

COLPI DI TESTA

Sport & Trauma Cranico Lieve

Milano 20 Settembre 2025



Trauma Cranico Lieve (TCL o TBI): Definizione e Sintomi Daniel Di Mattia



Traumatologia e Sport



Un numero superiore ai 70 milioni di soggetti in tutto il mondo subiscono una lesione cerebrale traumatica ogni anno. Frequentemente questi pazienti presentano delle patologie che necessitano di trattamenti chirurgici di emergenza per lesioni vascolari, dell'apparato muscolo scheletrico degli organi cavi e parenchimatosi.

Traumatologia e Sport



Nello Sport, in seguito ad un incidente o ad un infortunio, durante l'allenamento o nel corso di una competizione, si possono verificare lesioni traumatiche associate a traumi cerebrali.

TRAUMI CRANICI TRE PUNTI CARDINE



1) DIFFICOLTA' AL RICONOSCIMENTO

2) DIFFICOLTA' ALLA DIAGNOSI

**3) DIFFICOLTA' NEL STABILIRE I TEMPI DI
GUARIGIONE**

CLASSIFICAZIONE TRAUMI CRANICI SINTOMI E SEGNI



- ❖ NAUSEA
- ❖ VOMITO
- ❖ DISTURBI DELL'EQUILIBRIO
- ❖ VERTIGINI
- ❖ DISTURBI VISIVI
- ❖ SENSAZIONE DI SPOSSATEZZA
- ❖ IPERSENSIBILITA' ALLA LUCE E AI RUMORI
- ❖ STORDIMENTO

CLASSIFICAZIONE TRAUMI CRANICI SINTOMI E SEGNI



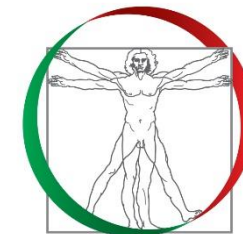
- ❖ SENSAZIONE DI ANNEBBIAMENTO
- ❖ SENSAZIONE DI RALLENTAMENTO
- ❖ DIFFICOLTA' A RICORDARE

CLASSIFICAZIONE TRAUMI CRANICI SINTOMI E SEGNI

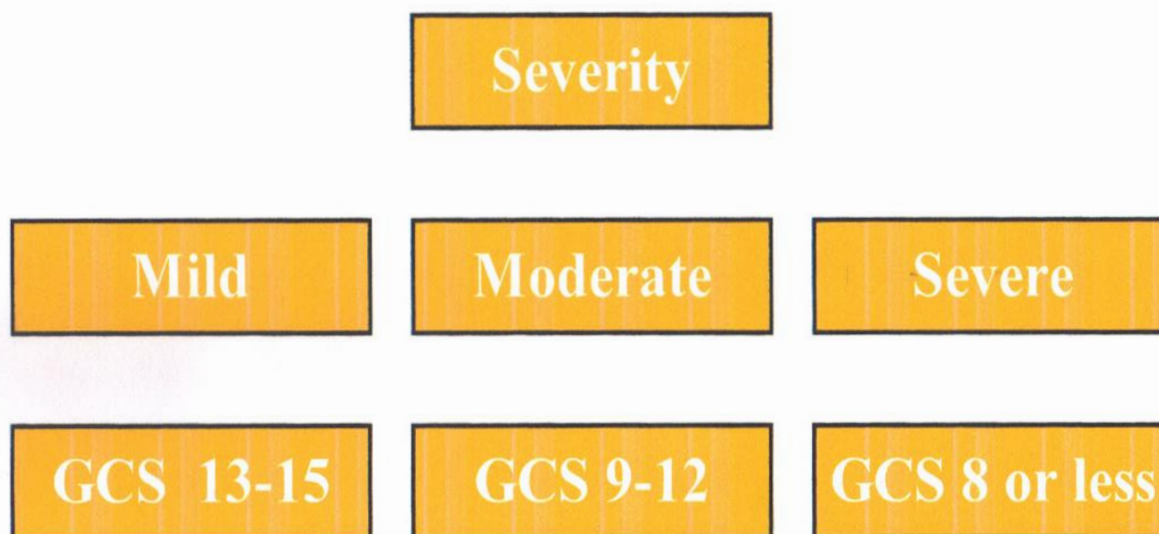


- ❖ FACILITA' A DIMENTICARE INFORMAZIONI O CONVERSAZIONI RECENTI
- ❖ CONFUSIONE NELLA RICOSTRUZIONE DI EVENTI RECENTI
- ❖ LENTEZZA NELLA RISPOSTA ALLE DOMANDE
- ❖ TENDENZA A RIPETERSI E PORRE SPESSO LE STESSE DOMANDE

CLASSIFICAZIONE TRAUMI CRANICI

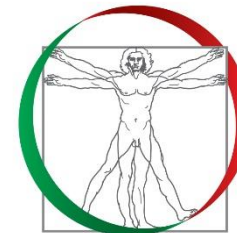


F. I. T. S. I.



GLASGOW COMA SCORE

GCS



F.I.M.S.I.

GLASGOW COMA SCORE		
Apertura degli occhi	spontaneamente	4
	alla parola	3
	al dolore	2
	non apre gli occhi	1
Risposte verbali	orientata, cioè il paziente relaziona con l'ambiente, capisce e risponde	5
	confusa	4
	parole non appropriate, parole a casaccio, urla, bestemmia, cose insensate, anche se pronunciate bene	3
	suoni incomprensibili, per esempio farfuglia	2
	nessuna	1
Risposte motorie	obbedisce ai comandi	6
	localizza il dolore, se non vi è risposta ai comandi si applica uno stimolo doloroso che viene mantenuto finché non si abbia il massimo della risposta: inizialmente si applica la pressione al letto ungueale con il risultato di estensione o flessione del gomito; se vi è una di queste risposte allora lo stimolo viene effettuato al collo o al tronco per ricercare la "localizzazione" che si intende effettuata quando gli arti si muovono per tentare di rimuovere lo stimolo doloroso.	5
	si retrae, flette normalmente ma non localizza il dolore.	4
	Anormale flessione allo stimolo doloroso (decorticazione)	3
	Estensione allo stimolo doloroso, si ha quando la risposta è in adduzione delle braccia, rotazione interna e pronazione dell'avambraccio nel modello stereotipato della decerebrazione. (decerebrazione)	2
	nessuna	1
RISULTATO		
Grave, con GCS ≤ 8	Moderata, GCS 9-13	Minore, GCS ≥ 14.

NEI TRAUMI CRANICI QUANDO E' INDICATA UNA TAC D'URGENZA?



Il rilevamento delle lesioni intracraniche si basa sulla TC del cranio, che è abusata e richiede ulteriori risorse e tempo.

NEI TRAUMI CRANICI QUANDO E' INDICATA UNA TAC D'URGENZA?



- ❖ GCS inferiore a 13 sulla valutazione iniziale nel reparto di emergenza
- ❖ GCS inferiore a 15 a 2 ore dopo l'infortunio sulla valutazione in pronto soccorso
- ❖ Sospetta frattura del cranio
- ❖ Nessun segno di frattura della base del cranio ma perdita di fluido cerebrospinale dall'orecchio o il naso
- ❖ Disturbi visivi
- ❖ Deficit neurologico focale
- ❖ Più di 1 episodio di vomito

CLASSIFICAZIONE TRAUMI CRANICI SINTOMI E SEGNI TARDIVI



- ❖ IRRITABILITA'
- ❖ TRISTEZZA
- ❖ TENDENZA A COMMUOVERSI
- ❖ NERVOSISMO
- ❖ SONNOLENZA E/O DIFFICOLTA' AD ADDORMENTARSI
- ❖ TENDENZA A DORMIRE PIU' O MENO DEL SOLITO

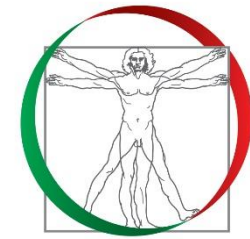
CLASSIFICAZIONE TRAUMI CRANICI



Lo SCAt6 è uno strumento standardizzato per la valutazione degli Atleti infortunati per la concussione e può essere utilizzato negli Atleti a partire dai 13 anni di età.

Per i soggetti più giovani, di età pari o inferiore ai 12 anni, si consiglia di utilizzare lo SCAt6 per bambini.

CLASSIFICAZIONE TRAUMI CRANICI SCAT6



F.I.T.S.I.

SCAT6™

Sport Concussion Assessment Tool
For Adolescents (13 years +) & Adults



What is the SCAT6?

The SCAT6 is a standardised tool for evaluating concussions designed for use by Health Care Professionals (HCPs). The SCAT6 cannot be performed correctly in less than 10-15 minutes. Except for the symptoms scale, the SCAT6 is intended to be used in the acute phase, ideally within 72 hours (3 days), and up to 7 days, following injury. If greater than 7 days post-injury, consider using the SCAT6/Child SCAT6.

The SCAT6 is used for evaluating athletes aged 13 years and older. For children aged 12 years or younger, please use the Child SCAT6.

If you are not an HCP, please use the Concussion Recognition Tool 6 (CRT6).

Preseason baseline testing with the SCAT6 can be helpful for interpreting post-injury test scores but is not required for that purpose. Detailed instructions for use of the SCAT6 are provided as a supplement. Please read through these instructions carefully before testing the athlete. Brief verbal instructions for each test are given in *Blue Italics*. The only equipment required for the examiner is athletic tape and a watch or timer.

This tool may be freely copied in its current form for distribution to individuals, teams, groups, and organizations. Any alteration (including translations and digital re-formatting), re-branding, or sale for commercial gain is not permissible without the expressed written consent of FIGC.

Recognise and Remove

A head impact by either a direct blow or indirect transmission of force to the head can be associated with serious and potentially fatal consequences. If there are significant concerns, which may include any of the Red Flags listed in Box 1, the athlete requires urgent medical attention, and if a qualified medical practitioner is not available for immediate assessment, then activation of emergency procedures and urgent transport to the nearest hospital or medical facility should be arranged.

Completion Guide

Orange: Optional part of assessment

Key Points

- Any athlete with suspected concussion should be REMOVED FROM PLAY; medically assessed, and monitored for injury-related signs and symptoms, including deterioration of their clinical condition.
- No athlete diagnosed with concussion should return to play on the day of injury.
- If an athlete is suspected of having a concussion and medical personnel are not immediately available, the athlete should be referred (or transported if needed) to a medical facility for assessment.
- Athletes with suspected or diagnosed concussion should not take medications such as aspirin or other anti-inflammatories, sedatives or opiates, drink alcohol or use recreational drugs and should not drive a motor vehicle until cleared to do so by a medical professional.
- Concussion signs and symptoms may evolve over time; it is important to monitor the athlete for ongoing, worsening, or the development of additional concussion-related symptoms.
- The diagnosis of concussion is a clinical determination made by an HCP.
- The SCAT6 should NOT be used by itself to make, or exclude, the diagnosis of concussion. It is important to note that an athlete may have a concussion even if their SCAT6 assessment is within normal limits.

Remember

- The basic principles of first aid should be followed: assess danger at the scene, athlete responsiveness, airway, breathing, and circulation.
- Do not attempt to move an unconscious/unresponsive athlete (other than what is required for airway management) unless trained to do so.
- Assessment for a spinal and/or spinal cord injury is a critical part of the initial on-field evaluation. Do not attempt to assess the spine unless trained to do so.
- Do not remove a helmet or any other equipment unless trained to do so safely.

Br J Sports Med: first published as 10.1136/bjsports-2023-079208 on 14 June 2023. Downloaded from http://bjsports.bmj.com/ on September 17, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

For use by Health Care Professionals Only

SCAT6™

Developed by: The Concussion in Sport Group (CISG)

Supported by:



CLASSIFICAZIONE TRAUMI CRANICI CRT6



CRT6™

Concussion Recognition Tool

To Help Identify Concussion in Children, Adolescents and Adults

What is the Concussion Recognition Tool?

A concussion is a brain injury. The Concussion Recognition Tool 6 (CRT6) is to be used by non-medically trained individuals for the identification and immediate management of suspected concussion. It is not designed to diagnose concussion.

Recognise and Remove

Red Flags: CALL AN AMBULANCE

If ANY of the following signs are observed or complaints are reported after an impact to the head or body the athlete should be immediately removed from play/ambulance and transported for urgent medical care by a healthcare professional (HCP):

<ul style="list-style-type: none"> • Neck pain or tenderness • Seizure, 'fits', or convulsion • Loss of vision or double vision • Loss of consciousness • Increased confusion or deteriorating conscious state (becoming less responsive, drowsy) 	<ul style="list-style-type: none"> • Weakness or numbness/tingling in more than one arm or leg • Repeated Vomiting • Severe or increasing headache • Increasingly restless, agitated or combative • Visible deformity of the skull
--	---

Remember

- Do not remove the athlete from play if a head injury is suspected. Do not attempt to move the athlete other than to provide primary support, unless trained to do so.
- Do not attempt to remove the athlete from play if a head injury is suspected.
- Do not attempt to remove the athlete from play if a head injury is suspected.
- Do not attempt to remove the athlete from play if a head injury is suspected.

If there are no Red Flags, identification of possible concussion should proceed as follows:

Concussion should be suspected after an impact to the head or body when the athlete shows direct neurological signs. Such changes include the presence of any one or more of the following: rapid onset of confusion; signs and symptoms of impaired or unresponsiveness; impaired brain function (e.g. confusion); or unusual behaviour.

This tool may be freely copied in its current form for distribution to clubs, teams, groups, and organizations. Any alteration, including translation, and digital re-formatting, re-branding or use for commercial gain is not permitted without the express written consent of BMJ.

Developed by: The Concussion in Sport Group (CISG)

Br J Sports Med: first published as 10.1136/bjsports-2023-107021 on 14 June 2023. Downloaded from <http://bjsm.bmj.com/> on September 18, 2023 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

CLASSIFICAZIONE TRAUMI CRANICI SCAT6 tool



Sport Concussion Assessment Tool SCAT6

What it measures:

The **SCAT6 tool** is used to assess concussions in athletes who are aged 13 years or older.

Valutazione delle commozioni cerebrali nello sport SCAT6

Cosa misura:

Il **Test SCAT6** viene utilizzato per valutare le commozioni cerebrali negli atleti di età pari o superiore a 13 anni.

TRAUMI NEL MOTORSPORT ACCERTAMENTI DIAGNOSTICI



L'introduzione dei test sui biomarcatori del trauma cranico e conseguente concussione cerebrale è già una realtà in USA ed in Francia dove viene utilizzata routinariamente sia nei Pronto Soccorso che nella Traumatologia Sportiva.

TRAUMI NEL MOTORSPORT ACCERTAMENTI DIAGNOSTICI



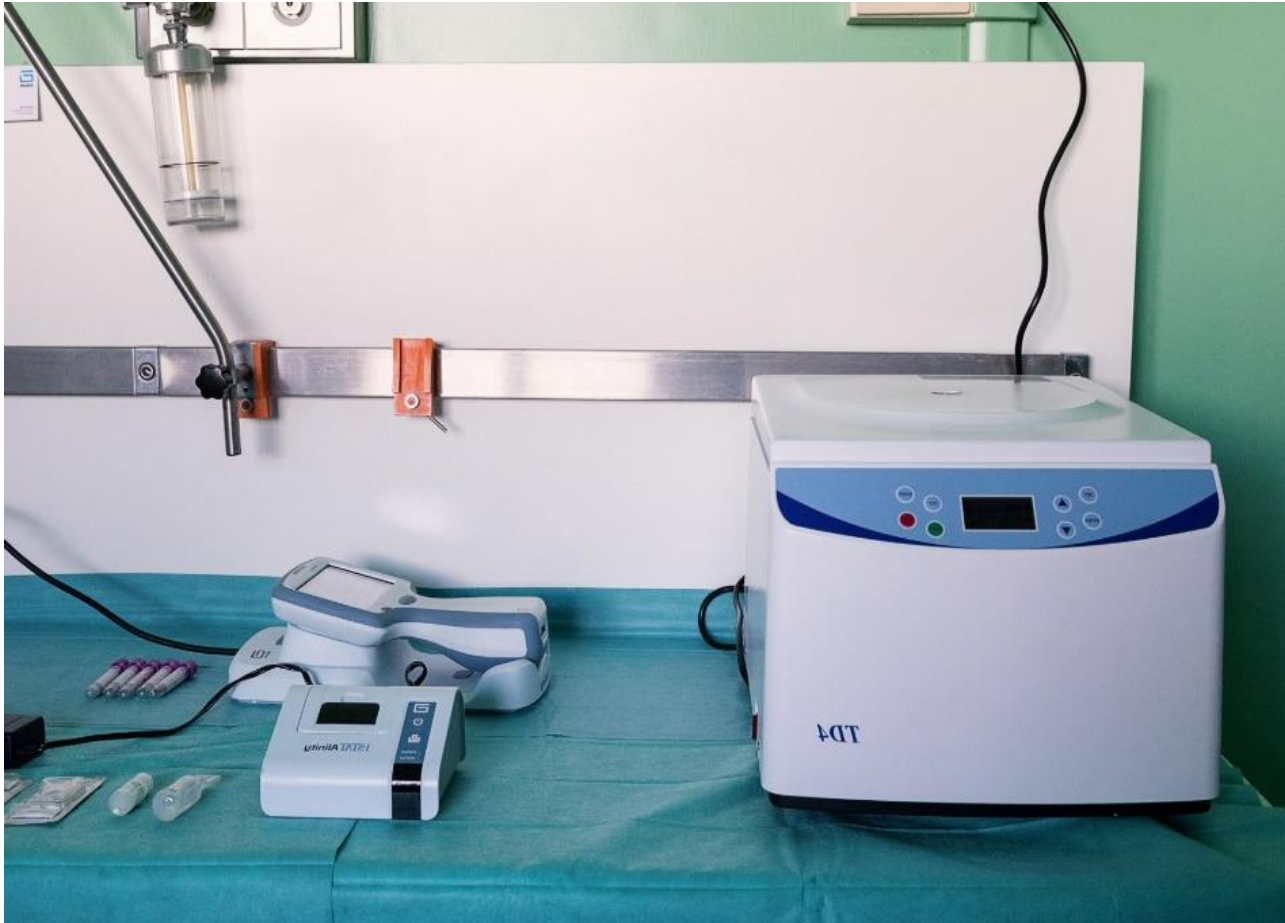
Il test al plasma i-STAT TBI di Abbott è il primo test rapido su un analizzatore portatile a ricevere l'autorizzazione FDA 510(k) e può determinare la necessità di una TAC per i traumi cranici anche lievi.

I risultati del test sono disponibili in circa 15 minuti. Tale servizio contemplava la possibilità di effettuare mediante Kit diagnostici ed un'apparecchiatura la i-STAT ALINITY fornita a titolo gratuito dalla Abbott la diagnosi precoce di concussione cerebrale dopo trauma cranico.

Kit diagnostici e l'apparecchiatura i-STAT ALINITY Abbott



SPORT



POLITRAUMA IN MOTORSPORT



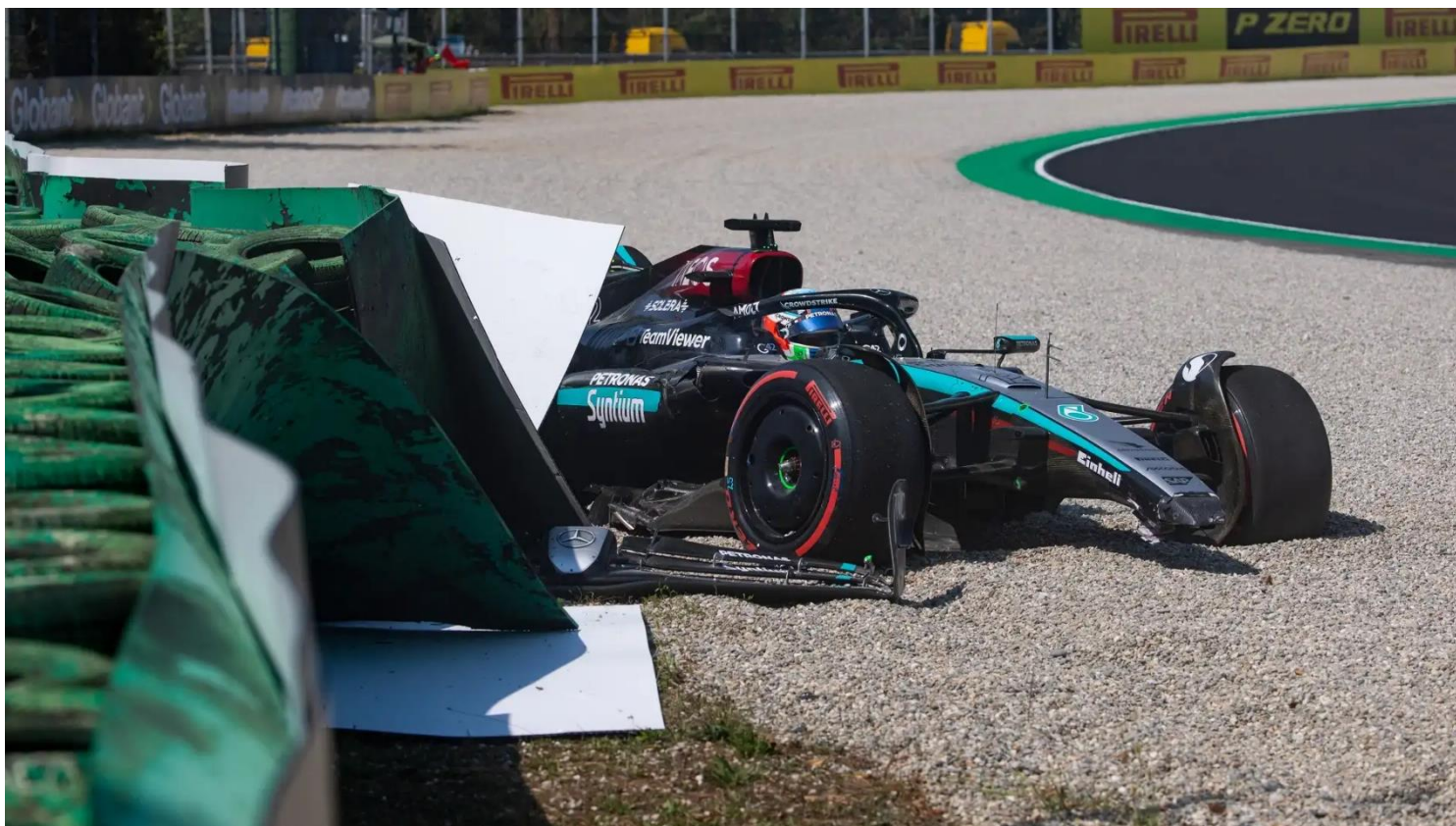
SPORT



POLITRAUMA IN MOTORSPORT



SPORT



POLITRAUMA IN MOTORSPORT



SPORT



POLITRAUMA IN MOTORSPORT



SPORT



POLITRAUMA IN MOTORSPORT



SPORT



TRAUMI CRANICI E SPORT



Le **Federazioni Internazionali** hanno ben presente il problema e stanno sviluppando i protocolli e le linee guida per il riconoscimento ed il trattamento del **POLITRAUMA** e della **CONCUSSIONE CEREBRALE**.

Ne sono esempi:

FIFA, UEFA, FIA, WORLD RUGBY, FIS, NFL, NHL.

TRAUMI CRANICI E SPORT



La TC è in grado di rilevare le emorragie, ma non è particolarmente sensibile nel rilevare le **DAI (Diffuse Axonal Injury)** o altre forme più sottili di lesioni cerebrali.

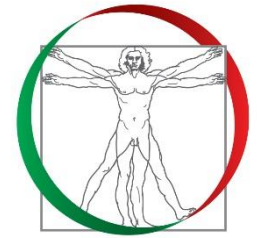
Inoltre, la scansione TC ripetuta può comportare un'elevata esposizione alle radiazioni per la popolazione a rischio, come i bambini.

TRAUMI CRANICI E SPORT



Pertanto, prevediamo lo sviluppo di un dispositivo **POC (Point of Care)** rapido come screening prima dell'uso della TC. È possibile che la misurazione ripetuta dei biomarcatori nel tempo possa essere utilizzata per individuare l'evoluzione della lesione, il peggioramento della lesione o il decorso del recupero cerebrale.

VISITA MEDICA DI IDONEITA' A RIPRENDERE LA COMPETIZIONE



F.ITSI

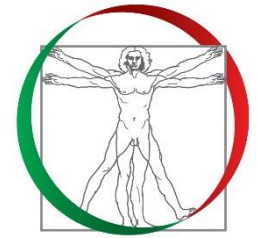
LA VISITA DI REINTEGRO NON DEVE ESSERE UNA FORMALITA'
ESEGUIRE I VARI TEST COGNITIVI
ATTENTA VALUTAZIONE NEUROLOGICA
PARLARE VIS-A'-VIS CON L'ATLETA (NON BASARSI SU TESTIMONI)

NON IDONEO....DARE SPIEGAZIONI E TEMPI DI RIVALUTAZIONE

IDONEODARE SPIEGAZIONI E SCRIVERE E FAR FIRMARE

In case of any abnormal symptom....the driver has been informed that he must slow down and drive back to his pit

VISITA MEDICA DI IDONEITA' A RIPRENDERE LA COMPETIZIONE



FMSI

LA VISITA DI REINTEGRO NON DEVE ESSERE UNA FORMALITA'
ESEGUIRE I VARI TEST COGNITIVI
ATTENTA VALUTAZIONE NEUROLOGICA
PARLARE VIS-A'-VIS CON L'ATLETA (NON BASARSI SU TESTIMONI)

NON IDONEO....DARE SPIEGAZIONI E TEMPI DI RIVALUTAZIONE

IDONEODARE SPIEGAZIONI E SCRIVERE E FAR FIRMARE

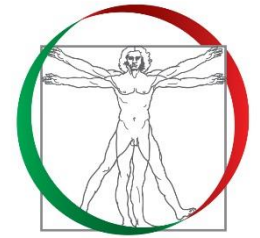
In case of any abnormal symptom....the driver has been informed that he must slow down and drive back to his pit

VISITA MEDICA DI IDONEITA' A RIPRENDERE LA COMPETIZIONE



Aspettare che tutti i sintomi e segni della concussione si risolvano considerando che la somministrazione di farmaci può mascherare dei sintomi post concussivi.

VISITA MEDICA DI IDONEITA' A RIPRENDERE LA COMPETIZIONE



F.ITSI

Un rientro anticipato alla competizione aumenta il rischio di peggioramento della sintomatologia e aumenta il rischio di un nuovo incidente con possibilità di sindrome da secondo impatto.

HEAD INJURY ANALYSIS



Open access

Protocol

BMJ Open
Sport &
Exercise
Medicine

Research Evaluating Sports Concussion Events—Rapid Assessment of Concussion and Evidence for Return (RESCUE-RACER): a two-year longitudinal observational study of concussion in motorsport

Naomi D Deakin ¹, John Suckling ², Peter J Hutchinson ¹

To cite: Deakin ND, Suckling J, Hutchinson PJ. Research Evaluating Sports Concussion Events—Rapid Assessment of Concussion and Evidence for Return (RESCUE-RACER): a two-year longitudinal observational study of concussion in motorsport. *BMJ Open Sport & Exercise Medicine* 2021;7:e000879. doi:10.1136/bmjsem-2020-000879

Accepted 17 December 2020



© Author(s) (or their employer(s)) 2021. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

¹Clinical Neurosciences, University of Cambridge, Cambridge, UK
²Department of Psychiatry, University of Cambridge, Cambridge, UK

Correspondence to
Dr Naomi D Deakin;
naomi.deakin@cam.ac.uk

ABSTRACT
Introduction Concussion is a clinical diagnosis, based on self-reported patient symptoms supported by clinical assessments across many domains including postural control, ocular/vestibular dysfunction, and neurocognition. Concussion incidence may be rising in motorsport which, combined with unresolved challenges to accurate diagnosis and lack of guidance on the optimal return-to-race timeframe, creates a difficult environment for healthcare practitioners.

Methods and analysis Research Evaluating Sports Concussion Events—Rapid Assessment of Concussion and Evidence for Return (RESCUE-RACER) evaluates motorsports competitors at baseline (Competitor Assessment at Baseline, Ocular, Neuroscientific (CARBON study) and post-injury (Concussion Assessment and Return to motorSport (CARS) study), including longitudinal data. CARBON collects pre-injury neuroscientific data; CARS repeats the CARBON battery sequentially during recovery for competitors involved in a potentially concussive event. As its primary outcome, RESCUE-RACER will develop the evidence base for an accurate trackside diagnostic tool.

Baseline objective clinical scoring (Sport Concussion Assessment Tool—5th edition (SCAT5)) and neurocognitive data (Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT)) will be assessed for specificity to motorsport and relationship to existing examinations. Changes to SCAT5 and ocular, vestibular, and reaction time function (Dx 100) will be estimated by the reliability change index as a practical tool for trackside diagnosis. Neuropsychological (Cambridge Neurophysiological Test Automated Battery (CANTAB)) assessments, brain MRI (7 Tesla) and salivary biomarkers will be compared with the new tool to establish utility in diagnosing and monitoring concussive injuries.

Ethics and dissemination Ethical approval was received from East of England-Cambridge Central Research Ethics Committee (18/EE/0141). Participants will be notified of study outcomes via publications (to administrators) and summary reports (funder communications). Ideally, all publications will be open access.

Trial registration number February 2019 nationally (Central Portfolio Management System 38259) and internationally (ClinicalTrials.gov NCT03844282).

INTRODUCTION

Concussion is defined by the Concussion In Sport Group as: 'a traumatic brain injury induced by biomechanical forces'¹ and is diagnosed clinically according to a constellation of symptoms including alterations of mental state and consciousness.² The natural history is believed to be benign, but there is significant individual heterogeneity in its severity and rate of recovery, with longer recovery periods in certain demographics, such as adolescents.³

Amidst rising concern about concussion in contact sports,⁴⁻⁷ there is scarce evidence in the scientific literature on the incidence, severity, and recovery of head injuries specifically in motorsport.⁸ What little there is suggests that even though there has been significant investment in safety, drivers continue to experience a greater risk of concussion compared with other high-risk sports.⁹ Furthermore, a recent survey in the international journal of motorsport medicine, *AUTO+Medical*, found that 70% of competitors: 'did not feel completely normal' when they attempted to return-to-race following concussion.¹⁰ This landscape in the motorsport environment specifically—a relatively high concussion incidence combined with competitors returning before they have fully recovered—may leave competitors in control of a high-speed vehicle that poses an ongoing threat to the individual, other participants, and the public. Accurate identification of concussion and a

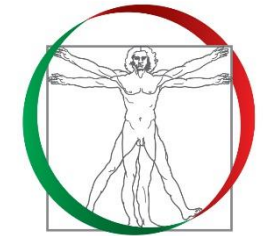
BMJ Open Sport Exerc Med: first published as 10.1136/bmjsem-2020-000879 on 13 January 2021. Downloaded from <http://bmjsem.bmj.com/> on July 16, 2023 by guest. Protected by copyright.

BMJ

Deakin ND, et al. *BMJ Open Sp Ex Med* 2021;7:e000879. doi:10.1136/bmjsem-2020-000879



HEAD INJURY ANALYSIS



Medicina dello Sport 2023 December;76(4):582-93
DOI: 10.23736/S0025-7826.23.04377-6

ORTHOPEDIC AREA

Early instrumental diagnostics on playground of head trauma in sporting events: the role of biomarkers to improve sports medical protocols in recognition and treatment of brain concussion

Diagnostica strumentale precoce in campo gara del trauma cranico negli eventi sportivi: il ruolo dei biomarcatori a completamento dei protocolli medico sportivi nel riconoscimento e trattamento della concussione cerebrale

Daniel G. Di MATTIA^{1,2*}, Anna MAFFIOLI^{1,3},
Gloria GOI^{1,3}, Giulio GUERRINI^{1,4}, Piergiorgio DANELLI¹

¹Luigi Sacco University Hospital, University of Milan, Milan, Italy; ²Italian Sports Medical Federation (FMSI), Rome, Italy; ³A&S 2 Milan, Milan, Italy

*Corresponding author: Daniel G. Di Mattia, Department of General Surgery, Luigi Sacco University Hospital, via Giovanni Battista Grassi 74, 20157 Milan, Italy; E-mail: mail@daniedimattia.it

SUMMARY

BACKGROUND: Introduction of diagnostic tools for cerebral concussion detection in head trauma must constitute a milestone in sporting events in order to immediately address the management and therapeutic process of the injured athletes, as well as the return-to-play in safety.

METHODS: Diverse activity in Contact Sports (i.e. Rugby, Boxing, American Football, Football, Ice Hockey) or in Individual Sports (Winter Sports, Cycling, Alpine Skiing, Bobsleigh, Skeleton) where there is a high risk of head trauma and consequent cerebral concussion, currently in Italy there is no other diagnostic method on playground than direct observation of the traumatic event by the Team Doctor and the subsequent objective examination of the athlete combined with anamnestic data.

RESULTS: The most obvious symptom of concussion is loss of consciousness, although most head and athletes experience other symptoms and signs such as headache, nausea and vomiting, dizziness, postural imbalance (ataxia), confusion with light-headedness or numbness, retrograde amnesia or anterograde, diplopia and photophobia. Sometimes the symptoms are absent or trivial and the injury is underestimated with possible subsequent immediate and delayed serious consequences as Second Impact Syndrome.

CONCLUSIONS: Introduction of biomarkers test of head trauma and consequent concussion in an American reality for the National Football League in the 2023-2024 championship. Estimates of the incidence of sport related concussion in the United States vary from underestimated by 200,000 cases up to a conceivable number of 3,800,000. When occurs a fatal outcome the fatal concussion was rarely subsequent to a previous undiagnosed event (RIS); data from the Centers for Disease Control and Prevention, in Italy there are no certain data on this matter. An appropriate estimate, calculated on data from Emilia Romagna, assumes around 120,000 cases per year in line with the American data, compared to the Italian population. To complete validated concussion protocols, it is necessary to introduce reliable biomarkers in order to recognize the athlete's injury and to obtain a diagnostic and therapeutic gold standard, as well for return-to-play of the athlete.

Key words: RIS; sports related concussion; biomarkers; mild traumatic brain injury; athletes.

Di Mattia DG, Maffioli A, Goi G, Guerrini G, Danelli P.
Early instrumental diagnostics on playground of head trauma in sporting events: the role of biomarkers to improve sports medical protocols in recognition and treatment of brain concussion.

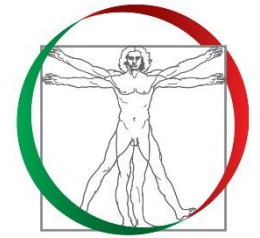
Med Sport 2023;76:582-93. DOI:
10.23736/S0025-7826.23.04377-6)

562

MEDICINA DELLO SPORT

December 2023

HEAD INJURY ANALYSIS



FMSI

Head Injury Analysis of Vehicle Occupant in Frontal Crash Simulation: Case Study of ITB's Formula SAE Race Car

Sandro Mihradi, Hari Golfianto, Andi Isra Mahyuddin & Tatacipta Dirgantara

J. Eng. Technol. Sci., Vol. 49, No. 4, 2017, 534-545 Accepted for publication October 30th, 2017.

Copyright ©2017 Published by ITB Journal Publisher, ISSN: 2337-5779, DOI: 10.5614/j.eng.technol.sci.2017.49.4.8

534 J. Eng. Technol. Sci., Vol. 49, No. 4, 2017, 534-545



Head Injury Analysis of Vehicle Occupant in Frontal Crash Simulation: Case Study of ITB's Formula SAE Race Car

Sandro Mihradi¹, Hari Golfianto², Andi Isra Mahyuddin³ & Tatacipta Dirgantara⁴

¹Mechanical Design Research Group, Mechanical Engineering Department, Faculty of Mechanical and Aerospace Engineering, Institut Teknologi Bandung, Jalan Ganesha 10, Bandung 40132, Indonesia

²Lightweight Structures Research Group, Aeronautics & Astronautics Department, Faculty of Mechanical and Aerospace Engineering, Institut Teknologi Bandung, Jalan Ganesha 10, Bandung 40132, Indonesia
E-mail: sanisro@fme.itb.ac.id

Abstract. In the present study, frontal crash simulations were conducted to determine the extent of various car speeds against the Head Injury Criterion (HIC), a measure of the likelihood of head injury arising from impact. The frontal impact safety of ITB's formula SAE race car developed by students was evaluated as a case study. LS-DYNA[®], an explicit finite element code for non-linear dynamic analysis was utilized in the analysis. To analyze head injury, a two-step simulation was conducted. In the first step, a full-frontal bumper test was simulated without incorporating a dummy inside the car. The output was the deceleration data of the car, which was used as input in the second step, a sled test simulation. In the sled test, only the cockpit and dummy were modeled. The extent of deceleration to the head of the dummy was then evaluated. The results show that HIC values at an impact speed of 7 m/s (25 km/h) to 11 m/s (40 km/h) were below the safe limit and still in the safe zone. However, the HIC values will exceed the safe limit when the speed of impact is the same as or greater than 12 m/s (43 km/h).

Keywords: finite element analysis; frontal collision; FSAE; head injury; impact simulator; sled test.

1 Introduction

The Society of Automotive Engineers (SAE) hosts a number of student design competitions, one of which is Formula SAE[®], which challenges students to design a formula-style race car. One of the essential aspects is safety, especially in the impact simulator (IA) and seatbelt design. The IA absorbs kinetic energy during frontal impact, while the seatbelt restrains the driver's body from moving forward due to deceleration. According to the 2013 Formula SAE Rules [1], the IA has to be able to absorb sufficient impact energy, i.e. when annotated

Received May 8th, 2017, Revised October 17th, 2017, Accepted for publication October 30th, 2017.
Copyright ©2017 published by ITB Journal Publisher, ISSN: 2337-5779, DOI: 10.5614/j.eng.technol.sci.2017.49.4.8

POLITRAUMA IN MOTORSPORT DIREZIONE GARA



POLITRAUMA IN MOTORSPORT PIANO DI EMERGENZA SANITARIO (PES)



SPORT

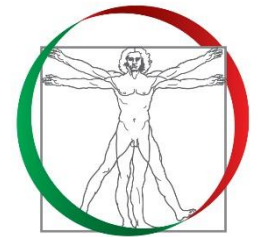


TRAUMA CRANICO CONCLUSIONI



E' auspicabile che oltre all'introduzione da parte di tutte le Federazioni Nazionali di protocolli per il riconoscimento, la diagnosi ed il trattamento della Concussione Cerebrale, venga presa in assoluta considerazione la possibilità di effettuare in campo gara la diagnostica precoce di Concussione Cerebrale tramite i Biomarcatori Cerebrali in conseguenza di un trauma cranico sportivo.

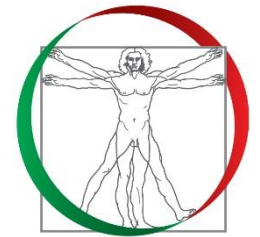
TRAUMA CRANICO NATIONAL FOOTBALL LEAGUE



FMSI



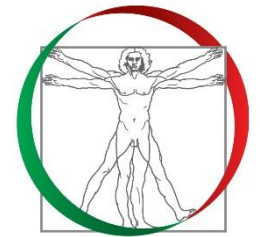
TRAUMA CRANICO MOTO GP



FMSI



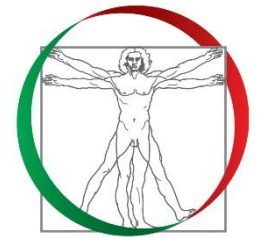
TRAUMA CRANICO BOXING



FMSI



TRAUMA CRANICO WINTER SPORTS



FMSI



MEDICAL SURVEY

Athletes need to know about concussions

Local ski racers aim to raise awareness of head injuries

By [Name]

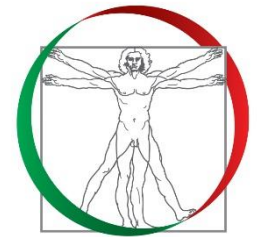
Local ski racers are aiming to raise awareness of head injuries among athletes and the general public. The Italian Ski Federation (FIS) has launched a campaign to educate athletes on the risks of concussions and the importance of proper safety gear.

The campaign includes a series of workshops and seminars for athletes, focusing on the signs and symptoms of concussions and the correct use of helmets and other protective equipment. The goal is to reduce the number of head injuries and ensure that athletes are better prepared to handle any potential head trauma.

The FIS also emphasizes the importance of proper technique and the role of coaches in ensuring that athletes are using their equipment correctly. The organization is committed to providing the highest level of safety and support for its athletes.



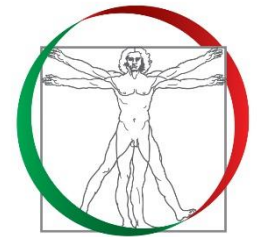
TRAUMA CRANICO ICE HOCKEY



F.M.S.I.



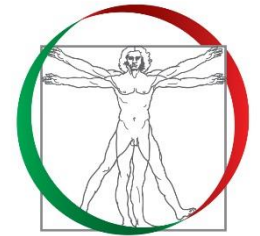
TRAUMA CRANICO RUGBY



F.M.S.I.



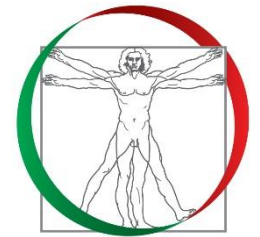
TRAUMA CRANICO SOCCER



FMSI



TRAUMA CRANICO MOTORSPORT



FMSI

