

Concussion Protocol

Preface

The World Karate Federation (WKF) is spearheading an initiative aimed at enhancing knowledge and promoting awareness around the identification and management of concussions among everyone engaged in the sport of karate.

This resource is intended for use by healthcare professionals operating within the karate community and aligns with the WKF's ongoing educational campaign, "Better Safe Than Sorry."

Understanding Concussion

A concussion is a form of traumatic brain injury that results from a forceful impact to the head, neck, or body, which transmits sudden, impulsive energy to the brain. This impact triggers a complex chain reaction involving neurotransmitters and metabolic processes, potentially leading to damage to nerve fibers, disrupted cerebral blood flow, and inflammation within the brain tissue.

Symptoms can emerge instantly or may take minutes to hours—or even days—to become noticeable. While many individuals recover within a few days, some may experience longer-lasting effects.

The consequences of a concussion can vary widely, from no visible impairment to short-term functional difficulties or even serious, life-threatening brain injuries. Because of this variability, medical professionals caring for karate athletes must be able to promptly identify potential concussions and perform an appropriate assessment—on or off the tatami—without delay.

The WKF Guidelines on Concussion Management

The WKF advocates for a standardized, evidence-based approach to support medical professionals, athletes, and all personnel involved in managing head injuries in karate. If there is even the slightest suspicion of a concussion at any point, the athlete must be immediately removed from competition or training. A thorough evaluation and proper treatment, as outlined in this protocol, should follow.

Several clinical features are commonly used to define the nature of a concussion. These include:

- A concussion can result from a direct blow to the head, face, or neck, or from an impact to another part of the body that transmits an impulsive force to the brain. After any cranial

or cervical injury, an assessment should include a thorough examination of related structures, such as the neck (in case of a head impact) and the vestibular system (after an injury to the head or neck). Symptoms alone cannot distinguish a concussion from cervical or vestibular injuries, and both may occur simultaneously.

- A concussion may cause neuropathological changes, but acute clinical signs and symptoms are mostly functional disturbances rather than structural damage. As such, standard structural neuroimaging studies typically do not show abnormalities.
- Concussions can present a variety of clinical signs and symptoms, and they do not always result in a loss of consciousness. The recovery of clinical and cognitive symptoms generally follows a sequential pattern. However, despite these common features, the course of a concussion can vary significantly: Symptoms may develop within minutes in some cases, while in others, they can take hours or even days to appear.
- Persistent symptoms can occur in certain instances.

Diagnosis

The WKF recommends using the latest version of the Sport Concussion Assessment Tool (SCAT, currently version 6) for baseline examinations. SCAT is the most widely used assessment tool in sports internationally and provides a series of multimodal tests to evaluate various aspects of brain function that are commonly affected in a concussion. It measures level of consciousness, orientation, neurocognitive function, self-reported symptoms, and postural stability. In addition, it includes a section for the assessment of acute concussions, which takes into account observable signs of a concussion, including red flags, the Glasgow Coma Scale, cervical spine function, as well as a neurological screening exam.

Physicians who use this tool vary greatly in terms of their training and experience in the evaluation and treatment of concussions, their expertise in cognitive assessment, and their understanding of the clinical and physiological manifestations of a concussion. Due to this variability, it is important that physicians familiarize themselves with all aspects of the tool, including the advantages and limitations of SCAT6. To this end, the following considerations should be taken into account:

- SCAT is most effective at distinguishing between athletes with and without concussion up to seven days after the injury, and its clinical utility decreases after 72 hours.
- SCAT6 is intended for adolescents (>12 years) and adults. The Child SCAT6 should be used with children between 8 and 12 years of age.
- SCAT6 is designed to assist in the standardized assessment of concussion during the acute phase of the injury. It is not intended to be used as a standalone diagnostic tool, but rather to inform clinical evaluation and diagnosis.
- SCAT6 is not intended to be used in isolation when making return-to-play decisions for an athlete.
- It is important to emphasize that some athletes who have suffered a concussion may score within normal ranges on SCAT6 (false negatives), while some individuals without a concussion may score poorly (false positives).

- Interpretation of SCAT6 data is a clinical task that includes examining the athlete in the context of personal, psychological, social, cultural, sporting, educational, and medical factors, as well as the characteristics and mechanism of the injury.
- Performance well below normative standards should prompt repeated and/or additional cognitive assessments to establish an accurate baseline and/or to rule out true cognitive impairment in the player.
- The modified Balance Error Scoring System (M-BESS) is more accurate if administered by the same person when the athlete is healthy and after the injury.
- Differences in SCAT6 performance have been linked to demographic variables (e.g., age, sex, and education), as well as cultural and linguistic factors.

Diagnosis and Management in the First 48 Hours After Trauma

A systematic approach is recommended in the first 48–72 hours after an incident that may cause a concussion in karate, beginning with the initial examination and continuing with diagnosis and treatment:

- Observation and recognition
- Initial inspection and examination (on the tatami)
- Examination off the tatami
- Post-incident examinations/observation and follow-up
- Observation and serial re-examinations until a concussion can be ruled out
- Gradual return-to-sport program

It should be emphasized that this procedure is the sole responsibility of the athlete's or competition's physician, depending on the phase. The physician should maintain a low threshold for removing a player from competition and observing them during the following 48–72 hours to assess symptom progression.

The purpose of the on-tatami evaluation is to identify whether there are signs or symptoms of a concussion, or if a concussion is suspected despite the absence of signs or symptoms. If this is the case, the physician must remove the player from the competition area to perform a more detailed examination. Due to the potential serious neurological consequences of a concussion, any suspicion of abnormal findings should prompt an appropriate examination. Post-incident examinations aim to establish a diagnosis that allows the initiation of precise therapeutic strategies and ensures a safe return to karate. The physician must be aware that an emergency may arise at any time in the hours and days immediately following a concussion; therefore, thorough repeated examinations are required until a concussion can be ruled out.

Ideally, the team physician should be familiar with each competitor individually, including their characteristics, medical history, and baseline test results, and should be able to communicate effectively with all of them.

Observation and Recognition

Tatami and delegation physicians must observe the bouts (or training sessions) paying special attention to possible mechanisms or situations that could cause a concussion. Concussions are especially frequent during collisions with elbows, knees, and shins. The best way to recognize the mechanism of injury and the player's behavior is through direct observation, supported, if possible, by an immediate video review. It is very important to make an immediate decision on whether to withdraw a competitor, since athletes who continue competing or training after suffering a concussion are at greater risk of sustaining new injuries, such as second impact syndrome or serious musculoskeletal injuries, due to the loss of fine motor control.

There are specific signs after a head injury that should increase the suspicion of concussion, as used and validated by FIFA (Davis GA, et al. 2019. International consensus definitions of video signs of concussion in professional sports. Br J Sports Med). Some of these are considered 'red flags':

- Impact seizures: Involuntary clonic movements comprising periods of asymmetric and irregular rhythmic jerks of axial or limb muscles.
- Remaining lying on the tatami surface without intentional movements for more than 2 seconds requires medical evaluation of the athlete and possible withdrawal. Significantly longer periods of immobility require immediate and permanent removal from competition.
- Tonic posture: The most characteristic is the so-called 'fencer's reflex.' It is an involuntary sustained contraction of one or more limbs (usually the upper limbs), such that the limb remains rigid despite gravity or the athlete's position. Tonic posture may involve other muscles, such as cervical, axial, and lower limb muscles. It can be observed while the athlete is on the playing surface or during a fall, where the karateka may also show no protective action.
- Absence of protective reflexes/flaccidity: Falling onto the tatami surface without protection (i.e., without extending hands or arms to cushion or minimize the fall) after direct or indirect head contact. The karateka shows loss of motor tone (which may be observed in the limbs and/or neck) before hitting the surface.
- Motor incoordination: Appears unsteady on their feet (including loss of balance, staggering/stumbling, difficulty standing up, falling) or in the upper limbs (including clumsiness). This may occur when standing up from the tatami or walking back to their position. It may also include going to the wrong side of the tatami.
- Vomiting.
- Visible signs after returning to the tatami following medical evaluation: The karateka shows no facial expression or apparent emotion in response to the environment. This may include lack of focus/visual attention and maintaining a blank or vacant stare.

If video recording is available for review, video analysis allows direct observation of the injury mechanism and identification of early/immediate signs (e.g., a competitor failing to take protective measures during a fall, a brief impact seizure, or a tonic posture), as well as signs that may appear in the period immediately after the injury (e.g., a karateka remaining immobile, showing motor incoordination, or displaying a stunned or vacant look).

Pre-Examination Considerations

Before the initial examination, it is important to consider the differential diagnoses of an athlete presenting with impaired consciousness or collapse. Possible emergencies (Table 1, taken from the FIFA Emergency Care Manual) include signs or symptoms of cardiopulmonary arrest or severe structural injuries to the brain, skull, face, cervical spine, or spinal cord, which are referred to as 'red flags'.

The evaluation and emergency management following any acute head trauma must be carried out according to clear principles and standardized practices. Any head trauma should be assumed to involve a concomitant cervical spine injury until ruled out by clinical examination or, if indicated, imaging studies.

Any suspicion of cervical fracture or vertebral spinal cord injury (for example, as indicated by a Glasgow Coma Scale score below 15 at the initial assessment, neck pain or tenderness, focal neurological deficit, paresthesia or limb weakness, or any other clinical suspicion of cervical spine injury) should lead to cervical spine immobilization and stabilization, appropriate removal of the karateka, and urgent transport to a hospital.

TABLE 1: Basics of Medical Emergency Treatment
(Taken from the FIFA Emergency Care Manual)

Domain	Concern, signs on examination	Actions	Consequence
Cardiopulmonary	Concern: Cardiopulmonary arrest Signs on examination: Unresponsiveness, not breathing normally	- Start cardiopulmonary resuscitation (CPR) chain: emphasis on chest compression and rapid defibrillation. - Place the automated external defibrillator (AED) but shock the player only if the AED device self-charges and verbally recommends pressing the shock button. - Place the player onto a spinal stabilisation device (e.g. spinal board) and extricate the player appropriately.	Remove the player from the pitch and continue emergency management if indicated. Consider immediate emergency transport to hospital.
Brain	Concern: Intracranial lesion Signs on examination: Glasgow Coma Scale score of <13, loss of consciousness, severe headache, repetitive vomiting, seizure/convulsion, abnormal posturing, new difference in pupil size, nystagmus, fall due to imbalance	- Neutralise and stabilise the cervical spine appropriately. - Maintain and protect the airway as safely as possible. - Ventilate the unconscious patient if necessary. - Place the player onto a spinal stabilisation device (e.g. spinal board) and extricate the player appropriately.	
Skull and face	Concern: Fracture Signs on examination: Severe headache, blood or clear fluid exiting from the ear(s) or nose, deformity, periocular or retroauricular haematoma	- Neutralise and stabilise the cervical spine appropriately. - Control any external bleeding. - Place the player onto a spinal stabilisation device (e.g. spinal board) and extricate the player appropriately.	
Cervical spine and neck	Concern: Fracture or intraspinal lesion Signs on examination: Deformity, severe pain, swelling over the neck, paresis, impaired sensation	- Neutralise and stabilise the cervical spine appropriately. - Place the player onto a spinal stabilisation device (e.g. spinal board) and extricate the player appropriately.	

Initial inspection and examination (on the tatami)

The results of the initial inspection and examination (on the tatami) form the basis for decisions regarding emergency management, transfer to hospital, withdrawal of the competitor and/or assessment off the tatami in a quiet area. The recommended elements for the initial inspection and examination are based on the latest version of SCAT (currently SCAT6) and the guidelines of the UK's National Institute for Health and Clinical Excellence (NICE) (Table 2). During this initial examination, it is essential to focus on the possibility of medical emergencies. The inspection focuses on visible signs (e.g. loss of consciousness, vomiting, mechanism of injury), while the examination assesses the key signs and symptoms of neurological impairment from different areas of the brain (cortical, subcortical, cerebellar, brainstem) and of cervical spine or spinal cord injury. Any loss of consciousness or a Glasgow Coma Scale score of less than 15 indicates a brain injury. At any time during this initial assessment, the medical personnel attending to the injured athlete may be assisted by information from other available resources, such as video replays or eyewitness accounts. The procedures for using such resources, as well as the relevant lines of communication, must be agreed upon prior to the competition with the Organizing Committee and the Referees' Committee. In any of the following non-emergency cases, the injured athlete must be removed from the field of play for evaluation and/or treatment:

1. The result of one or more aspects of the initial assessment is considered or suspected to be abnormal, and the athlete is withdrawn from competition to allow more time for examination.
2. All tests are normal, but concussion is suspected, in which case the athlete may be allowed to continue competing after a brief assessment in a separate area.

TABLE 2: Example checklist for initial inspection and examination (on the tatami) of a possible concussion.

(Taken from the FIFA Emergency Care Manual)

Inspection	1 Acute signs		
	Short-term loss of consciousness	No	Yes
	Deformity or swelling of the head or neck or holding of the head due to pain/for stabilisation	No	Yes
	Blood or clear fluid exiting from the ear(s) or nose	No	Yes
	Blank look	No	Yes
	Slowness in getting up	No	Yes
	Vomiting	No	Yes
	Uncharacteristic behaviour	No	Yes
Examination	2 Glasgow Coma Scale: 15 points		
	Eye opening: spontaneous (4 points)	Yes	No
	Verbal: oriented (correctly gives name, place, date) (5 points)	Yes	No
	Motor: obeys commands (6 points)	Yes	No
	3 Selected new acute symptoms		
	Headache or pressure in the head	No	Yes
	Neck pain	No	Yes
	Nausea	No	Yes
	Vertigo, dizziness, drowsiness, unsteadiness	No	Yes
	Blurred or double vision, sensitivity to light	No	Yes
	Tinnitus, hypacusis, hyperacusis	No	Yes
	Impaired sensation in the upper or lower extremities	No	Yes
	4 Orientation and memory (Maddocks questions)		
	What venue are we at today?	Correct	Incorrect
	Which half of the match is it now?	Correct	Incorrect
	Which team scored last in this match?	Correct	Incorrect
	Which team did your team play against in their last match?	Correct	Incorrect
	Did your team win their last match?	Correct	Incorrect
	5 Delayed, slow or inappropriate responses	No	Yes
	6 New difference in pupil size, crossed eyes, spontaneous nystagmus	No	Yes
	7 Range of motion of the cervical spine, only if no acute neck pain		
	Active rotation to the left and right from a neutral position	Normal and painless	Impaired or painful
	Active flexion and extension from a neutral position	Normal and painless	Impaired or painful
	8 Strength of the upper and lower extremities	Normal	Impaired
	9 Touch sensation of the upper and lower extremities	Normal	Impaired
	10 Balance, control and coordination of posture and the limbs		
	Stand on both legs with heel and toe together (eyes closed, 10 seconds; if failed, maximum 1 repetition)	Stable/no sway	Failed
	Finger-to-nose task (right and left) (eyes closed, 2 repetitions, both sides)	All trials correct	Failed
If no signs or symptoms and nothing to suggest a concussion injury -> player allowed to return to match play or training; further observation until leaving the sports facilities.		If any emergencies -> emergency management.	

Examination of the karateka off the tatami

The examination off the tatami should focus on potential emergencies (Table 3). In all competitions/training sessions where a doctor is available, testing of ocular motor function should be included. Obvious minor injuries, such as lacerations or contusions, can be treated during the process if practical and if it does not pose a risk or affect the examination.

Table 3: Selected signs and symptoms indicating red and yellow flags after head injury.
(Taken from the FIFA Emergency Care Manual)

Domain	Red flags	Yellow flags	
Alertness/ attention	Glasgow Coma Scale score of <13	Signs	Glasgow Coma Scale score of 13 or 14, blank look, confusion, disorientation, delayed, slow or inappropriate response, difficulty concentrating or remembering things
		Symptoms	Feeling slowed down, not feeling "right", drowsiness, fatigue, low energy
Neuromotor	Seizure/convulsion or postictal signs, abnormal posturing	Signs	Impaired control of trunk or limb movements
Headache	Severe headache, repeated vomiting	Signs	Nausea or vomiting (once), holding of the head
		Symptoms	Pressure, headache
Dizziness/ balance	Fall due to imbalance	Signs	Imbalance
		Symptoms	Vertigo, dizziness, fogginess, unsteadiness
Vision/ocular motor function	Crossed eyes, nystagmus, other acute disordered eye movements, new difference in pupil size	Symptoms	Blurred vision, eyes being unable to follow a finger/other moving target, sensitivity to light
Emotions/ behaviour		Signs	Emotional instability, irritability or aggression with little or no provocation
Hearing	Acute hearing loss	Symptoms	Hyperacusis, hypacusis, tinnitus
Cervical spine/ spinal cord	Pain, tenderness, swelling, deformity, paresis, impaired sensation in the upper or lower extremities	Signs	Impaired hearing, tinnitus, sensitivity to noise
		Symptoms	Neck pain
Skull/face	Blood or clear fluid exiting from the ear(s) or nose, deformity, periocular or retroauricular haematoma	Signs	Contusion, laceration
Personal history	Anticoagulation, clotting disorder	Previous brain injury	

Red flags: Potentially life-threatening problems or signs of intracerebral or extracerebral injury
-> if any of these cases occur: emergency treatment and consider immediate transfer to hospital.

Yellow flags: Neurological or orthopaedic impairment -> if any of these cases occur or the doctor has doubts: more detailed examination, consulting a specialist if necessary. If yellow (suspicious) flags are identified during the initial examination on or off the field, the player should be evaluated more thoroughly through a detailed neurological examination.

This detailed neurological assessment should include an examination of the following:

- Cranial nerves
- Vestibular, balance, and coordination functions, including spontaneous nystagmus, head impulse test, vertical ocular deviation, dynamic visual acuity, balance (Romberg test), and positioning manoeuvres
- The cervical spine, including range of motion, stability, proprioception, strength, and muscle tone
- Motor function of the upper/lower extremities.

Standardized neurocognitive tests should also be performed. Based on the results of the neurological examination, the physician may decide to perform further tests. Athletes who are removed from competition or training and show signs or symptoms of concussion or other significant head injury at any time must complete the Return to Karate Programme before resuming normal sporting activities, under the supervision of a physician.

Observation and periodic reassessment until concussion can be ruled out.

The team or competition doctor should continue to observe the athlete. Medications that may mask or worsen symptoms should be avoided unless a more serious head injury has been ruled out. Any worsening or new signs or symptoms should prompt urgent treatment in the case of warning signs or further examination in the case of cautionary signs. Before leaving the sports facility, all injured athletes should be re-examined for worsening or new signs and symptoms. Before travelling without access to emergency care (e.g., on airplane flights), any worsening of symptoms related to any type of brain, head, or neck injury should be checked, and all possible doubts should be dispelled through the use of appropriate diagnostic imaging techniques.

An initial CT scan is recommended on the day of injury if any of the following circumstances apply:

- Glasgow Coma Scale score below 13 (or below 15 after two hours).
- Suspected skull fracture.
- More than one episode of vomiting.
- Seizures after the injury.
- Loss of consciousness.
- Persistent anterograde amnesia.
- Focal neurological deficit.

It is important to note that, in many cases, concussion is diagnosed without radiological findings. **Concussion is a clinical diagnosis.** Current guidelines and consensus statements agree that an athlete with concussion (even if only suspected) should not return to karate practice on the same day but should follow a gradual process of return to sport.

In general, all athletes who have suffered a concussion (even if only suspected) should be observed for 72 hours by their team physician. The 72-hour period has been chosen because symptoms may develop with latency. The team doctor or a member of the athlete's delegation should assess the injured athlete daily during this period and pay particular attention to whether the signs and symptoms do not improve or even worsen in intensity, or whether the player develops new signs/symptoms.

If the symptoms are minimal or improve and the results of all tests are normal, the player may be medically cleared to begin a gradual return-to-play programme. If warning signs persist, the player should be referred to a medical specialist (ideally a neurologist with experience in sports concussions) for further evaluation and treatment.

Table 4: Karate Return-to-Sport Strategy

Adapted from: McCrory et al. (2017) and based on the Judo model by Parachute & Judo Canada

Stage	Aim	Activity	Goal of Each Step	Rest Between Stages	Duration Between Stages (Adult)	Duration Between Stages (Youth)
1. Symptom-Limiting Activity	Daily activities that do not make symptoms worse	- Short walks - Light household tasks - School or work-related tasks (as tolerated) - No physical exertion or screen time overload	Gradual re-introduction of mental and physical activity	>= 24-48 hours	1-2 days	2-4 days
2. Light Aerobic Activity	Increase heart rate	- Walking or light jogging (15-20 min) - Stationary cycling at a comfortable pace - No kata, kihon, or kumite - Avoid overheating and dehydration	Elevate heart rate safely without provoking symptoms	>= 24 hours	1 day	1-2 days

3. Sport-Specific Exercise	Add movement	- Basic kihon (e.g. punches, blocks, footwork) at low intensity - Light shadow boxing - Modified kata without kiais or explosive movements - No contact or pad work	Reintroduce karate-specific movement without risk of contact	>= 24 hours	1 day	1-2 days
4. Non-Contact Training Drills	Exercise, coordination, and increased thinking	- Moderate-intensity kihon and kata - Light bag work (no heavy striking) - Movement-based kumite drills without partners - Controlled plyometrics and agility work	Build sport-specific coordination and conditioning without head impact	>= 48 hours	1-2 days	2-3 days
5. Full Contact Practice (Only after medical clearance)	Restore confidence and assess functional skills	Part A (Controlled): - Controlled pad drills and partner kumite with light contact - Full kata at full speed - Coaching feedback and assessment Part B (Unrestricted): - Full speed	Ensure athlete can safely tolerate full training demands before return to competition	As tolerated	1-2 days	2-3 days

		and intensity training - Full kumite with light-to-moderate contact - Sparring scenarios under coach supervision				
6. Return to Sport	Full training & competition	- Resume regular training - Return to competition (kata/kumite) - Monitor for any symptoms recurrence	Full return to pre-injury activity and competition level	-	7-14 days total	14-28 days total

The timelines in this strategy are **MINIMUM** recommendations and may vary between individuals. Some athletes may experience symptoms that require longer rest and recovery. All progression through the stages should be based on symptom resolution and guided by a medical professional.