Return to training and play following concussion or traumatic brain injury

La vuelta al entrenamiento y la competición tras una conmoción y traumatismo craneoencefálico

Cristian Solis Mencia

Specialist Doctor in Physical Education and Sports Medicine Doctor for the Complutense Cisneros. Rugby Club Medical consultant on Brain Concussion for the APOME (Spanish Association of Male and Female Rugby Players).

doi: 10.18176/archmeddeporte.00106

Return to play following Brain concussion or Traumatic Brain Injury (TBI) is a constantly evolving subject. 20 years ago, return to play was a dichotomous decision, where it was left to the athlete to decide whether or not to return to unrestricted sports practice once the symptoms had disappeared[1]. This type of management of the return to sports practice was associated with further concussions in the same season, most of which occurred in the first 10 days after the injury[2]. In year 2000, a document put forward the idea of a gradual return to sports practice (RTP or Return to Play)[3], which was adopted by the Concussion in Sport Group at the first world conference in 2001[4]. This RTP protocol was revised and modified at the Concussion in Sport world conference held in 2016[5].

RTP is a protocol to be implemented following concussion in which there is a gradual increase in the sport-specific physical demands. In this respect, athletes are required to be symptom-free before beginning the first stage of the RTP protocol[5,6]. This RTP protocol has 6 stages (Table 1) and permits a symptom-free athlete to progressively advance stage by stage. Each stage must have a 24- to 48-hour duration. Should a symptom occur, then the athlete must return to the previous stage and remain symptom-free for at least 24 hours before advancing to the following stage. Although the RTP protocol is widely accepted, it was empirically prepared and, therefore, studies need to be made in order to assess the effectiveness of the advancement in stages, as well as the duration of the same[6].

The consensus statements on managing sport-related concussion recommend rest as part of RTP[6,7]. Rest is justified for at least three reasons. Firstly, rest probably reduces post-concussion symptoms, easing discomfort during the acute recovery period by mitigating post-concussion symptoms. Secondly, after concussion, rest may promote recovery by minimizing brain energy demands during metabolic and haemodynamic recovery at a neuronal level[8]. Thirdly, in the first 7-10 days following concussion, athletes have an increased risk of sustaining another concussion[9]. However, studies have not clearly demonstrated the benefit of strict rest in recovery after concussion[7,10]. Although there are currently no studies to clarify the optimal rest time[11], there is consensus on recommending a 24- to 48-hour period of relative physical and mental rest[5,6,12].

After a brief period of rest, activity should be resumed below cognitive and physical symptom-exacerbation thresholds. Exercise has an effect on the nervous system, improving: the balance of the autonomic nervous system, CO_2 sensitivity, increasing the expression of brain-derived neurotrophic factor genes, the state of mind and sleep[13,14]. Due to changes in the functioning of the autonomic nervous system and the control of cerebral blood flow in brain concussion[15,16], exercise may help in recovery. Studies have shown that symptom sub-threshold exercise improves recovery after brain concussion[17-20], this exercise intensity threshold can be determined through a test performed on a treadmill or exercise bike[21,22]. Due to this evidence, aerobic exercise and activity in the early stages of recovery following concussion do not replace RTP and must be integrated into the latter.

There must be no contact in stages 1-4 of RTP, and an athlete must be symptom-free in order to advance to stage 5 where contact exercises are introduced. As a result, medical assessment is required to give authorisation to advance to contact exercises. In this regard, neurocognitive tools such as SCAT[5] or similar are useful for this assessment[5,12]. This RTP

Correspondence: Cristian Solis Mencia
E-mail: csolis.mencia@gmail.com

Table 1. Strategy for Gradual Return to Play (RTP).

Stage	Rehabilitation stage	Exercises to be performed	Objective of the stage
1	Symptom-limited activity	Daily activities that do not provoke symptoms	Gradual reintroduction of work/school activities
2	Light aerobic exercise	Light running, swimming, static cycling, at a slow to medium pace	Increase heart rate
3	Sport-specific exercise	Running drills, no head impact activities	Add movement
4	Non-contact training drills	Progression to more complex training drills (e.g. passing drills). May start progressive resistance training	Exercise, coordination and cognitive load
5	Full contact practice	Normal training activities	Restore the athlete's confidence and allow trainers to monitor skills
6	Return to play	Rehabilitated player	Complete physical and cognitive recovery

Table 2. Consensus Recommendations.

Recommendations	Class of evidence	Level of evidence
6-stage RTP protocol.	I	C
Physical and mental rest for 24-48 hours following brain concussion.	I	C
Start aerobic exercise after a 24- to 48-hour period of rest, following brain concussion at an intensity below the symptom threshold, as part of the RTP.	IIa	B
Perform RTP under supervision (rehabilitator or physiotherapist).	IIa	C
The athlete must be assessed and authorised by a specialist doctor with experience in brain concussion before moving on to stage 5 or starting contact exercises.	I	C
The minimum time required to advance to stage 5 or to the start of contact exercises must be 12 days for adult athletes.	IIb	C
For athletes under 19 years of age, the minimum time required to advance to stage 5 or to the start of contact exercises must be 28 days.	IIb	C
Athletes under 19 years of age must have resumed normal educational activities before advancing to stage 5.	IIa	C

RTP: gradual return to play.

must be performed under supervision (rehabilitator or physiotherapist) and must never be done alone[20]. The time taken for the RTP varies, depending on the athlete's age and medical history, and must be managed on an individual basis. The time described for elite athletes to return to play following brain concussion ranges from 7 to 10 days[23-25]. However, recent studies on American football players reported a time of 12 days[26] and close to 30 days for military athletes[27]. In a review conducted, it was reported that the physiological recovery of the central nervous system takes from 15 to 30 days, while symptom resolution took less time[28]. Furthermore, it has been reported that there is a greater probability of sustaining further concussion in the first 10 days of recovery[2].

On the other hand, the reported recovery time for adolescents and children is greater, being approximately 4 weeks[29]. Furthermore, students should not return to normal sports practice until their school attendance is back to normal[5]. However, due to a scarcity of studies, it is not possible to determine the age at which recovery as an adult can be considered. Based on this evidence, it is reasonable to consider that there must be a minimum period of 28 days and students must have resumed normal school life before starting contact exercises. Considering current evidence, as a consensus we would recommend (Table 2):

- Perform a 6-stage RTP protocol.
- Ensure physical and mental rest for 24-48 hours following brain concussion.
- Start aerobic exercise after a 24- to 48-hour period of rest, following brain concussion, at an intensity below the symptom threshold, as part of the RTP.
- Perform the RTP under the supervision of a rehabilitator or physiotherapist.
- The athlete must be assessed and authorised by a specialist physician with experience in brain concussion before moving on to stage 5 of the RTP protocol or starting contact exercises.
- The minimum time required to advance to stage 5 or to the start of contact exercises must be 12 days for adult athletes.
- For athletes under 19 years of age, the minimum time required to advance to stage 5 or to the start of contact exercises must be 28

days. Moreover, athletes must have resumed normal educational activities before advancing to stage 5 or to the start of contact exercises.

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