Abstract

Assessment of player's postural control following a lower limb injury is of interest to sports medicine practitioners due to its fundamental role in daily tasks and sporting activities. The aim was to longitudinally monitor professional rugby union players 'postural control during each phase of the rehabilitation programme (acute, middle, late) following a lower limb injury. Seven male rugby union players (height 1.80 ± 0.02 m; mass 100.3 ± 11.4 kg; age 24 ± 4 years) sustained a time loss, non-contact lower limb injury. Static postural control was assessed via sway path (m) and dynamic postural control was assessed via vertical postural stability index (VPSI). Group differences ($p < 0.05$) were reported across the acute, middle, and late phase. Smaller magnitudes of sway path were observed for eyes-open sway path, and for the middle and late phase smaller magnitudes of VPSI ($p < 0.05$) at the at end session compared to first session. Whereas larger magnitudes of VPSI were found between baseline and the last session ($p < 0.05$). Large inter and intra-individual variation was apparent across the three phases of rehabilitation. Postural control improvements were identified during rehabilitation. However, postural control did not return to baseline, with altered kinetics throughout each rehabilitation phase.

Keywords: *RTP, static, dynamic, sway path and vertical postural stability index*

Word Count: 4373

Introduction

In rugby union, lower limb injuries account for a higher injury incidence and burden compared to upper limb injuries[1–3]. The majority occur due to a non-contact mechanism, predominantly during running, change of direction (e.g., side stepping, cutting) and jump landing manoeuvres[4,5]. How such movements are executed ('movement pattern') as well as their ability to control their centre of mass ('postural control') may predispose players to injury[5,6]. Following a non-contact lower limb injury, athletes may alter their movement pattern, whilst maintaining pre-injury levels of performance[7–9]. Therefore, using performance metrics, such as jump height, alone likely overestimates an athlete's rehabilitation status[10].

During rehabilitation, practitioners should focus on a player's injured structure, postural control, static vector alignment and movement pattern[11]. In particular, assessing an athlete's postural control during rehabilitation is important as it measures an athlete's ability to maintain, achieve or restore a state of balance during any posture or movement[12]. Maintaining postural stability requires the integration of sensory information and execution of appropriate motor responses[13]. However, practitioners typically overlook the importance of postural control assessments during rehabilitation, instead focussing on an athlete's movement pattern during the first landing of a drop jump and/or change of direction manoeuvres.

Postural control can be evaluated using both static and dynamic functional assessments[14–16], thus allowing investigation of changes to a player's sensorimotor control throughout the course of their rehabilitation until their return to play (RTP). This multidimensional system (sensorimotor) encompasses the interaction of visual, vestibular, and somatosensory systems providing neural feedback via proprioception to the central nervous system (CNS) to maintain posture.

It is proposed that the rehabilitation process should be divided into three phases (acute, middle and late), to follow the progressive nature of rehabilitation and the associated kinetic assessments that are measured in each phase of RTP [11]. Early assessments of static postural control have been thought to highlight any sensorimotor disparities and ensure they are accounted for throughout the rehabilitation programme[17–20]. During the earlier stages of rehabilitation, assessments of postural control are typically measured through static postural control assessments, and are suggested to highlight any sensorimotor disparities (e.g., larger centre of pressure (CoP) sway path)[17–20]. Static postural control, however, has been suggested to not represent the functional demands of sports such as rugby union. Although, research has found athletes who demonstrate better postural control in the early stage of rehabilitation predict an athlete's recovery during the later phase of RTP[20] and static postural control is associated with more complex biomechanical assessments such as landing or jumping[20–22]. Static postural control is deemed the underpinning of all human movement, with it being related to athletes' progression throughout rehabilitation (during the middle-to-late rehabilitation phase) following injury.

Dynamic postural control is typically measured using the dynamic postural stability index (DPSI; Wikstrom et al. 2005). The DPSI quantifies the ability of an athlete to maintain control when transitioning from a dynamic to static state (e.g., landing a jump), and has been suggested to better represent the functional demands of multiplanar sports than solely assessing static postural control[15]. Specifically, the DPSI has been proposed to reflect player's ability to decelerate their centre of mass (CoM) upon landing[22]. Assessments of dynamic postural control provide practitioners with an objective measure of an athlete's response to perturbation of the CoM and provides additional insight that static assessments alone cannot provide. Furthermore, DPSI is thought to be associated with the peak vertical force that individuals must dissipate upon landing[22]. Higher DPSI scores have been found in athletes at the point of RTP following a lower limb injury when assessed through uniplanar and multiplanar assessments compared to controls and uninjured limbs[16,23]. Moreover, higher vertical postural stability index (VPSI) scores have been found in runners with hip, thigh, knee, ankle and foot injuries compared to uninjured runners, suggesting it is the attenuation of vertical as opposed to anterior-posterior and medial-lateral forces that are affected following a lower-limb injury[24]. This may imply that there are central mediated changes following an injury, with the sensorimotor system being unable to adapt to the required vertical ground reactions forces experienced during landing and deceleration of the CoM. Furthermore, non-linear dynamics theory may provide additional support for these central mediated changes, as following an injury there are reduced degrees of freedom in an athlete's motor program to adapt to the change in the situation and neuromuscular feedback impairment results[25].

To the authors knowledge, no study has longitudinally assessed postural control across the entire rehabilitation period through to point of RTP in any playing level. Prospective longitudinal investigation of professional athletes provides practitioners with a comprehensive understanding of athlete responses to medically supervised and guided rehabilitation following a lower limb injury. Therefore, the aim of this study was to longitudinally monitor professional rugby union players ‘postural control during three phases of the rehabilitation programme (acute, middle, late) following a lower limb injury. It was hypothesised that there would be initial deficits in players static and dynamic assessment of postural control compared to baseline, however over the phases of rehabilitation there would be improvements in static and dynamic postural control.

Methods

Participants: A season long prospective funded field-based applied study was conducted. The final cohort of injured players were seven male rugby union players (height 1.80 ± 0.02 m; mass 100.28 ± 11.38 kg; age 24 ± 4 years) from a professional rugby union team based in South Wales, UK. Each player had sustained a minimum of 14-days' time loss non-contact lower limb injury[26]. To overcome the fundamental issues of the small sample size due to resource constraints[27], a compromise power analysis was calculated (GPower; version 3.1.9.7) ensuring power was met at 0.8, with an alpha level of 0.05 and medium effect size of 0.6. Effect sizes were computed to assess the relevance of differences between testing sessions. Ethical approval was obtained from the University Institutional Review Board.

Protocol

Phases of RTP: Pre-injury baseline data were collected for all players within the team (n = 37) during pre-season testing. Upon sustaining an injury all players received an individual rehabilitation plan following their professional medical diagnosis from the same practitioner who was the medical lead of the RTP program. The nature of this environment meant that we could control for 'safe' progression of players with supervised and guided rehabilitation. All players sustained a lower limb injury whilst playing for the professional team during the same playing season. The same medical lead of the RTP created individual rehabilitation programme for all players. Immediately following injury, players entered a RTP programme comprising three phases (acute, middle, late; Figure 1). The progression of players to the subsequent phase of RTP (acute to middle, middle to late, late to RTP) was an informed decision between relevant stakeholders (e.g., medical performance manager, medical lead of the RTP program and the strength and conditioning RTP coach). Postural control was assessed during each phase. Players were tested weekly to determine their readiness to progress to the next stage of the RTP programme, and this helped to determine the first and last testing session within each rehabilitation phase. Subsequently, data recorded during the first and last session of each rehabilitation phase were used in analysis. All players received an individual rehabilitation programme designed by the medical lead of the RTP programme. The progression of players through the phases of RTP (Figure 1) was a shared decision between the medical performance manager, medical lead of the RTP programme and strength and conditioning RTP coach.

FIGURE 1 HERE

Injury detail: The knee was the most commonly injured body area (n = 4), followed by the hip (n = 2) and then the ankle (n = 1). Ligament injuries accounted for 57% of all lower limb injuries and muscle accounted for the remaining 43%. The mean and median duration of player's time in each phase can be found in Table 1. One physician from the team was responsible for recording and reporting all injury details. Injury records were checked for missing data by an independent researcher.

TABLE 1 HERE

Postural control assessments: In the acute phase, unilateral postural control was assessed under two conditions: eyes-open and eyes-closed[28]. Data were collected using a PASCO dual axis force plate (PS-2142; 1000 Hz). Each trial was 20 seconds in duration, interspersed with 30 second rest between trials. Players were instructed to stand on their injured limb, place their hands on their hips, flex (90 degrees) their contralateral non weight bearing limb at the knee and to look straight ahead for both conditions. Players were informed that should they come out of this starting position, they should regain it as soon as possible as the trial would not be stopped.

During the middle phase players performed a unilateral drop jump from 20 cm[29] onto a PASCO single axis force plate (PS-2141; 1000 Hz). Players were instructed to stand upright with their hands on their hips, rolled off the injured leg to land on the injured leg, and once they hit the floor to jump as high as they can, whilst spending as little time as possible on the force plate. Players had 30 seconds rest between trials. Prior to data collection the force plate was calibrated according to manufacturer specifications, and prior to each test the force plate was zeroed.

During the late phase a lateral hurdle hop was performed on PASCO single axis force plate (PS-2141; 1000 Hz). Players were required to hop unilaterally over a 15 cm hurdle and immediately hop back to their initial starting position[11]. If testing their right leg, players were instructed to stand on their right foot to the left of the hurdle (on the left force plate), with the first hop being in a rightwards direction over the hurdle, and the second hop back in a leftwards direction to the original starting position. Each trial was interspersed with 1-minute rest periods.

Data analysis: All biomechanical data were processed using a customised written MATLAB script (Matlab R2019b). A 4th order, recursive low pass Butterworth filter with a cut-off frequency of 35 Hz for static postural control (acute phase) and 25 Hz for dynamic postural control assessments (middle and late phase) determined by residual analysis. Sway path was calculated for the acute phase static postural control assessments as the total distance of the CoP trajectory[30] during the final 5 seconds of each trial to measure the static phase of static postural control. Within our laboratory, the test-retest reliability and concurrent validity of three trials has been shown to have high agreement and measurement precision when assessing the final 5 seconds of static unilateral postural control [31]. Additional analysis found the concurrent validity to have small differences illustrating heteroscedasticity between Kistler laboratory-grade and PASCO force plates (Additional file 1). The test-retest reliability observed moderate intraclass coefficient correlation (ICC) were observed for sway path across the interval for eyes open (ICC 0.60-0.81) and eyes closed (ICC 0.62-0.95).

During the middle and late phases, dynamic postural control was assessed (Wikstrom et al. 2005) using vertical force to determine the VPSI. The VPSI is a measure of the fluctuation from body weight to standardise the vertical ground reaction force of the landing, describing the attenuation of force upon landing[15]. The second landing of dynamic postural control assessments were analysed. Within our laboratory, the validity of the VPSI was assessed against the DPSI score for both dynamical postural control assessments used in the middle and late phases (unilateral drop jump and lateral hurdle hop, respectively), with a small bias being observed between the separate calculations (Additional file 2). The mean test-retest reliability displayed excellent ICC for the drop jump (ICC 0.94 (0.86-0.97) and moderate ICC for hurdle hop (ICC 0.79 (0.51-0.91)).

Statistical analysis: Means ± SD of all three trials for each participant were computed. For statistical analysis the Shapiro-Wilk test were used to test for normality, for all variables. Simple, last category contrast analysis was used to compare player's responses between pre-injury baseline and the last session of each of the RTP phases, as well as between the first and last session of each RTP phase (acute, middle, late). Relative change (RC; %) were calculated as the difference between the first and last session of each phase, relative to the last session. The RC was also calculated between pre-injury baseline and the last acute session. Due to the small sample size Hedges' *g* effect size (g) was used to determine the magnitude of change and interpreted as small (g = 0.2–0.5), medium (g = 0.51–0.8) and large (g > 0.8; Hedges 1981). The coefficient of variation (CV) for each variable within each phase was calculated ($CV\% = \frac{\text{standard deviation}}{\text{group mean}} \times 100$) to assess the dispersion of players' response relative to the mean, being independent of the unit which the variable was calculated from. All statistical analysis was performed using SPSS (v.27.0), significance was set at $p < 0.05$.

Results

In the acute phase (Figure 1), a shorter sway path was observed for the eyes-open condition in the last session (0.19 ± 0.06 m) compared to the first session (0.17 ± 0.04 m; F(1) 11.88, p 0.01, η2 0.66, *g* 0.81; Figure 2). For eyes closed a larger sway path were observed for the last session (0.52 ± 0.13 m) compared to baseline (0.41 ± 0.10 m; F(1) 19.28, p 0.01, η2 19.38, *g* 0.75; Figure 2).

When looking at the CVs across the three testing sessions (pre-injury baseline, the first and last testing session), static postural control individual player dispersion of CVs widen across all testing sessions. During eyes open, CV increased from baseline (21%) to first session (33%) and then decreased in the last session (25%). The first testing session had the largest intra-variability (CV 33%) compared to pre-injury baseline and the last testing session (CV 21% and 27% respectively). During eyes closed assessments, the CV dispersion for inter- variability was lowest at baseline (20%) and, increases in the first (24%) and last (26%) testing session. The intra-variability for eyes closed assessment showed the last testing session to have the largest variability within the acute phase (CV 26%) compared to the initial two testing sessions (24% and 20% respectively).

FIGURE 2 HERE

A larger VPSI was observed at the end session compared to the pre-injury baseline for drop jump (middle phase; F(1) 47.99, p <0.001, η2 0.89, *g* 2.72; Table 2). The difference between RTP first and last testing sessions found VPSI to reduce over the sessions (F(1) 47.99, p 0.05, η2 0.89, *g* 0.74). In the drop jump, all players had lower VPSI at pre-injury baseline compared to the last testing session (Table 3). In contrast, two out of seven players (001 and 004) increased their VPSI between the first and last testing session. The CV dispersion is highest at baseline (25%) and, decreases in the first (18%) and last (20%) testing session. The intra-variability was the largest at players pre-injury baseline (CV 25%) compared to the first and last testing session (CV 18% and 20% respectively).

TABLE 2 HERE

Similar to the middle phase, VPSI during the hurdle hop (late phase) was lower in the pre-injury baseline compared to the last session (F(1) 32.47, p 0.001, η2 0.84, *g* 0.94 respectively; Table 2). Additionally, a smaller VPSI was observed between first and last testing sessions (F(1) 7.69, p 0.03, η2 0.56, *g* 1.67). The variability between players kinetic strategy for the lateral hurdle hop shows all of seven players increased VPSI between the baseline and last testing session (Table 3), with CV dispersion increasing from pre-injury baseline (41%) to first session (63%) and then decreasing in the last session (23%). The intra-variability between players movement pattern for the lateral hurdle hop was the smallest during the last testing session (CV 23%) compared to preinjury baseline and the first testing session (CV 41% and 63%).

TABLE 3 HERE

Discussion

The aim of this study was to characterise the longitudinal alterations in postural control throughout rehabilitation following lower limb injury in professional rugby union players. At a group level there was a significant difference ($p < 0.05$) in players last testing session across each phase compared to pre-injury baseline, suggesting players had not returned to pre-injury postural control levels. However, players' postural control did improve over the course of rehabilitation as there were significant improvements between the first to last testing sessions of each phase. Inter-individual variation was relatively unchanged during early and middle rehabilitation but was reduced during the late rehabilitation phase.

Within the acute phase of rehabilitation at a group level a larger sway path was observed for the static postural control assessment for the eyes-closed condition between pre-injury baseline and end testing session. A larger sway path may suggest a reduced static postural control ability, and may be explained by the disruption in afferent signals from the mechanoreceptors following a lower limb injury[32]. Following an injury, mechanoreceptors have been found to inhibit postural control due to being unable to actively change the tension of the joint[33–35]. Moreover, it is important to consider the lack of familiarity in this task, leading to a decreased static postural control (as seen through larger sway path). Conversely, for eye-open conditions there were improvements between the first to end sessions of the acute rehabilitation phase. Whilst this study was the first to consider static postural control improvements in the acute phase of RTP, other studies have shown similar improvements in the late phase of RTP[36]. These improvements could be associated with rehabilitation targeting deficits into the somatosensory system specifically mechanoreceptors and proprioceptors[37–39]. Furthermore, these improvements may further suggest that the individualised rehabilitation programme each player undertook in the acute phase of RTP focused on targeting the relevant aspects of the efferent components of the neural system[40]. This may, therefore, allow improvements in the transmission of sensory information, regarding joint position, movement, and strain, through afferent pathways to the CNS[41]. These findings support previous research that has shown that increasing task complexity, such as eyes-closed conditions, leads to larger magnitudes of change in postural control (e.g., larger sway path) than simpler tasks, such as eyes-open conditions[42].

Five out of seven players displayed a larger sway path in the last session of the acute phase compared to pre-injury baseline for eyes-closed assessments. Additionally, there is a larger dispersion in players’ response during the last testing session compared to pre-injury baseline. This could suggest that individual player responses differ as the trial progresses and suggests the strategy players employ to ensure their CoM remains above the base of support varies between players[43]. The larger dispersion between players may indicate that at the end of the acute phase of RTP, there are larger inconsistencies in the way players execute the static postural control trial. A possible explanation for this could be that following an injury the alterations occur to players sensorimotor system and their ability to control their CoM likely varies[38,44]. Within practice the assessment of dynamic postural control may provide practitioners with the tool to determine the aberrant landing mechanisms. This may suggest persistent deficits to players' neurosensory characteristics, through an inability to control and stabilise themselves on landing, and as a result of the inability to absorb and dissipate kinetic energy during impact[16]. During the middle and late phase, the assessment of dynamic postural control show group level differences between testing sessions. Improvements were evident across the two phases between the first and last testing session of each phase, during the middle phase five players and all players in the late phase decrease their VPSI. These findings likely suggest that across the middle and late phases, players have a greater capability to decelerate their CoM following reactive rebound uniplanar and multiplanar biomechanical assessments. This could imply that when comparing to the first testing session of the middle and late phase of rehabilitation the mechanoreceptors are able to actively change the tension of the joint prior to landing[35,45]. Findings could also infer an improvement in a players' landing strategy to ensure they are able to actively change the tension of the joint in order to react efficiently to the base of support displacements or to external mechanical stimuli.

During the middle phase, P1 demonstrated the opposite kinetic response when performing the uniplanar dynamic movement and P4 showed no improvement, which may be harmful as VPSI is an indicator of a player's interaction of neurophysiological, biomechanical, and motor control[38]. The difference in VPSI for P1 likely infers a control strategy alteration, whereby there are changes in the sensorimotor system facilitating players inability to dissipate force upon landing. This implies that there are central mediated changes following an injury with the sensorimotor system being unable to adapt to the required landing and deceleration of the CoM[25]. Therefore, it may be suggested that pratcioners should routinely assess a player's dynamic postural control throughout the latter phases of their RTP.

In line with previous research, this study offers further support that negative alterations occur in players ability to control and stabilise themselves upon landing following a lower limb injury. Despite improvement across the middle and late phase, there were still group level deficits in players VPSI at the end of both phases when compared to players pre-injury baseline movement pattern. At an individual perspective all players displayed an increase in VPSI at the end of both phases, however the magnitude of this increase varied between players. This increase is indicative of a poorer/worse VPSI score and may suggest alterations in the neurosensory characteristics, possibly reflecting an inability for players to absorb kinetic energy during impact[16]. Therefore, although rehabilitation during the middle phase seemingly improved a player's ability to decelerate their CoM following reactive rebound biomechanical assessments, players did not return to their pre-injury baseline score. This supports previous research that has observed deficits in biomechanical assessments at the point of RTP[46–48], meaning players' control during landing linear movements were not adequately addressed in the middle and late phase of rehabilitation. As such, these findings suggest that there is a need to quantify landing kinetics during the later phase of RTP, ensuring that players' rehabilitation programmes aim to restore their ability to control their CoM on landing and are assessed through lateral biomechanical assessments and prior to the point they are cleared to RTP. Therefore, it is advisable that pratcioners should look to use dynamic assessments of postural control throughout an athlete's rehabilitation as the findings reinforce that landing is a complex action, requiring dynamic resistance from structures to withstand the forces experienced on landing and simultaneously enable rapid deceleration of the CoM. The aberrant landing mechanisms in this study suggest persistent deficits to players' neurosensory characteristics through an inability to control and stabilise themselves on landing, subsequently resulting in an inability to absorb and dissipate kinetic energy during impact.

This study is the first to characterise the group and individual postural control patterns throughout rehabilitation, showing the association injury has on the complex nature of players movement pattern and the varying degrees of freedom players have to execute the same movement following a lower limb injury. It appears that players sit along a continuum for movement pattern where their unique responses to cope with the consequences of a lower limb injury can be quantified. For example, there is variability in players responses to rehabilitation, although all players show deficits in VPSI at the end testing session during the dynamic postural control assessments there is varying magnitudes of differences. It could be inferred that despite similar magnitudes of VPSI between the middle and late phase, there is a larger dispersion in the late phase than the middle. Thus, this may imply that task complexity may influence the degeneracy that occurs[49,50]. Based on the self-organisation theory[51] individuals may use varying combinations of degrees of freedom to achieve the same outcome, in this case landing. For the middle phase, smaller dispersion are evident in VPSI compared to the late phase across all three testing assessments (pre-injury baseline, the first testing session, and the end testing session). These findings may suggest that as the complexity of assessment increases so does the variability between kinetic strategy. Once again it could be postulated that the kinetic strategy adopted is individual to each player[52]. Despite the individual nature of a player's response to RTP practitioners should routinely assess dynamic postural control, as VPSI may assist in the ability to detect changes in the sensorimotor system through prospective outcome-oriented investigations.

We acknowledge that there were several limitations in this study, first, although kinetic analyses were performed on the biomechanical assessments, only vertical ground reaction force was quantified during the acute, middle, and late phase of RTP, due to the 'infield' nature of the study. This limitation prevented the assessment of medio-lateral and anterior-posterior forces (Fx and Fy, respectively), that would have provided insight into the directional force that was being applied to the body. Secondly the results can only be applied to elite male rugby union players, meaning further research is required to examine if postural changes over the duration of the trial were observed in different populations. A final limitation of this study was the sample size due to resource constraints[27], as this would have affected the power of the measurement and is therefore a likely reason for the moderate positive correlations being non-significant. However, as this is a prospective study, the lower sample size is typical due to the nature of data collection.

The study supports the existence of players independent response to rehabilitation following a lower limb injury, with alterations in players movement strategy sitting along a continuum, varying in the magnitude of change evident in the varying dispersion of player responses. In summary, the findings from the investigation highlight that in all phases of RTP, players alter their kinetic strategy to attain the same performance magnitudes from the first to end session. However postural control deficits are present at the end of each phase. Therefore, whilst players may not have returned to their pre-injury movement strategies, it is likely that they developed compensatory strategies to overcome this. This suggests that the prescribed rehabilitation programme fails to account for the factors that expose players to greater risk of injury occurrence. This suggests practitioners should incorporate investigation of static and dynamic postural control into their assessment of a player's rehabilitation following lower limb injury. Due to the changes in the athlete's motor program to adapt and subsequently receive neuromuscular feedback it may elicit players to a great risk of reinjury.

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Tables

Table 1: Mean ± SD and median (95% CI) of weeks spent in each phase

RTP phase	Mean duration	Median duration
Acute	7±4	4 (11-3)
Middle	10±5	10 (19-1)
Late	6±2	6 (10-2)

Table 2: Mean ± SD group VPSI pre-injury baseline, initial and end testing session of the drop jump and lateral hurdle hop [CV]. Effect size (g) and relative change (RC) between testing session comparison

				Testing Comparison			
				Baseline – Last		First – Last	
				g	RC%	*g*	RC%
Middle phase - Drop jump		Baseline	**9.69±2.29 [25%]**+	2.72	82%		
	RTP	First session	**20.32±4.13 [18%]***			0.74	17%
		Last Session	17.51±3.44 [20%]				
Late phase - Hurdle hop		Baseline	**8.73±3.57 [41%]**+	1.67	93%		
	RTP	First session	**25.45±16.02 [63%]***			0.94	42%
		Last Session	14.53±3.38 [23%]				

Abbreviations: *g*: effect size, RC: relative change, RTP: return to play. *Note*: Bold indicates $p \leq 0.05$, or hedges g ≥ 0.80 *** and dashed underlined** indicates significant difference between the first and last session. **+ and underlined** significant difference between pre-injury baseline and the last session

Table 3: Mean ± SD individual player VPSI for the middle phase (drop jump) and end phase (lateral hurdle hop

Player	Phase	Session	**Middle phase - Drop jump**	**Late phase – Hurdle hop**
001	Baseline		7.39±0.98	6.42±0.56
	RTP	First session	14.83±1.56	19.34±3.14
		Last Session	16.06±1.98	9.55±1.89
002	Baseline		6.00±0.56	8.14±0.98
	RTP	First session	20.60±3.98	20.41±2.16
		Last Session	12.92±1.21	15.87±1.65
003	Baseline		10.97±1.43	10.89±1.25
	RTP	First session	23.08±0.76	29.20±2.78
		Last Session	22.02±3.54	16.36±2.01
004	Baseline		10.48±2.76	7.24±1.43
	RTP	First session	16.33±1.85	26.99±4.12
		Last Session	16.84±2.12	19.56±2.68
005	Baseline		12.84±1.01	4.40±0.98
	RTP	First session	20.80±2.09	36.16±4.87
		Last Session	15.90±1.45	15.58±1.27
006	Baseline		10.34±2.12	11.18±1.69
	RTP	First session	27.38±2.98	20.59±2.65
		Last Session	22.32±1.12	15.44±0.88
007	Baseline		8.54±0.67	9.82±1.02
	RTP	First session	27.38±3.17	25.48±3.98
		Last Session	16.98±1.99	13.60±3.02

Figure Captions

Figure 1 — Return to play testing timeline

Figure 2 — Mean ± SD and individual player responses in the acute phase (eyes open and eyes closed static postural control assessments) between baseline, and the first and last session of the acute phase for sway path intervals. * Indicates significant difference between sessions ($p < 0.05$)