build a model for the current role of the S&C coach in athlete rehabilitation, as seen in Figure 8.

Participants thought that most S&C coaches currently have minimal involvement in athlete rehabilitation. It seems that physiotherapists perform most of the rehabilitation, and "S&C [coaches] will pick people up in that grey area… that exists between where physio finishes and return to play starts." (P3). S&C coaches, therefore, mainly work in the end stages of rehabilitation. In lower-level sport settings, "…physios will make all the calls around when athletes are ready to [return to sport] …" (P3). However, some highly trained S&C coaches have greater involvement, working in early rehabilitation. S&C coach 4 recalled that in one setting, the S&C coach and physiotherapist "…team tagged massage, we team tagged injury management…" (SC4).

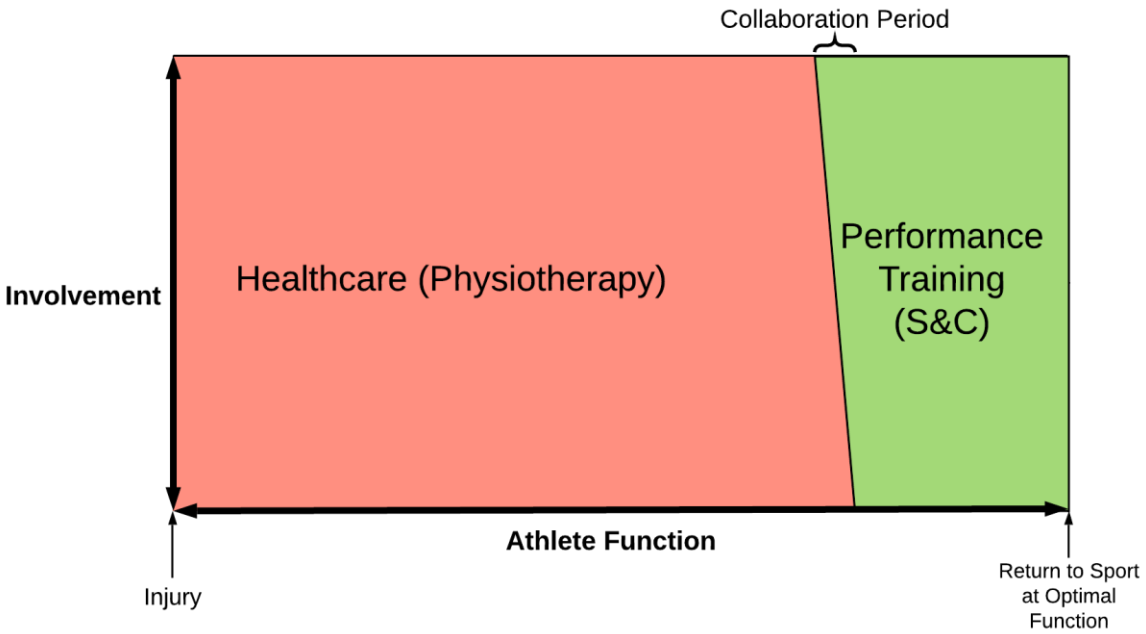
The physical roles of S&C coaches that participants identified were planning and providing performance rehabilitation to injured athletes. Again, how much of this S&C coaches can provide seems to be quite variable. Some S&C coaches and physiotherapists "…work closely… because every day you're planning and adjusting… athletes' programmes…" (P3). More often, S&C coaches are not involved in planning rehabilitation. Some S&C coaches have found that, without their input, physiotherapist lead rehabilitation programmes that "…were good in principle but… there just didn't seem to be enough resistance to make any change..." (SC2).

S&C coaches can help add this resistance and sport specificity, but their involvement in rehabilitation depends on their relationship with the physiotherapist and athlete.

Participant perceptions on teamwork between S&C coaches and physiotherapists were mixed: "there's been some great examples and some terrible." (SC2). Some had good experiences, working "interchangeably" (SC4) as needed, but it seems that in most cases, "...people come to physio and only the lucky few end up with a strength and conditioning coach." (P4). It was suggested that the best teamwork occurs in high-performance sport and team sport environments (e.g. "High Performance [Sport] New Zealand" (P2)), but community sport S&C coaches often have minimal or no teamwork with physiotherapists. This is explained in more detail in the variables theme.

Figure 8

The perceived current role of S&C coaches in athlete rehabilitation



Proposed Role

The proposed role was created based on commonly suggested roles for S&C coaches. Four main themes relating to the proposed ideal role of the S&C coach in athlete rehabilitation were identified from the data: 'Level of involvement', 'physical roles', 'teamwork', and 'understanding your own role' (Table 2).

Participants felt that the S&C coach should be involved as soon as the athlete is injured. The S&C coach's role would be minimal at first, about "…90:10 in favour of the physio" (SC2). As the athlete's function improves, the S&C coach's involvement would increase, and the physio's involvement should decrease. The roles may be shared "…50:50 in end-stage rehab" (P4), and then S&C coaches would have a significant role in generic specific and sport-specific development of the athlete (e.g. "99% S&C" (SC2) or "95:5" (SC4); Figure 9).

In this proposed role, S&C coaches' roles could include anything except for making the diagnosis. It was suggested that "the physio… will examine, re-evaluate, diagnose, and… manage the pain" (SC2), but S&C coaches "need to have a voice… around what the plan looks like going forwards" (SC/P). In early rehabilitation, S&C coaches should help the physiotherapist to keep the rehabilitation "…angled towards… performance outcomes…" (SC/P) and allow the athlete to stay conditioned for sport: "…ankle surgery, for example… we can still do stuff with the upper body… cardiovascular [training]" (P1). S&C coaches would have the most roles in performance rehabilitation near the end of rehabilitation, adding "functionality and… individuality to the training" (SC4) to prepare the athlete for their sport.

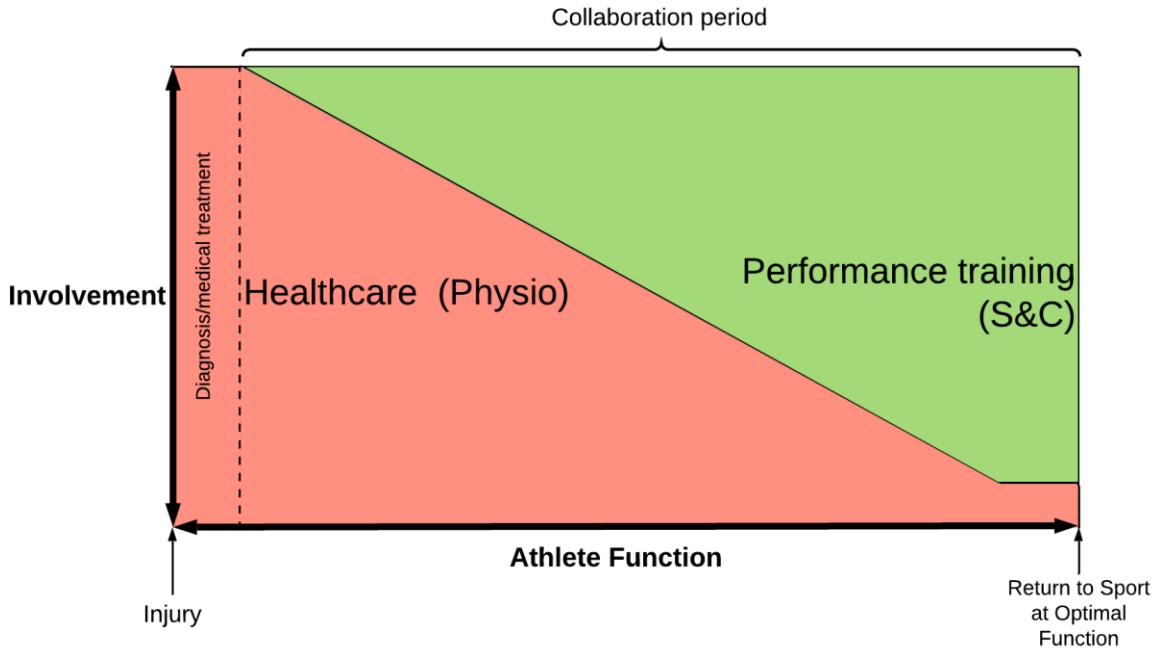
All participants agreed that coordinating the S&C coach's and physiotherapist's roles requires excellent teamwork skills. They thought that the S&C coach and medical

team should regularly communicate and "work collaboratively" (P2) throughout the athlete's complete rehabilitation (see Figure 9– collaboration period) "…to try and achieve a full and sustained return to play" (P2). They also thought that physiotherapists and S&C coaches could form a "symbiotic relationship" (P2) and agreed that they are "…both required in programmes because [they] add value and… knowledge that's closely linked" (P3).

This proposed role should be flexible, and the S&C coach must understand their role for this to happen. Participants thought that "…the [S&C] coach …has to know his or her limitations and refer on…" (P1). They felt that more experienced S&C coaches would have greater roles in areas they are skilled in, but ultimately "...egos need to be put aside so that the athlete gets the best deal…" (SC4).

Figure 9

The proposed role of S&C coaches in athlete rehabilitation



Variables

Participants identified multiple variables that affect the role of the S&C coach in athlete rehabilitation. These variables were categorised into four main themes: 'rehabilitation team structure', 'relationships in the rehabilitation team', 'governance', and 'the athlete' (Table 2). These variables may act as barriers to S&C coaches performing their role or scenarios that require the S&C coach to adapt their role. Some may lead to a larger role for S&C coaches (See Figure 10), and some lead to a larger role for physiotherapists (Figure 11).

Figure 10

S&C coach dominant athlete rehabilitation

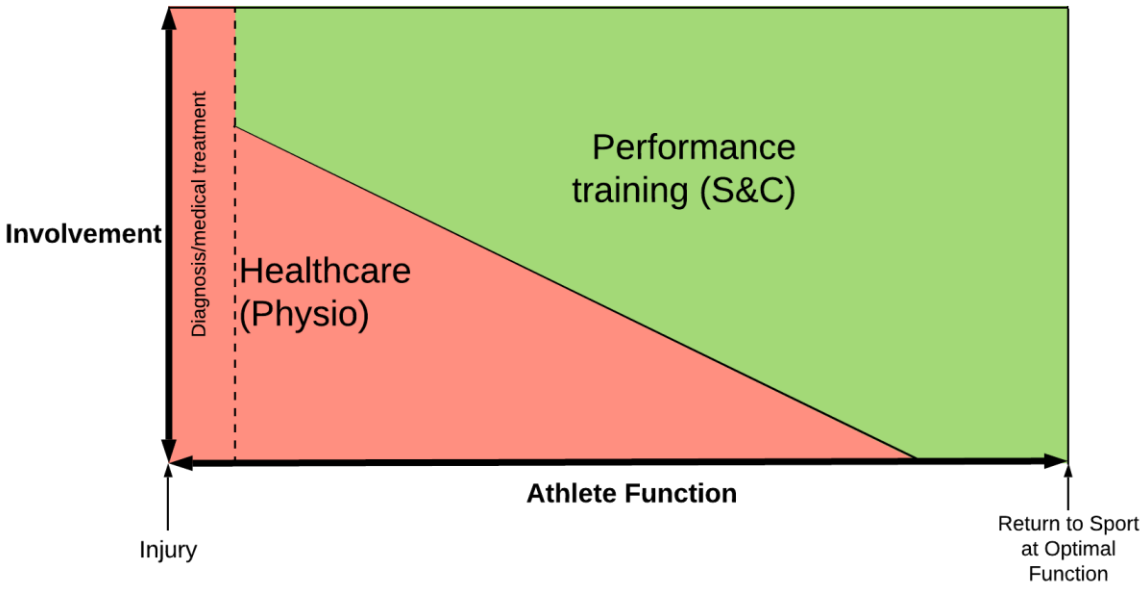
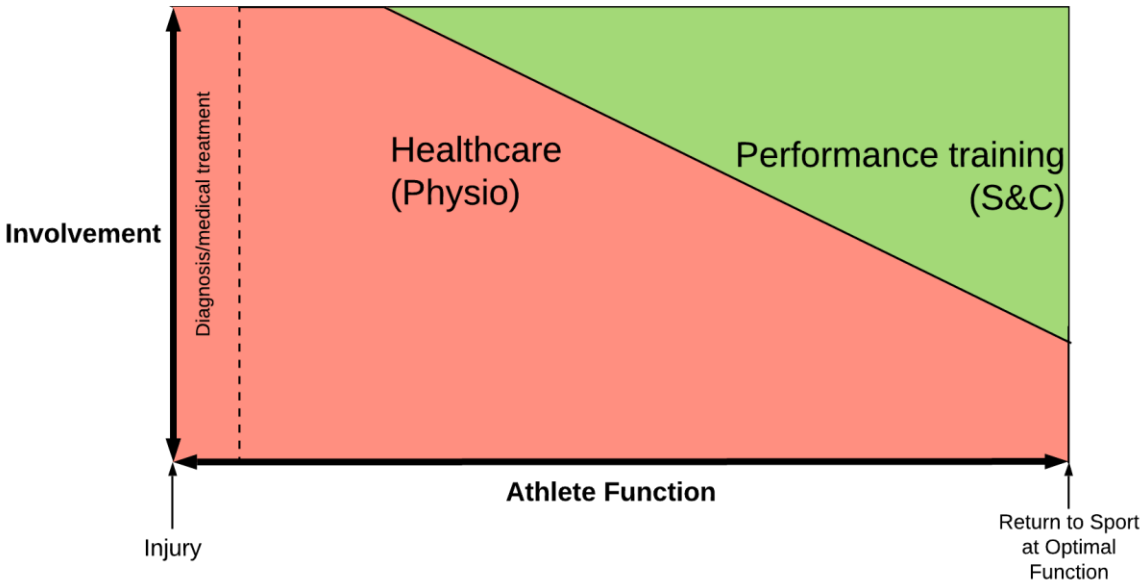


Figure 11

Physiotherapist dominant athlete rehabilitation



Participants suggested that the organisation of the rehabilitation team and the skills and experience of team members determines how roles are distributed. They thought that the relative experience of the S&C coach and physiotherapist should affect how involved the S&C coach is in each section of the rehabilitation. For example, if the S&C coach is relatively more experienced in rehabilitation than the physiotherapist, then the S&C coach should take up more roles earlier (Figure 10) and vice versa (Figure 11). This system ensures that "whoever is leading [rehabilitation] is just whoever is best suited for the job." (SC/P). In addition, participants thought that S&C coaches are "…more involved… earlier in an interdisciplinary team… [and] later in a multidisciplinary team." (P3).

Participants regularly discussed the relationships and communication that the S&C coach has with the other rehabilitation team members and how this would affect their role. They stressed that if S&C coaches develop good relationships and communicate with the rehabilitation team, their role increases. Physiotherapist 2

thought that this was because "building the relationship creates trust and …you know that they'll do a good job..." (P2).

Some participants suggested that the governing structure, including accreditation and funding of S&C coaches, may also affect their roles in athlete rehabilitation. They indicated that mandatory accreditation and a governing body would help "…strengthen the whole relationship between the two professions…" (SC1) physiotherapy and S&C. Physiotherapist 2 felt that referring physiotherapists "…want to have some… level of comfort that, that there's… standardization" (P2). A governing body could also set up funding structures so S&C coaches can "make a living out of it, …support themselves… and have… career progression… if it's not sustainable, it won't work." (P2).

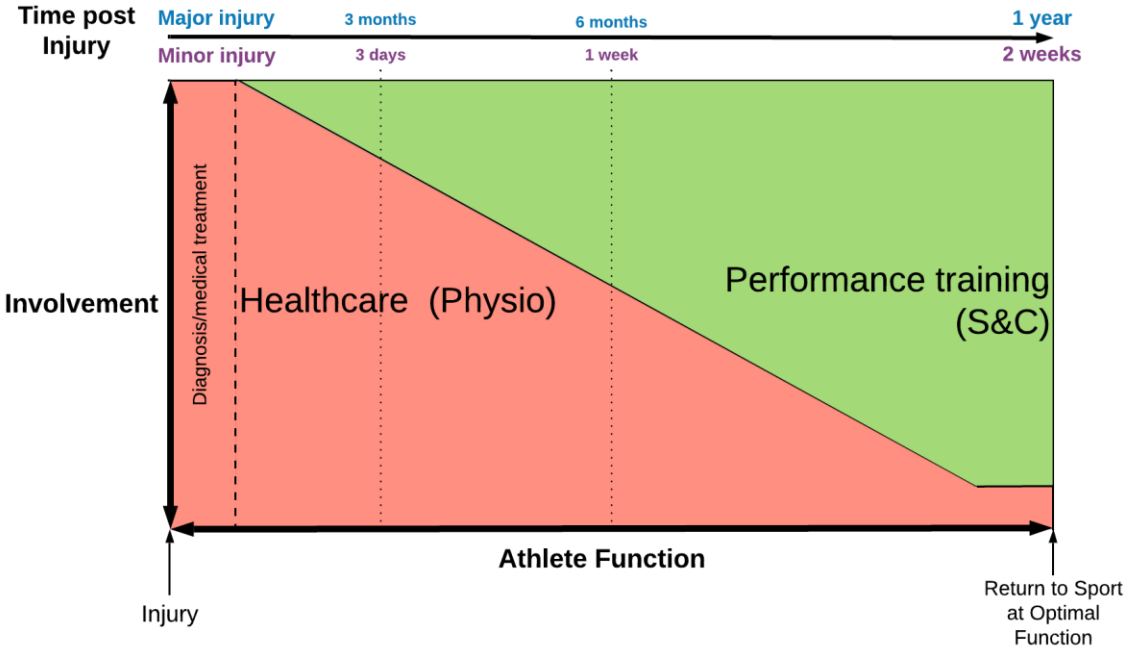
Most participants agreed that the critical variable is the athlete as they are the focus for rehabilitation. Ultimately athletes can choose their healthcare providers, and they may not include the S&C coach. Therefore, the athlete must understand the role of the S&C coach to see their value and comply with their programmes. "If the player… can still get by, and perform on-court… doing the bare minimum, they might go 'I can perform, why do I need to do this extra stuff?'" (P1).

Participants thought that "…it depends on the level and type of sport as well…" (P1). For example, high-level sports will have more funding and resources to support an S&C coach in athlete rehabilitation, but "In the amateur side of things, it becomes… much more challenging because… generally, you don't have a physio or an S&C...." (SC/P). In addition, elite athletes are more likely to require an S&C coach to meet their performance needs. For instance, "…social basketball… nobody bothers getting a [S&C] coach." (P1).

The athlete's injury must also be considered. Participants thought that the distribution of roles between the physiotherapist and S&C coach should not change because of the severity and type of injury. They thought both should have proportionately more involvement in injury that has a long timeframe: "it's similar. It's just on a longer scale" (SC3) (Figure 12).

Figure 12

Perceived effect of injury severity on involvement in athlete rehabilitation



Significance

Overall, participants felt that the role of the S&C coach is significant to athlete rehabilitation. Their comments were categorised into two themes: 'S&C coaches have a positive effect on athlete rehabilitation', and 'S&C coaches have a negative or no effect on athlete rehabilitation' (Table 2).

Participants noted multiple positive effects of involving S&C coaches in athlete rehabilitation. They saw the S&C coach as a valued member of the athlete rehabilitation team. Seven of nine participants, including all the physiotherapists, thought that the S&C coach was at least as important as the physiotherapist in athlete rehabilitation. They seem to "…build a great amount of trust…" (SC1) with physiotherapists and often already have "buy-in" (SC1) (P1) from athletes, which helps the rehabilitation team as it "…gets your athlete's trusting you…" (P3)**.**

S&C coaches may be able to provide additional support to physiotherapy. S&C coaches can see "…athletes for a longer period of time than what the physio can." (SC1). This may mean they can achieve more within one exercise session. Participants also thought that physiotherapists and S&C coaches could learn from each other if they collaborate and ask questions such as: "Okay, why are we doing this? Can we do it better?" (SC3).

All participants discussed the significance of S&C coaches' performance mindsets. They thought that having the S&C coach involved helps "…to find your sweet spot..." (P3), balancing medical and performance goals. They thought this would lead to better athlete outcomes and improve compliance to rehabilitation "…because they feel like they are training in a wellness environment, not a sickness environment, so they actually feel like they're just training." (SC4).

Overall, participants agreed that "…athlete outcomes are number one…" (P3) in athlete rehabilitation, and having an S&C coach involved would lead to better outcomes. Some suggested that athletes would have "...shorter time out of the game." (P3), while others thought that "…it may not improve on-time… but… they can probably get better outcomes..." (P2). Most thought that performance rehabilitation and injury reduction go "hand in hand…If you're better prepared, you'll… perform better, and you're less likely to get injured." (SC3).

However, there were negatives that participants brought up as well. Some thought that "there is no problem in the rehabilitation process without an S&C [coach]" (SC1). Many athletes get good outcomes in RTS without S&C coaches. However, the same could be said of any medical professional, and 'good outcomes' are not always the best outcomes. It, therefore, seems essential to consider the context and the athlete's needs before deciding whether an S&C coach is suitable.

There were some concerns about S&C coaches and physiotherapists crossing professional boundaries. "…S&C [coaches] try and get involved too early …when a player is not ready and push them too much… or vice versa, where the physios don't trust the S&C [coach]...." (SC3). This could make it difficult for athletes to know what information is best for their rehabilitation: "Getting told from one guy 'look, you're not quite ready. …and you've got your S&C [coach] saying, '…I think you're ready… The athlete will be thinking… 'Who do I believe?'" (P3).

Participants thought that negative scenarios only happened when communication and relationships between S&C coaches and the rest of the rehabilitation team are poor. If the variables listed in the above section are all considered, they thought that S&C coaches would positively affect athlete rehabilitation.

Discussion

To our knowledge, this is the first study that has explored the perceptions of physiotherapists and S&C coaches on the role of the S&C coach in athlete rehabilitation. The themes in this study were analysed in four categories. These themes in their respective categories were: Current role (teamwork with the rehabilitation team, level of involvement, and physical roles), proposed role (teamwork with the rehabilitation team, level of involvement, and physical roles), variables (rehabilitation team structure, governance, relationships in the rehabilitation team, and the athlete), and significance (positive and negative).

This study adds to emerging literature that attempts to clarify the role of S&C coaches in athlete rehabilitation. Previous literature provides a general framework (W. Kraemer et al., 2009; Lorenz et al., 2010; Maestroni et al., 2020; Reiman & Lorenz, 2011). This study explored the perceptions of S&C coaches and physiotherapists to clarify how the role is currently performed and how they think it should be performed.

The current role of the S&C coach was not clearly defined across all participants, but a spectrum of roles could be ascertained. Perceptions on the role of the S&C coach in athlete rehabilitation were mixed, suggesting that S&C coaches perform various roles depending on the S&C coach and the context. The spectrum of roles spans from not involved at all to only involved in performance rehabilitation during the end stages of rehabilitation to involved throughout the whole rehabilitation process. It seems that most are either not involved or only involved in end-stage rehabilitation, but S&C coaches with high skill levels or in highly collaborative team environments will have a much more significant role. Most agreed that S&C coaches that have minimal involvement in athlete rehabilitation should be more involved.

Participants had a much more consistent proposed role for the S&C coach in athlete rehabilitation. They thought S&C coaches should have some involvement following a health professional's diagnosis, and their greatest involvement should be in the performance rehabilitation of injured athletes. The athlete has a greater need for performance rehabilitation as their function improves. Therefore, participants suggested that the S&C coach's role should be small at first but increase as athlete function improves and the physiotherapist's role decreases. Therefore, S&C coaches and physiotherapists would be required to collaborate throughout the whole rehabilitation process, and their teamwork would have to be excellent. In addition, participants agreed that the S&C coach's role must be flexible and account for contextual and personal variables in the athlete's rehabilitation.

S&C coaches seem to perform their role in athlete rehabilitation more easily in interdisciplinary teams than multidisciplinary teams. However, if multidisciplinary teams communicate well, then the S&C coach can still perform their role. Many rehabilitation teams are multidisciplinary. Patients are sequentially passed between health professionals with minimal collaboration (Chamberlain-Salaun et al., 2013; Körner, 2010). This seems to be how most S&C coaches are currently included in rehabilitation teams, especially in community sport settings. Participants thought interdisciplinary teams, which have greater collaboration (Chamberlain-Salaun et al., 2013; Körner, 2010), are preferable for S&C coaches to perform their role. Participants that worked in interdisciplinary teams were usually involved in high-level sport or team sports on a contract basis. This allows S&C coaches and physiotherapists to have regular informal and formal, face-to-face communication. Therefore, they can collaborate efficiently in the planning and implementation of rehabilitation: "you've got S&C [coaches] you work closely with them because every

day you're planning and adjusting players' and athletes' programmes" (P3). Therefore, professionals in community settings (i.e., multidisciplinary teams) will have to be more creative with their communication methods to improve relationships and collaboration. Participants suggested phone calls, text messages, email, video calls, organising face-to-face meetings, or attending gym or physiotherapy sessions.

Once teams are collaborating effectively, it is easier to organically understand and distribute roles to suit each other's strengths (Green & Johnson, 2015; Rosen et al., 2018; Sims et al., 2015b). Participants saw the importance of this and commented that S&C coaches and physiotherapists need to understand their own roles as well as each other's to ensure that tasks are distributed to "…whoever is best suited for the job." (SC/P). This must be decided on multiple factors, including their knowledge and practical skills, personality, relationships with the athlete, and rehabilitation team members. The critical variable identified by participants is the athlete. Therefore, the proposed role of S&C coaches takes a 'patient-centred approach' (Rathert et al., 2013). Athletes must understand and value what S&C coaches can provide to involve them in their rehabilitation.

Participants identified the current governing structure of S&C as a barrier to S&C coaches performing their role in athlete rehabilitation. S&C does not have a nationally recognised governing body in NZ, and they are not obligated to gain qualifications to practice. S&C 4 has described it as "…a cowboy industry" (SC4). Many employers will expect experience or qualifications. However, to health professionals, that are not as well informed, it may be hard to assess an S&C coach's competence without knowing them personally. This may also explain why S&C coaches seem to perform their role more easily in interdisciplinary teams. Their education is so variable that many need to develop and understand their role through

face-to-face collaboration with health professionals. Ultimately, S&C coaches who do not have personal relationships with health practitioners will receive fewer referrals and won't develop this role. A governing body may highlight the importance of the S&C coach's role in athlete rehabilitation, provide more consistent education and competency thresholds, and create funding structures for S&C coaches. If S&C coaches cannot get paid for their work in rehabilitation, it will not be sustainable.

Research Implications

This is the first qualitative study to assess the role of the S&C coach in athlete rehabilitation. Although this study provides the perceptions of S&C coaches and physiotherapists on the role, further research on perceptions of other rehabilitation team members would help clarify the proposed role and their understanding of the role. Most notably of these team members would be the athlete themselves, because ultimately, the athlete will be the one deciding their rehabilitation pathway.

Furthermore, the proposed role of the S&C coach identified in this paper can be tested through quantitative research. For example, researchers could develop a randomised controlled trial that compares S&C coaches working collaboratively in this proposed role versus a control of standard physiotherapy. A study like this could assess rehabilitation time, rehabilitation outcomes, performance outcomes, and injury recurrence with and without the input of S&C coaches. Future studies should focus on this type of research to assess whether the proposed role of S&C coaches is effective in athlete rehabilitation.

Strengths and Limitations

The sample size of nine participants interviewed in this study is relatively small but adequate for saturation of homogenous groups (Guest et al., 2006). While a mix of

Physiotherapists and S&C coaches may not be considered homogenous, participants were linked through their experience in athlete rehabilitation and agreed on many ideas. In addition, both physiotherapists and S&C coaches were equally represented in this study. As the ninth interview provided no further subthemes, data saturation was achieved.

A key strength of this paper is that it provides a 'real world' perspective of the role of S&C coaches in athlete rehabilitation. While this may not capture the views of all physiotherapists and S&C coaches, it gives insight into the opinions of those who have experience in rehabilitating athletes. Quantitative data does not further support this, but it provides fertile ground for future study and clinical application. Therefore, the proposed role should be tested in research and clinically in athlete rehabilitation teams.

Purposive sampling would be considered a key limitation of this paper. This sampling strategy risks bias of the researcher impacting the selection process, but heterogeneous sampling helped ensure diversity among participants. The participants selected represent a range of ages, experiences, and education and have worked with various sports and competitive levels. The two female and seven male participants correlates well with S&C coach (Dwyer et al., 2019; B. W. Jones et al., 2019) and sports physiotherapy populations (Öhman et al., 2001). Although physiotherapy is female-dominated overall (Physiotherapy Board of New Zealand, 2020a; Reid & Dixon, 2018), men are more likely to be involved in sports physiotherapy (Dahl-Michelsen, 2014; Öhman et al., 2001). Even so, the participants selected were from NZ, and their views may not represent physiotherapists and S&C coaches in other countries where processes and professional roles differ.

Conclusion

This study found that physiotherapists and S&C coaches in NZ do not think that S&C coaches can perform their role in rehabilitation optimally. These participants believed that S&C coaches should have much more involvement and collaboration with physiotherapists in athlete rehabilitation. However, there are multiple barriers to their role. A key barrier is a lack of role clarity. This study should help to clarify the S&C coach's role in rehabilitation and help rehabilitation teams understand the variables that affect this role. This may lead to more opportunities for S&C coaches to work in athlete rehabilitation.

Chapter 4: Discussion

What is the Role of the S&C Coach in Athlete Rehabilitation?

As seen by this research, to define the role of the S&C coach in athlete rehabilitation, we must address three questions: “What does the literature say the role of the S&C coach is?” “What is the role that S&C coaches currently perform?” or “What is the optimum role for the S&C coach in athlete rehabilitation?”. Therefore, this thesis theorised the role of S&C coaches in athlete rehabilitation based on available literature in chapter two and chapter three explored the perceptions of S&C coaches and physiotherapists on this role. Chapter three gave insight into what participants thought the current role of the S&C coach is in athlete rehabilitation and what they think the role should be in the future.

The available literature suggests that the role is not currently in S&C coaches’ scope of practice. There is a gap in the rehabilitation pathway for athletes that is left by healthcare professionals (i.e. orthopaedics, physiotherapists) that have comparatively low knowledge in performance rehabilitation. Some S&C coaches are already engaging in rehabilitative practices and filling this gap. However, many have little to no involvement, and some do not yet have the experience required to do this safely.

The optimum role of the S&C coach, therefore, should be to provide performance rehabilitation to the best of their abilities in collaboration with a physiotherapist. Physiotherapists and S&C coaches in this study both suggested that S&C coaches should provide performance rehabilitation, but they stressed that they must understand their own abilities in relation to other rehabilitation team members to

determine their own personal scope. If S&C coaches and physiotherapists can both do this, then they can form a symbiotic relationship where the athlete benefits from the healthcare knowledge of the physiotherapist and the performance knowledge of the S&C coach.

Through the theorised role in chapter 2 and the role proposed by physiotherapists and S&C coaches, this thesis found three key areas that must improve for S&C coaches to perform their role in athlete rehabilitation:

1. Involve S&C coaches earlier in the rehabilitation process.
2. Allow S&C coaches to provide safe performance rehabilitation throughout athlete rehabilitation.
3. Improve teamwork between physiotherapists and S&C coaches.

The Theoretical Role of the S&C Coach

In chapter two, the S&C coach's role in rehabilitation was theorised through the framework suggested by Kraemer et al. (2009) and the literature that is available on doctors, athletic trainers and physiotherapists. It was concluded that S&C coaches should have a role in the end stages of athlete rehabilitation that increases as athletes are in greater need of performance rehabilitation. This theoretical role fills the gap in rehabilitation that is not fulfilled by health professionals (Asif et al., 2017; Macleod, 2000; Physiotherapy Board of New Zealand, 2018; Pigozzi, 2009; World Confederation for Physical Therapy, 2011). While some may argue that physiotherapists could be performing this role, the reality is that many physiotherapists do not have the experience required to develop the performance of multiple injured athletes across their varying sports codes. Asking physiotherapists to

do this is wearing them too thin because this is outside the average physiotherapist's scope of practice (Physiotherapy Board of New Zealand, 2018). The load of rehabilitation would be much lighter if it were shared across two professions (i.e. physiotherapists and S&C coaches). This statement is supported by the perceptions of physiotherapists and S&C coaches in chapter three. Currently, physiotherapists are unlikely to just start communicating with S&C coaches. Physiotherapists would need to be educated and welcoming of the role of S&C coach into rehabilitation and similarly S&C coaches will need to be educated and accredited with their role in rehabilitation. This would ensure that medical rehabilitation and performance rehabilitation meets in the middle through the physiotherapist and S&C coach.

The Perceived Role of the S&C Coach

In Chapter three, a thematic analysis of interviews with S&C coaches and physiotherapists suggested that if S&C coaches are involved in rehabilitation, their role is similar to the role theorised in chapter two. However, most added that this varies significantly depending on the context of rehabilitation. These variables were identified as secondary outcomes of this thesis and will be discussed later.

Currently, it seems that many healthcare practices are informed by traditional, hierarchical approaches where patients are handed over from one professional to another in a stepwise fashion. This seems to also apply to the relationship between physiotherapists and S&C coaches (Figure 8). These hierarchical models of healthcare makes collaboration and relationships more difficult to establish within healthcare teams (S. A. Nancarrow et al., 2013; Sims et al., 2015b). In athlete rehabilitation, this has led to a 'grey area' (Figure 7) where athletes receive no

professional assistance. Although there are some examples of intricate collaboration, particularly in elite sport settings, these seem rare.

The Proposed Role of the S&C Coach

Participants proposed that S&C coaches should be involved much earlier in the rehabilitation programme to perform their role optimally (Figure 9). This would require collaboration between physiotherapists and S&C coaches. Participants thought S&C coaches should provide a performance training context to the entire rehabilitation, communicating and collaborating with physiotherapists to coordinate their roles. They suggested that S&C coaches should be somewhat involved as soon as the health professional has made a diagnosis and progressively increase their involvement as the athlete's function improves. S&C coaches must be involved early enough in the rehabilitation process to allow more time to plan, communicate and enact performance rehabilitation. In this respect, the transition for an athlete from the physiotherapist to the S&C coach can be likened to the transition for a patient in hospital from doctors and nurses to a physiotherapist. Physiotherapists are involved from the start but as the patient's need for physiotherapy increases, the physiotherapist's role increases. This should also apply to athletes as their need for performance rehabilitation increases.

If physiotherapists and S&C coaches collaborate well with each other during athlete rehabilitation, this could lead to a range of benefits for the patient and healthcare providers. As described in chapter 2, simply teaming these two professions up is not enough. Better teamwork leads to improved outcomes; poor teamwork leads to worse outcomes than working independently. Therefore, physiotherapists and S&C

coaches must support and value each other's roles, ensure equitable communication strategies and improve collaboration for the benefit of all parties involved.

Barriers and Variables that Affect the Role of the S&C Coach

Involving S&C coaches in athlete rehabilitation must take into consideration the various contexts and barriers to them performing their role. Therefore, defining the role is not as simple as listing physical roles (e.g., weights training, sprint training, injury prevention). Participants in chapter three suggested multiple variables that may impact the role, including: The structure of the rehabilitation team, the S&C coach's relationships within the rehabilitation team, how S&C is governed, and different athletes. Participants, therefore, suggested that the S&C coach's role should be dynamic, and their role should change somewhat with each context.

Sharing Roles

The structure of the rehabilitation team can affect the role of S&C coaches in athlete rehabilitation due to the type of team and the relative experience of the team members. Physiotherapists and S&C coaches in this study suggested that there should be a dyad of leadership, and roles of the S&C coach and physiotherapist should be distributed based on their relative abilities in each area. Therefore, the athlete benefits from receiving care from the professional that is best suited to each role. This kind of symbiotic relationship is increasingly being seen between physicians and nurses in healthcare and can be mutually beneficial (C. Clausen et al., 2017; Saxena, 2021; St. Fleur & Mckeever, 2014). However, it is dependent on the quality of the relationship between the physiotherapist and S&C coach, role clarity and their willingness to give up control of certain tasks to the professional that

is better suited (C. Clausen et al., 2017; S. A. Nancarrow et al., 2013; Saxena et al., 2018).

Types of Rehabilitation Teams

Participants in chapter 3 also thought that S&C coaches could perform their role more easily in interdisciplinary rather than multidisciplinary teams. They argued that S&C coaches in interdisciplinary teams would benefit from simpler forms of communication and collaboration by talking face to face with physiotherapists. This idea is supported because smaller teams in close proximity often work more collaboratively (S. A. Nancarrow et al., 2013; Price & Lau, 2013; Sims et al., 2015b). Therefore, having clinics or gyms that employ both physiotherapists and S&C coaches will help to improve these relationships.

However, S&C coaches and physiotherapists may not need to work in close proximity to develop a closer relationship. Athletes, healthcare professionals, and coaching staff often work in separate facilities or in different locations across the country. Therefore, a range of tools must be utilised to achieve the same levels of collaboration. Following the events of the covid-19 pandemic, most of the world now has first-hand experience with the intricacies of achieving this level of collaboration without face-to-face contact. Online conferencing software and team communication platforms have been common tools. These and other methods can be utilised to improve collaboration in multidisciplinary teams (Appleman et al., 2020; Hurst, 2020; Karis et al., 2016).

Relationships Between Physiotherapists and S&C Coaches

It is especially important for S&C coaches that want to be involved in athlete rehabilitation to have a good relationship with physiotherapists. Currently, many S&C

coaches are left ‘out of the loop’ during rehabilitation because they do not have an established connection with physiotherapists. Better connections with their athlete’s physiotherapists will ensure that they will be kept informed and have a greater role. S&C coaches can develop these relationships by contacting their athlete’s physiotherapist. When they find a physiotherapist that they trust and communicate well with, they should refer their athletes to them to strengthen this relationship. Physiotherapists should also refer athletes to S&C coaches that they trust and are suitable fits for the athlete. This relationship will benefit both parties because physiotherapists that have good relationships with S&C coaches will get more clients referred to them and vice versa. This sets up a two-way referral system similar to what is often seen between doctors and secondary healthcare providers (Enabulele & Enabulele, 2018; Legge, 2019; Li et al., 2018). If this relationship is not established, then physiotherapists will still have a role in athlete rehabilitation, but S&C coaches will likely be left out because their role is not yet seen as essential to athlete rehabilitation. Therefore S&C coaches that want to be involved in an athlete’s rehabilitation should try to contact the athlete’s physiotherapist as early as possible.

Governance of the S&C Profession

There may need to be steps taken to regulate and uplift the S&C profession to popularise the role of S&C coaches in athlete rehabilitation teams. Most of the participants in this study did not agree that compulsory qualification or accreditation was necessary for S&C coaches. However, they suggested that creating a minimum threshold of competence for S&C coaches would help improve overall respect and trust in the profession by limiting the few outliers that discredit the name. Whichever way this is achieved, a governing body for S&C coaches in NZ could help achieve

this. The NZSCA seems like a suitable body to support in this role, but the number of accredited S&C coaches is still in its early stages.

A key issue for S&C coaches is that the profession is unregulated, so it is hard for the public and health professionals to trust that all S&C coaches are competent. S&C coaches may take ideas from other governing bodies, such as the PBNZ. One key role of PBNZ is ensuring that physiotherapists meet a minimum threshold of competence to maintain their registration (Physiotherapy Board of New Zealand, 2018) The Medical Council of NZ has similar minimum standards that a doctor must meet to maintain their registration (Medical Council of New Zealand, 2021). These thresholds aim to minimise bad experiences or unsafe practices. This instils trust in the public that all physiotherapists or doctors are at least at this minimum level of competency. *SC2* explains this well: "…they might be an average physio, but if they're a physio then they've at least done this… So 'bad' for a physio is not as bad as 'bad' for a strength conditioning coach.".

NZSCA aims to provide similar minimum competence standards for S&C coaches. They provide accreditation for different levels of competency from level 1: foundational to level 2: S&C practitioner coach and to level 3: S&C advanced practitioner coach. It is important that more S&C coaches and employers support this accreditation process to uplift the profession. If enough S&C coaches are accredited through NZSCA it will help other professions understand their expertise. This would be especially important for increasing S&C involvement in rehabilitation roles where the risks are higher, and competence is essential.

The difficulty of establishing such a professional body is that it takes time to develop one that would benefit all S&C coaches. Therefore, all participants in chapter 3

stressed that this body must be efficient and provide opportunities for S&C coaches for it to be supported. A governing body requires people to be paid to run it and regulate the profession. If these people do not advocate for and empower S&C coaches, then most S&C coaches will not see the benefit in paying them to do this. Physiotherapy and Medicine have been legally recognised professions for more than 100 years in NZ (Sainsbury, 2016; School of Physiotherapy University of Otago, 2021). They have had a long time to develop professional bodies that work for their best interests. S&C coaches have only been recognised more recently. They have not needed to be a legally recognised profession because they are not health professionals, but they will need to if they engage in athlete healthcare and rehabilitation.

Setting up a regulatory body for S&C coaches that want to engage in rehabilitation may be more suitable than demanding that all S&C coaches gain registration for rehabilitation. This would ensure that the body is accepted by all those that register. This would require some sort of short qualification and would need to be incentivised with pay for services in healthcare. For example, if S&C coaches were able to be paid through ACC for their services, then this would incentivise qualification. If this is set up, then the S&C coaches will be uplifted, and it helps them enter more rehabilitation spaces. As more health professionals and athletes are aware of their potential benefits in rehabilitation, they will have a greater role in rehabilitation.

Athlete's Autonomy

Ultimately athletes are all individuals that can choose their own rehabilitation pathway. Therefore, it is important that S&C coaches establish strong relationships with their athletes and highlight the importance of S&C to achieving a full RTS while maximising their performance. Part of establishing these relationships is considering

the variability of each athlete, their injury, and the context in which they are rehabilitating. For example, some elite athletes that are more experienced in training and assessing their own bodies may need less professional assistance in training. This may mean that the S&C coach merely provides guidance in the end stages of their rehabilitation, depending on the desires of the athlete. The S&C coach should not be overbearing in their approach to preserve their relationship, but help guide the athlete towards the optimal rehabilitation pathway.

Some athletes may decide to take a more independent approach or utilise an alternative provider. In these situations, it is not the S&C coach's job to dictate an athletes rehabilitation, but the S&C coach should help educate the athlete on the benefits of S&C to better inform their choice. The S&C coach may also discuss how they can work with other providers to provide a more holistic approach to rehabilitation.

The athlete's sport must also be considered. Each S&C coach will have a particular set of skills, and some may be more suited to certain sports. Therefore, pairing the right S&C coach to the right athlete is important to ensure sport-specific training. This especially applies to community S&C coaches that aren't linked to the athlete's sports team.

Finally, the athlete's injury will also determine how much involvement the rehabilitation team, including the S&C coach, has in their injury. Mild injuries will require less involvement as they will heal faster and be less debilitating. More severe injuries or mild injuries that have not rehabilitated in the expected time frames (chronic injuries) will need more involvement. In these cases, the S&C will be required to maintain or return performance throughout a longer rehabilitation.

Therefore, health professionals and S&C coaches should encourage transparent communication with the athlete on their injuries so that an appropriate amount of input from these professionals is given through their rehabilitation.

Clinical Implications

S&C coaches have the skills required to fill the performance rehabilitation gap in athlete rehabilitation. High rates of reoccurring injuries and decreases in sport-specific performance following injury suggest that health professionals alone may not be enough to fully return athletes to their pre-injury function, especially after long-duration injuries (Barber-Westin & Noyes, 2020; Mohtadi & Chan, 2018). One study has found that higher-level professional football players have a lower recurrence of injuries (Hägglund et al., 2013). They suggest that these players have better and more regular access to physiotherapy and medical staff, but they also train more frequently when injured than when they are healthy. Therefore, the S&C coaches have a large role in maintaining the injured players loads and smoothly transitioning them back to full function. S&C coaching should also be provided to lower-level players to ensure equitable health outcomes.

Therefore, in the clinical context, we must develop strategies for including S&C coaches in the athlete's rehabilitation. In its simplest terms, to allow S&C coaches to perform their role as proposed in this research, we need to improve the relationship and communication between physiotherapists and S&C coaches. One strategy is to set up clinics or gyms that have physiotherapists and S&C coaches, similar to sports medicine clinics that have sports doctors and physiotherapists. However, if this is not practical, collaboration and communication must be improved through the use of technology.

Of course, we must consider the range of variables that participants in this study have identified. However, the majority of these will improve organically if physiotherapists and S&C coaches make a concerted effort to communicate with each other during an athlete's rehabilitation. If they communicate well, they will be able to create a suitable rehabilitation pathway that provides the athlete with improved health and performance. With this plan in place, the athlete can better understand both roles and buy into the S&C coach's role. If the rehabilitation is successful and communication was good, the relationship between the physiotherapist and S&C coach will improve, leading to more referrals for both parties.

Research Implications

This study takes an in-depth exploration into the role of the S&C coach in athlete rehabilitation. Most of this research is qualitative, which can provide a wealth of information when developing theories. This study showed that there is a potential role for S&C coaches in athlete rehabilitation. It also showed that both physiotherapists and S&C coaches are amenable to the role and positive about it. New qualitative research should focus on the athlete's perspective on the S&C coaches' role in rehabilitation to further strengthen these theories.

In addition, new quantitative research on this topic should test these theories. New research should aim to assess the efficacy of this role in athlete rehabilitation. A randomised controlled trial that assesses rehabilitation time, rehabilitation outcomes, performance outcomes and injury recurrence with and without the input of S&C coaches would be a suitable means of assessing this. Long term injuries such as ACL rehabilitation may be easier to standardise due to the wealth of studies and

protocols already developed (M. J. Anderson et al., 2016; Cooper, 2019; Davies et al., 2017). This information may support the role of the S&C coach in theory, but data on cost-effectiveness should also be investigated to support potential government funding such as ACC.

Strengths and Limitations

Chapter two provides a logical and evidence-based theory of the role of the S&C coach in athlete rehabilitation. A systematic search of the literature was used to summarise the most common roles in athlete rehabilitation and identifies a clear gap in the rehabilitation pathway. In addition, it explores international scopes as well as NZ to understand how S&C may fit and utilises expert opinion to guide the theory.

However, there is no evidence to show the effectiveness of this role in practice. The literature review was only able to theorise the role. There was not enough literature on this subject to support a systematic search; therefore, a narrative review and hypothesis of the role were undertaken. It is not a conventional literature review, and therefore it does not follow traditional reporting guidelines.

Chapter three was able to gain a more 'real world' view of the role as it shows the perspectives of physiotherapists and S&C coaches. This gives insight into how the role might work in practice. There were 9 participants that were interviewed. Purposive sampling allowed for participants with a range of ages, experience levels and sports and equally represented S&C coaches and physiotherapists. In addition, the gender balance accurately represented the S&C and physiotherapy population.

While purposive sampling was able to accurately represent the population, it is also a key limitation of this study due to the bias of the sampler. Furthermore, those that wished to be interviewed are more likely to be people that are interested in the role

of S&C coaches in athlete rehabilitation and, therefore, more likely to have positive opinions of S&C coaches. Also, the perspectives of athletes would help further clarify the role.

Conclusion

S&C coaches' skills should be better utilised in athlete rehabilitation, especially in community sport settings. This thesis has found that there is a 'grey area' between medical rehabilitation and performance rehabilitation. This grey area is evident in both the literature, as described in chapter 2 and in practice, as described by physiotherapists and S&C coaches in chapter 3. Both the literature and the participants in chapter 3 suggest that this 'grey area' can be filled with better communication and role allocation between physiotherapists and S&C coaches. The key difference is that the literature suggests that S&C coaches should be involved in end-stage rehabilitation after the physiotherapist, and participants suggested that they should be involved throughout rehabilitation.

While the role suggested by participants seems ideal, it is not without its barriers. The type of team environment, relationships, governance of the S&C profession and athlete's autonomy must all be considered when finding the right role for S&C coaches in athlete rehabilitation. Therefore S&C coaches and physiotherapists should be flexible within their roles to ensure that the athlete gets the best out of both during their rehabilitation. If this level of collaboration is achieved, athletes should have an optimal rehabilitation that also encourages a return to performance in their sport.

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Appendices

Appendix A: Ethics Approval

24 February 2020

Andrew Armstrong
Institute of Sport, Exercise and Health
Otago Polytechnic
Private Bag 1910
Dunedin 9054

Dear Andrew

Ethics approval for project
Reference Number: 840
Application Title: *Physiotherapist and Strength and Conditioning Coaches' Perceptions of the Role of Strength and Conditioning Coaches in Athlete Rehabilitation*

Thank you for your application for ethics approval for this research project.

This letter is to advise that the Otago Polytechnic Research Ethics Committee review panel has approved your application, following the amendments made in response to feedback.

We wish you well with your work and remind you that at the conclusion of your research to send a brief report with findings and/or conclusions to the Ethics Committee.

All correspondence regarding this application should include the project title and reference number assigned to it.

This protocol covers the following researchers: Andrew Armstrong, Simon Body, Codi Ramsey.
Project approval is valid for three (3) years from date of letter.

Regards

[redacted]

Dr. Liz Ditzel
Chair, Otago Polytechnic Research Ethics Committee

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Appendix B: Sampling survey

Below is a link to the sampling survey used for this study:

https://otagopolytechnic.au1.qualtrics.com/jfe/form/SV_8kTD5MXezZYkx8N

Appendix C: Participant Consent Form

Participant Consent Form

Consent to take part in research

- I..... voluntarily agree to participate in this research study.
- I understand that even if I agree to participate now, I can withdraw at any time or refuse to answer any question without any consequences of any kind.
- I understand that I can withdraw permission to use data from my interview, in which case the material will be deleted.
- I have had the purpose and nature of the study explained to me in writing and I have had the opportunity to ask questions about the study.
- I understand that participation involves voluntary participation in an interview as selected by the researcher.
- I understand that I will not benefit directly from participating in this research.
- I agree to my interview being audio-recorded.
- I understand that all information I provide for this study will be treated confidentially.
- I understand that in any report on the results of this research my identity will remain anonymous. This will be done by changing my name and disguising any details of my interview which may reveal my identity or the identity of people I speak about.
- I understand that disguised extracts from my interview may be quoted in a dissertation.
- I understand that if I inform the researcher that myself or someone else is at risk of harm, they may have to report this to the relevant authorities - they will discuss this with me first but may be required to report with or without my permission.
- I understand that signed consent forms and original audio recordings will be retained in Dunedin, New Zealand by Otago Polytechnic for seven years.
- I understand that a transcript of my interview in which all identifying information has been removed will be retained for seven years following the completion of the thesis.
- I understand that I am entitled to access the information I have provided at any time while it is in storage as specified above.
- I understand that I am free to contact any of the people involved in the research to seek further clarification and information. Names, degrees, affiliations and contact details of researchers (and academic supervisors when relevant).

Signature of research participant

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Signature of participant Date

Signature of researcher

I believe the participant is giving informed consent to participate in this study

---------- ----------

Signature of researcher Date

Appendix D: Participant Information sheet

I. **Participant Information Sheet**

PARTICIPANT INFORMATION SHEET

Study title: **Physiotherapist and Strength and Conditioning Coaches' Perceptions of the Role of Strength and Conditioning Coaches in Athlete Rehabilitation**

Location:	**New Zealand**	Ethics committee ref.:	
Lead investigator:	**Andrew Armstrong**	Contact phone number:	(03) 972 7434

General introduction:
Strength and Conditioning (S&C) coaches have strong and long-term relationships with athletes. They are constantly adapting programs to ensure that athletes are performing in peak physical conditioning. Ideally rehabilitation requires injured athletes to return to peak physical conditioning. S&C coaches may provide the training required to rehabilitate to this standard however the S&C coaches role in the rehabilitation process is unclear.

Aim of the project:
I aim to address the question: "What are the perceptions of physiotherapists and S&C coaches on the role of S&C coaches in athlete rehabilitation?".

My contact details are written below please contact me if you have any questions:

Phone number: (03) 972 7434 Email: ARMSAS1@op.ac.nz

Who will participate in this study?
- Physiotherapist/strength and conditioning coach working in New Zealand
- This study aims to analyse the perceptions of physiotherapists and strength and conditioning coaches on the role of the strength and conditioning coach

How will interviews be conducted?
Interviews will take place either on location at Otago Polytechnic or through the web conferencing platforms Adobe Connect or Zoom (please enquire about these platforms).

Interviews will be conducted starting March 2020 onwards. They will be up to 60 minutes in duration with some time beforehand to set up and get acquainted.

How will information from this study be stored?

All interviews will be recorded and stored on a laptop computer and encrypted with a password. At the end of the project any personal information will be destroyed for any raw data on which the results are based. The data will be retained in secure storage for a period of seven years following the completion of the thesis, after which it will be destroyed.

The results of the project may be published in an academic journal and will be part of a master's thesis project which will be stored in a repository online at the Robertson Library at Otago Polytechnic. Additionally, data from this project may be used at a presentation in an academic conference but my anonymity / confidentiality will be preserved.

How will the data recorded in the interview be used?
The interview will be transcribed. These transcriptions will then undergo thematic analysis. The themes identified will then be compared between physiotherapists, strength and conditioning coaches and current literature to gain a greater understanding of the role of the strength and conditioning coach in athlete rehabilitation.

Will being in this study help me?

This study aims to improve the clarity of the role of the strength and conditioning coaches in athlete rehabilitation thereby improving communication between medical and performance professionals and continuity of care for injured athletes.

How will my confidentiality and/or anonymity be protected?
All participants will be given pseudonyms and any identifying information shall be removed. Quotations from the interviews may be used but they will not contain any information that can be used to identify the participant or others.

Can I change my mind and withdraw from the project?
You can decline to participate without any disadvantage to yourself. If you choose to participate, you may stop participating in the project and withdraw information that has been supplied. You can refuse to answer any particular question and ask for the recorder/camera /audio/ video to be turned off at any stage.

By signing below, you agree that you: have you read and understood this form, understand the aims of this study and would like to take part in this research.

Participant's Full Name: _____

Participant's Signature: _____

Date: _____

Statement of Researcher Obtaining Informed Consent
I, the undersigned, have fully explained the details of this research study to the participant named above.

Andrew Armstrong
(Name of Researcher)

_____ _____
(Signature of Researcher) Date

Appendix E: Interview Prompts

Interview Questions

Interview Schedule and prompts

1) Introduction
    a) Introduction
        i) Ask for consent to record
            (1) We can stop at any time
            (2) It is ok not to answer any of the questions
            (3) Any identifying information in this interview will be kept anonymous.
        ii) Introduce myself and a little about my background
    b) Please tell me about your **experience** with being / Strength and Conditioning Coaches being **involved in athlete rehabilitation**
        i) Positives? Negatives?
        ii) How has your experience differed when you have been /an S&C coach involved by comparison to not involved?
        iii) How would the outcome of athlete rehabilitation change with the inclusion/exclusion of a strength and conditioning coach in the rehab team?
            (1) Prompt: Tell me more about…. why do you say it would….
    c) Who do you think have been the most important members of the rehabilitation team in determining athlete return to sport outcomes?
        i) Why?
            - (e.gs minor ankle sprain vs major ankle surgery)
    d) What do you believe should be the **role of the strength and conditioning coach** in athlete rehabilitation?
        i) Prompt: Tell me more about….
        ii) Significance?
        iii) How does this ideal differ to your experience? *(perceived ideal vs perceived actual)*
            (1) Is this role you have described practical today?

(2) What influences the role they may have? Are there any barriers to them performing their role?

(3) What would have to change to achieve the ideal role?

iv) Has the role changed during your time working as an S&C coach/physio?

2) Idea formation

a) Tell me about your **experiences working in athlete rehabilitation teams**.

i) Can you please discuss the collaboration and communication there has been in these rehab teams?
(1) How do you communicate with S&C coaches?
(2) How often do you communicate with S&C coaches?
(3) How closely do you communicate with S&C coaches?

ii)

iii) What did the S&C coach have to offer in the team that you have described? / how may the team and outcome have changed if an S&C coach was involved?

- Multidisciplinary = *usually not working in the same building, most communication is over the phone, email etc…*
- Interdisciplinary = *working closely together and collaborating regularly with face-face communication, often with team meetings*

iv) How did your experience in an interdisciplinary team differ from you experience in a multidisciplinary team?

v) How does the S&C coaches role change between different teams?

b) How would your perceptions change if S&C coaches were **obligated to gain certification** under a nationally recognised governing body?

c) Ideas to expand upon
i) e.g. You mentioned "x" can we go a little deeper into this idea?
ii) e.g. earlier you said "x" why do you think this is? Can you help me understand this a little better?

3) Idea Clarity

a) It has been suggested that, in the rehabilitation continuum, physiotherapists and strength and conditioning coaches should **work together in 'end-stage rehabilitation'** and the **strength and conditioning coach** should then take over to **provide performance training** before return to sport.

i) To what extent do you agree or disagree with this *(Perceived ideal vs. literature ideal)*

ii) In your experience, how does this differ from what actually happens in athlete rehabilitation? *(Perceived actual vs literature ideal)*

b) Ideas to clarify
   i) e.g. So far, I'm getting the idea that "x" can you help me develop this idea?
   ii) e.g. 2 You said that "x" can you just help make this idea a little clearer for me?

c) What additional comments you would like to make with regards to this study?

Appendix F: Themes and subthemes

Current role (CR)		
Subthemes	**Themes**	**Description**
collaboration with the medical team	Teamwork with the rehabilitation team	The level of communication and collaboration between S&C coaches and physiotherapists is variable and context dependent.
Relationship and communication with the medical team		
Sharing roles with physios	Level of involvement	S&C coaches are generally involved in the end of rehab, sharing some roles with the physiotherapist. Otherwise they are not involved until 'cleared' by the physiotherapist.
Involved at the end of rehab		
Some are involved in athlete rehab		
Performance training in rehab	Physical roles	Some S&C coaches may be involved in the planning of end stage and performance rehabilitation. They have a key role in providing performance training and goals for athletes, but they are often left out of the rehab process.
Planning and adapting rehabilitation programmes		
what S&C coaches don't do		

Ideal role (IR)		
Subthemes	**Themes**	**Description**
Communicating with the athlete and performance team	Teamwork with the rehabilitation team	The S&C coach is in constantly communicating and collaborating with members of the healthcare and performance teams acting as a bridge between these teams in athlete rehabilitation.
Communicating and building a relationship with the medical team		
Collaborating with the medical team		
Large role in late stage rehab	Level of involvement	S&C coaches have a small role in early athlete rehab and this role increases in late stage rehab as the athlete is functionally closer to their return to sport goals.
Sharing roles with the physiotherapist		
Small role in early rehab		
Performance training in rehab	Physical roles	S&C coaches apply performance principles to rehabilitation, planning, assessing and implementing rehabilitation training programmes in collaboration with the medical team. They must not cross professional boundaries into medical roles.
Planning and adapting rehab programmes		
What S&C coaches shouldn't do		
Adapting to the scenario	Understanding your own role	S&C coaches must understand their own knowledge, skills and confidence in specific rehabilitation settings to know when and how to apply their skills in rehabilitation.
Understanding your abilities and limitations		

Variables that affect the role (V)		
Subthemes	**Themes**	**Description**
S&C coach's knowledge, skills and confidence	Rehabilitation team structure	The S&C coach's role and level of involvement will change dependent on the type of team they are involved in and their knowledge skills and confidence in each stage of rehabilitation relative to their team members
Physiotherapist's knowledge, skills and confidence		
Type of team		
Funding	Governance	A governing body for S&C coaches with an accreditation process and funding structures would influence how they operate
Accreditation and regulation		
Relationship with the performance team	Relationships in the rehabilitation team	Relationships with members of the medical and performance teams will affect how involved S&C coaches are in the athlete rehabilitation process
Relationship with the medical team		
Communication with the physio		
Athlete's understanding	The Athlete	The S&C coach's role will change dependent on the athlete's individual circumstances and needs
Injury severity		
Level and type of sport		
Athlete's choice		

Significance of the role (S)		
Subthemes	**Description**	**Themes**
Trust	Team S&C coaches have spent time to develop trust in their athletes and coaching staff	Positive
Time available	S&C coaches generally spend more time with athletes	
Performance mindset	S&C coach's performance mindset can supply important goals and information for rehab	
Professional development	Physios and other medical professionals can learn from the S&C and vice versa	
Athlete outcomes	Athletes may return to sport with better outcomes if S&C is involved in rehab	
Equally important in rehab	S&Cs are equally important as all other members of the rehab team	
Not essential	S&Cs are not essential for athletes to return to sport	Negative
Crossing professional boundaries	If professional boundaries are not made clear this may cause role disputes	