Učinci tjelesnog vježbanja na oporavak mladih sportaša od posljedica potresa mozga

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POPIS KRATICA KORIŠTENIH U RADU

BCBT – Buffalo test biciklom (prema engl. *The Buffalo Bicycle Test*)

BCTT – Buffalo test na traci za trčanje (prema engl. *The Buffalo Treadmill Test*)

CBF – moždani protok krvi (prema engl. *cerebral blood flow*)

CDC – Centar za kontrolu i prevenciju bolesti (prema engl. *The Centers for disease control and prevention*)

CISG – Skupina za potres mozga u sportu (prema engl. *Concussion in Sport Group*)

CT – kompjuterizirana tomografija

FIFA – Svjetska nogometna organizacija (prema franc. *Fédération Internationale de Football Association*)

GCS – Glasgowska ljestvica za procjenu stanja svijesti (prema engl. *Glasgow coma scale*)

KGFP – Kiseli glijalni fibrilarni protein (prema engl. *glial fibrillary acidic protein*)

KPKS – Kronični poslijekomocijski sindrom (prema engl. *persisent post-concussive syndrome*)

KTE – Kronična traumatična encefalopatija (prema engl. *chronic traumatic encephalopathy*)

MR – Magnetska rezonanca

PMPS – Potres mozga povezan sa sportom (prema engl. *sports-related concussion*)

SCAT5 – Upitnik za procjenu potresa mozga u sportu (prema engl. *Sport Concussion Assessment Tool*)

TOM – Traumatska ozljeda mozga

VAS – Vizualno – analogna skala

SADRŽAJ

SAŽETAK

Učinci tjelesnog vježbanja na oporavak mladih sportaša od posljedica potresa mozga

Matko Leović

Potres mozga povezan sa sportom česta je posljedica traumatskog incidenta u mladih sportaša koji se može dogoditi na treningu ili utakmici. Bitna je hitna reakcija medicinske službe na mjestu ozljede, a dijagnosticiranje potresa mozga i težina ozljede provode se putem posebno dizajniranog upitnika (npr. *SCAT5*) kako bi se odredilo koji sportaš se može odmah vratiti sportskoj aktivnosti, a kod kojega je potrebna daljnja dijagnostička obrada. Simptomi potresa mozga su nespecifični što otežava postavljanje dijagnoze. Najčešći simptomi su glavobolja i omaglica, a simptomi se dijele u četiri kategorije: tjelesni, kognitivni, emocionalni i poremećaji spavanja.Većina simptoma se povlači unutar prvih tjedan dana od ozljede, no 10% djece će imati i simptome kroz duži period. Ukoliko simptomi traju duže od mjesec dana govori se o kroničnom post-komocijskom sindromu, KPKS. Donedavno se smatralo kako je strogi odmor najbolji način za oporavak mladih sportaša, no na temelju recenzije 60 000 članaka, *CISG* konferencija (prema engl. *Concussion in Sport Group*) donijela je preporuku o uvođenju aerobnog vježbanja u tretman oporavka mladih sportaša. Suboptimalno aerobno vježbanje koje potencira 60 do 80% maksimalnog srčanog ritma pri izvođenju vježbi pokazalo se kao tretman koji uspješno djeluje na regulaciju parcijalnog tlaka ugljikovog dioksida u krvi i smanjenje moždanog protoka krvi. Iako dosadašnje studije ohrabruju istraživače o učincima aerobnog vježbanja, potrebna su daljnja istraživanja kako bi se razvili točni parametri i modaliteti liječenja.

KLJUČNE RIJEČI : potres mozga, kronični post-komocijski sindrom, srčani ritam, aerobno vježbanje

SUMMARY

Effects of exercise on recovery after concussion in young athletes

Matko Leović

Sports-related concussion is a common result after traumatic incident which can occur at training ground or during the game. Emergence reaction is necessary at the place where the injury have occured, and diagnostics and injury severity are established through specifically designed questionnaire (e.g. *SCAT5*) to determine which player can return to sports activity and which player must go through further diagnostics evaluation. The symptoms of concussion are not specific and thus is harder to establish proper diagnosis. The most common symptoms are headache and dizziness and symptoms are divided into four main categories: somatic, cognitive, emotional and sleep disorders. Most of the symptoms are resolved in first week after injury, but 10% of children will have symptoms after that period. If symptoms last longer than one month, diagnosis of persistent post-concussive syndrome can be established. Until recently, treatment recommendation for these patients was strict rest, but after reviewng over 60 000 articles *CISG* conference declared new recommendation to include aerobic exercise into young athlete's treatment. Suboptimal aerobic exercise which potentiate 60-80% of maximum heart rate during exercising was shown to be effective in reducing partial pressure of carbon dioxide and in reducing cerebral blood flow. Although up-to-date studies are very convincing, further studies are needed to establish exact treatment parameters and modalities.

KEY WORDS: concussion, persisent post-concussive snydrome, heart rate, aerobic exercis

1. UVOD

U posljednih nekoliko desetljeća dogodio se velik razvitak sportske medicine, ne samo one koje se bavi odraslima, već i mladima. Razvitak se dogodio u promjenama metoda treninga i sportske opreme, ali isto tako u prevenciji i liječenju ozljeda. Ozljeda koja može rezultirati produženim oporavkom i trajnim posljedicama jest traumatska ozljeda mozga, TOM (prema engl. *traumatic brain injury, TBI*).

TOM je značajan javnozdravstveni problem u svijetu zbog nedovoljno poznate prevalencije, kao i zbog činjenice da ne postoji točno određena terapija ili protokol za oporavak takvih pacijenata. Ipak, u posljednje vrijeme ohrabruju radovi koji govore o utjecaju aerobnog vježbanja pa se tako ta tema nametnula znanstvenoj zajednici, pogotovo u SAD-u koji generira znatan dio znanstvenog opusa o ovoj tematici.

The Centers for disease control and prevention (*CDC*) je vodeća američka javnozdravstvena organizacija, a ona definira TOM kao ozljedu uzrokovanu nagnječenjem, udarcem ili trzajem glave koji izaziva poremećaje normalne moždane funkcije (1). Ozljeda može biti blaga, tj. uzrokovati manju promjenu mentalnog stanja ili svijesti, ili teška, tj. uzrokovati duži period nesvjesnosti ili amnezije nakon incidenta. U literaturi se blaga moždana ozljeda (prema engl. *mild traumatic brain injury, mTBI*) poistovjećuje sa potresom mozga, iako neki znanstvenici smatraju kako su to odvojeni entiteti (2). Kako imaju sličnu definiciju i simptomatologiju, u ovom diplomskomu radu o njima će se govoriti kao sinonimima.

Damjanov potres mozga definira kao klinički sindrom s prolaznim neurološkim ispadima koji uključuju gubitak svijesti, poremećaj disanja i gubitak refleksa (3). Najčešće se razvija u slučajevima akceleracijske ozljede mozga, a promjene u mozgu su reverzibilne. Oporavak je brz i potpun, ali amnezija može potrajati. Katkad se slika komplicira psihogenim

problemima. Tkivna se oštećenja ne nalaze neuroradiološkim oslikavanjem mozga niti pri mikroskopskom pregledu tkiva. Robbins navodi kako ne treba nužno biti prisutan gubitak svijesti (4). Ponavljajuće epizode potresa mozga mogu rezultirati trajnim neuroškim oštećenjima, uključujući kognitivna oštećenja, parkinsonizam i kroničnu traumatičnu encefalopatiju.

Definicija potresa mozga povezana sa sportom detaljno je razrađena 2016.godine na konferenciji *Concussion in Sport Group* (*CISG*) koja je održana u Berlinu. Okupila je mnoge stručnjake sportske medicine pod okriljem Međunarodnog olimpijskog odbora, *FIFA-E* i Međunarodne hokejaške federacije. Grupa eksperata recenzirala je oko 60 000 članaka na tu temu i došla do zaključaka koji su navedeni u daljnjem tekstu.

Potres mozga povezan sa sportom, PMPS (prema engl. sports related concussion, *SRC*) definiran je kao traumatska ozljeda mozga uzrokovana biomehaničkim silama (5).

Nađeno je nekoliko zajedničkih karakteristika:

1. Sila je prenesena na glavu, a udarac može biti u području lica, glave ili vrata.

2. Neurološki poremećaji se uglavnom odmah očituju i brzo spontano prolaze, ali se mogu očitovati i tek nakon nekoliko minuta, sati ili dana.

3. Poremećaji i akutni klinički znakovi uglavnom su odraz funkcionalnog oštećenja pa se stoga ne mogu detektirati na slikovnim pretragama (CT, MR). Moguća su i strukturna patološka oštećenja.

4. Gubitak svijesti ne mora biti prisutan uz ostale kliničke znakove.

5. Oporavak je brz i postupan, iako može biti i produljen.

6. Simptomi se ne mogu dovesti u vezu sa zlouporabom droge, alkohola ili lijekova te drugih ozljeda (kralježnice,vestibularnog sustava) ili prijašnjim komorbiditetima.

CISG konferencija značajna je jer je novim spoznajama dopunila i predložila modalitete liječenja PMPS-a koji su ustanovljeni na prijašnje četiri konfencije (2001,2004,2008,2012). Isto tako, definirani su kriteriji za određivanje kroničnog poslijekomocijskog sindroma, KPKS (prema engl. *persistent post-concussive symptom, PPCS*). Kratica *PPCS* također može značiti i „*persisent post-concussive syndrome*“ (6). KPKS se definira kao trajanje simptoma potresa mozga dulje od 10-14 dana za odrasle, a dulje od 28 dana za djecu i mlade (1 mjesec) (5).

2. METODE

Pregled dosadašnjih spoznaja o učincima tjelesnog vježbanja na oporavak mladih sportaša od posljedica potresa mozga provedena je analizom rezultata dosadašnjih istraživanja objavljenim u dostupnim znanstvenim i stručnim radovima. Pretraživanje je napravljeno prema četiri kriterija koja su uključivala pretragu po MeSH terminima i ključnim riječima, period objavljivanja, jezik i dostupnost rada. U pretragu su uključeni izvorni, pregledni i stručni radovi. Analiza dostupne literature uključivala je definiranje problema, pronalaženje stručnih i znanstvenih radova pretraživanjem bibliografske baze podataka PubMed, komercijalnih znanstvenih baza podataka (Google znalac) i slobodnih dostupnih elektroničkih izvora; prikupljanje literature, analizu objavljenih radova i pregled dobivenih rezultata. Također su pregledane smjernice stručnih društava i ustanova u medicini rada i sporta. Osim elektroničkih zapisa, pregledani su i dostupni udžbenici i tiskane publikacije iz područja sportske medicine, fiziologije i fiziologije sporta. Izvorni, pregledni i stručni znanstveni radovi prikupljeni su bibliografske baze podataka PubMed jer je besplatna i pokriva široko područje biomedicine i zdravstva. Koristili su se MeSH termini „ *traumatic brain injury*“, „*brain concussion*“, „*persistent post-concussive symptome*“, „*persistent post-concussive snydrome*“ i kombinirali su se s ključnim riječima „*sports related* „ i „*aerobic exercise*“ upotrebom Booleovih izraza rijeci AND, OR, NOT u pojmove. Analizirani su dostupni radovi koji su objavljeni u periodu od srpnja 1991.do svibnja 2020. godine, objavljeni na engleskom i hrvatskom jeziku. Radovi iz ovog perioda su odabrani jer su tada krenula krenula prva istraživanja o općim pozitivnim učincima aerobnog vježbanja, kao i o patofiziologiji potresa mozga. Pregledom naslova radova i sažetaka, odabrani su radovi koji udovoljavaju kriterijima ovog istraživanja te oni koji su dostupni u cijelosti (″full-texts″).

3. EPIDEMIOLOGIJA

U 2014. godini u Sjedinjenim Američkim državama zabilježeno je ukupno 2,87 milijuna slučajeva traumatske ozljede mozga, od čega je bilo 2,53 milijuna hitnih posjeta; 280.000 hospitalizacija i 56.800 smrtnih ishoda (1). Među djecom zabilježeno je 837.000 sveukupnih slučajeva, od čega je 2529 djece preminulo. Slučajni padovi, udarac u objekt ili objektom te automobilske nesreće najčešći su mehanizmi ozljeda. Ta tri mehanizma su sudjelovala sa 47,9%, 17,1% i 13,2% udjela u hitnim posjetama. Problem je ipak u nepotpunim podatcima, jer *CDC* ne prikuplja podatke izvan bolničkih centara (npr. od liječnika opće prakse).

Po nekim prijašnjim podatcima *CDC*-a godišnje je bilo 300.000 slučajeva traumatske ozljede mozga koje su uzrokovane sportskim aktivnostima (7). Među te slučajeve nisu bile uračunate osobe sa očuvanom sviješću i one koje su se javile medicinskom osoblju izvan bolnice (1). No, kako se navodi, studije ukazuju da je gubitak svijesti prisutan u samo 8 do 19,2 % slučajeva, onda je realnija procjena kako je tada godišnje 1,6 do 3,8 milijuna sportaša u SAD-u doživjelo potres mozga koji je povezan sa sportskim aktivnostima , od čega je njih 30% u dobi 5 do 19 godina (8). Ako bi taj podatak vrijedio i za rezultate iz 2014. godine, taj bi broj vjerojatno bio još i veći. Tome broju treba pridodati i one koji su pretrpjeli blagu traumatsku ozljedu, tj. potres mozga, a da to nisu nikome prijavili. Potres mozga povezan sa sportskim aktivnostima stoga je bitan iz epidemiološkog kuta jer je ukupan broj ozlijeđenih nepoznat, ali i unatoč činjenici da će 90% ozlijeđenih oporaviti u roku 7-10 dana, 10% mladih sportaša može imati simptome i nakon tog razdoblja (8). Istraživanja pokazuju da se raspon djece koja će bolovati od PMPS-a nakon tri mjeseca kreće u rasponu 14 do 29% (9). Sportovi koji se navjiše povezuju s potresom mozga su američki nogomet i hrvanje među dječacima, ženski nogomet, muški nogomet te ženska košarka (8).

4. PATOFIZIOLOGIJA

Djeca i mladi skloniji su potresu mozga zbog različitih strukturnih i muskuloskeletalnih obilježja (9). Imaju veći udjel vode u tijelu, nedovršenu mijelinizaciju i slabije vratove koji bolje prenose, tj. lošije spriječavaju akceleracijsko- deceleracijske sile koje su odgovorne za nastanak potresa mozga zbog pomicanja mozga unutar lubanje. Zbog pomicanja mozga, dolazi do aksonskoga oštećenja, tj. aksonskoga istezanja. Aksonskim istezanjem dolazi do mehanoporacije neuralnih membrana, što uzrokuje efluks kalijevih, a influks kalcijevih iona (10). Takva promjena ionskih potencijala uzrokuje otpuštanje glutamata koji potiče citotoksičnu kaskadu koja je odgovorna za znakove kognitivne disfunkcije (11). Kako neuron pokušava ispraviti tu promjenu membranskoga potencijala, dolazi do povećanog trošenja ATP-a i njegova manjka. To uzrokuje manjak energije i porast broja oksidirajućih tvari, što se očituje simptomima kao što su konfuzija i gubitak svijesti (8).

U posljednje vrijeme sve više se istražuje mehanizam upale, zasnovan na međudjelovanju neutrofila i makrofaga, koji dolaze na mjesto oštećenja, sa mikroglijalnim i astrocitnim stanicama (12). Dolazi do porasta lučenja citokina, od kojih je najvažniji kiseli glijalni fibrilarni protein , KGFP (prema engl. *Glial Fibrillary Acidic Protein, GFAP*) koji je važan biobiljeg astrocitne aktivacije, a izrazito je povišen nakon traume mozga (13) . Od ostalih molekula istražuju se proupalni citokini kao što su IL-1α, IL-β i TNF-α. Razine IL-β dugo se mogu detektirati, a razina korelira sa ozbiljnošću traumatske ozljede mozga (14). Iako se mislilo da prethodi lučenju neuroprotektivnih faktora, istraživanja pokazuju da inhibicijom djelovanja IL-1β dolazi do smanjenja moždanog edema i regresije simptoma (15). TNF-α pokazuje neuroprotektivno i neurotoksično djelovanje, što se povezuje s njegovim dvostrukim vezivanjem na receptore u mozgu (16). Također, poznato je da navedeni proupalni citokini

potiču lučenje protupalnih citokina, kao što su IL-10 i TGF-β, kako bi došlo do ravnoteže upalnih procesa u mozgu (17).

Patofiziološki mehanizam koji uzrokuje nemogućnost vježbanja, tj. netoleranciju prijašnjih uobičajenih sportskih napora, zasniva se na ozljedi centra za kardiopulmonalnu funkciju u produženoj moždini ili diskonekciji produžene moždine s baroreceptorima i srcem (18). Time dolazi do disregulacije autonomnog živčanog sustava koji postaje neosjetljiv na povišene razine arterijskog CO_2 u krvi ($paCO_2$) što dovodi do relativne hipoventilacije. Zbog toga dolazi do vazodilatacije u krvnim žilama mozga i povišenja intrakranijalnog tlaka zbog povećanog protoka krvi kroz mozak, *CBF* (prema engl. *cerebral blood flow*) što uzrokuje simptome poput glavobolje, osjećaja vrtnje, povraćanja itd. (19).

Tajje mehanizam u središtu pozornosti ovog rada, jer se dosad pokazao kao onaj mehanizam na koji se može djelovati kako bi se spriječili ili ublažili simptomi, a na temelju egzaktnih parametara. Kao posebno opasan mehanizam koji dovodi do toga stanja navodi se rotacijska ozljeda u području gornje vratne kralježnice (6).

5. KLINIČKA SLIKA

Klinička slika potresa mozga je nespecifična i u diferencijalnoj dijagnozi trebaju uzeti ostale neurološke poremećaje i poremećaje drugih organskih sustava . Diferencijalne dijagonze su vidljive u Tablici 1., a podatci su prilagođeni prema Barlow i sur. (2016). Zbog velikoga mogućega broja simptoma, sportaš koji je zadobio ozljedu mozga ne mora nužno dobiti dijagnozu potresa mozga. Simptomi se brzo javljaju, varijabilni su, u pravilu kratko traju i brzo se povlače. Glavobolja i omaglica najčešći su simptomi (8).

Simptomi potresa mozga mogu se podijeliti u četiri kategorije : tjelesni, emocionalni, kognitivni i poremećaji spavanja. Podatci su vidljivi u Tablici 2. i Tablici 3., a prilagođeni su prema Hobbsu i sur. (2016).

Tablica 1. Diferencijalna dijagnoza potresa mozga

DIFERENCIJALNA DIJAGNOZA
Intrakranijsko krvarenje (-epi ili subduralno, intercerebralno, subarahnoidno)
Migrena, glavobolja
Epilepsija
Ozljeda vestibularnog sustava
Ozljeda cevikalne kralježnice
Vestibularna ozljeda cervikalnog podrijetla
Cervikalna caskukarna ozljeda
Simptomatska ili komunicirajuća arahnoidna cista
Sinkopa
Promijenjeni mentalni status zbog korištenja supstanci ili zbog med. poremećaja
Depresija
Anksioznost
Hipohondrijaza
Somatizacija / konverzija

Tablica 2. Tjelesni i kognitivni simptomi

TJELESNI
Glavobolja
Mučnina
Problemi s ravnotežom
Omaglica
Problemi s vidom
Umor
Fotofobija
Fonofobija
Parestezije
KOGNITIVNI
Osjećaj magle u glavi
Osjećaj usporenosti
Otežano koncentriranje
Problemi s pamćenjem
Zaboravljanje nedavnih događaja ili razgovora
Usporeno odgovaranje na pitanja

Tablica 3. Emocionalni simptomi i poremećaji spavanja

EMOCIONALNI
Razdražljivost
Osjećaj tuge
Osjećaj nervoze
POREMEĆAJI SPAVANJA
Spavanje duže od uobičajenog
Spavanje kraće od uobičajenog
Otežano usnivanje
Učestalo buđenje

5.1 TJELESNI SIMPTOMI

Glavobolju iskusi do 90% ozlijeđenih. Najčešće se radi o tenzijskoj glavobolji i migreni. Od ostalih vrsta može doći do muskuloskeletalnoe boli zbog trzajne ozljede vrata. Bol može potrajati na mjestu udara ili laceracije i do nekoliko mjeseci (20).

Simptom omaglice osjeća oko 50% ozlijeđenih. Može biti vestibularne ili nespecificirane etiologije. Neki pacijenti mogu osjetiti i pravu vrtoglavicu, a najčešći uzroci su benigni paroksizmalni pozicijski vertigo, potres labirinta unutarnjeg uha, perilimfatička fistula (20).

Nakon ozljede, mladi sportaši česti imaju problema s ravnotežom : u hodu se njišu ili padaju (21). Poremećena ravnoteža može biti uzrokovana ozljedom vidnog sustava. Zato je pregled ravnoteže putem *SCAT-5* upitnika vrlo bitan u procjeni ima li netko potres mozga.

5.2 KOGNITIVNI SIMPTOMI

Odmah nakon potresa mozga većina ozlijeđenih prijavljuje osjećaj magle u glavi, javlja se gubitak tijeka misli, lošija je konverzacija, pacijent ima problema sa prisjećanjem, ne može se sjetiti riječi za ono što želi izreći. Iako se velika većina djece oporavi u roku od par dana, rizičnim faktorima smatraju se poslijetraumatska amnezija duža od 30 minuta i abnormalnosti EEG-a unutar 24 sata nakon ozljede. Isto tako, mogućnost trajnih posljedica ili produljenoga oporavka povezuje se s prethodnim potresima mozga (9).

5.3 EMOCIONALNI SIMPTOMI

Spektar psihijatrijskih problema može se pojaviti nakon potresa mozga: anksioznost, depresija, poremećaji osobnosti, poslijetraumatski stresni poremećaj, poremećaj pažnje/hiperaktivni poremećaj te *ADHD*. S porastom ozbiljnosti ozljede, u do 36% djece pojavljuju se takvi poremećaji unutar 6 mjeseci. Kada postoji neki od ovih simptoma, potrebno je uključiti multidiciplinarni tim gdje je ključna pomoć psihijatra.Za depresivne epizode može se koristiti liječenje sertralinom, a anksioznost se može liječiti kognitivno-bihevioralnom terapijom. Ono što se ne smije zaboraviti je činjenica da podrška obitelji ima veliku ulogu u samom liječenju i njegovoj uspješnosti (9).

5.4 POREMEĆAJI SPAVANJA

Pojavljuju se u 50% djece i adolescenata nakon blage moždane ozljede. Prvo se pojavljuje hipersomnija, i najčešća je tegoba unutar prvih 7 do 10 dana od ozljede. Nakon toga, pojavljuju se problemi s otežanim usnivanjem, a podatci govore da nakon 3 mjeseca 38% djece ima problema s otežanim usnivanjem, češćim buđenjem i manjom efikasnošću spavanja što se vidi i na polisomnografiji. Bitno je detaljno uzeti anamnezu kako bi se vidjelo postoje li neki već postojeći ili novi čimbenici koji utječu na spavanje kao što su anksioznost,depresija ,uzimanje lijekova. Od lijekova koji se povezuju s insomnijom valja spomenuti lijekove koji se primjenjuju za liječenje poremećaja pažnje. U liječenju insomnije bitno je voditi dnevnik spavanja, a od farmakoterapije mogu se uzimati melatonin i amitriptilin, koji također mogu pomoći u slučaju kada postoje i glavobolje, kao i hipnotici zopiklon i zolpidem. Bitno je odabrati terapiju koja ne bi maskirala ostale simptome potresa mozga. Kod kronične insomnije, kognitivno -bihevioralna terapija je učinkovitija od farmakološke (9).

5.5 SECOND IMPACT SYNDROME

U literaturi ovaj se naziv rabi kao komplikacija preranoga povratka sportskim aktivnostima nakon pretrpljenoga moždanog udara. Smatra se da je riječ o gubitku autoregulacije moždanoga protoka, što dovodi do porasta intrakranijalnoga tlaka i difuznoga moždanog edema (22). Porast intrakranijalnoga tlaka izrazito je opasan, jer može dovesti do hernijacije, a samim time do kome i smrti. Osim ovoga sindroma i njegovih neželjenih posljedica, prerani povratak sportskim aktivnostima može dovesti do novoga potresa mozga i smanjenja

kognitivnih sposobnosti i vremena reakcije koji su potrebni za sportski uspjeh. Osim toga postoji i neurometabolički prozor u kojemu je mozak posebno susceptibilan na ozljedu (23).

5.6 KRONIČNA TRAUMATIČNA ENCEFALOPATIJA

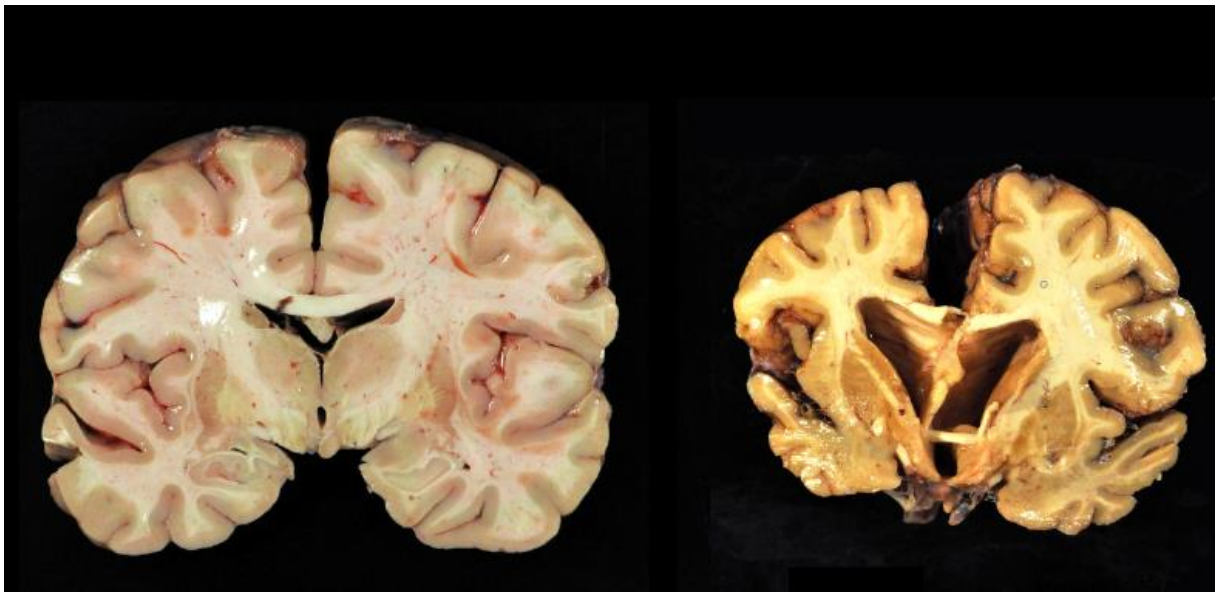
To je kronična komplikacija ponavljanih traumatskih ozljeda mozga, još uvijek nedovoljno razjašnjenoga patofiziološkog mehanizma (24). Kronična traumatična encefalopatija prvotno je opisana 1920-ih i 30-ih kao „dementia puglistica“ ili „punch drunk symdrome“ u boksača, koji su se očitovali simptomima parkinsonizma, disartije i demencije. Bolest se najšće javlja u boksača, igrača američkoga nogometa, hrvača, hokejaša na ledu i nogometaša.Trauma ne mora nužno završiti potresom mozga, nego može uzrokovati asimptomatska oštećenja, jer poznato je kako se bolest pojavljuje tek nakon 8-10 godina. Obično se slijed razvoja simptoma dijeli u četiri faze (25) :

1. Faza: Pojavljuju se simptomi konfuzije, dezorijentiranost i glavobolje.

2. Faza: Kako dolazi do atrofije moždane mase, javlja se gubitak pamćenja i impulzivno ponašanje.

3. i 4. Faza : Demencija se progresivno pogoršava, hipomimija, tremor, gluhoća, problemi s ravnotežom, suicidalnost.

U pozadini bolesti riječ je o atrofiji moždane kore, pogotovo frontalnoga i temporalnoga korteksa (Slika 1.)



Slika 1. Zdrav mozak (lijevo), mozak pacijenta s kroničnom traumatskom leukoencefalopatijom (desno), Izvor: Boston University Center for the study of Traumatic Encelopathy

Kronična traumatska encefalopatija je taupatija, koju ipak treba razlikovati od Alzheimerova sindroma, jer do nakupljanja tau (τ) proteina ne dolazi u istim regijama mozga. Terapija za ovu bolest još uvijek, na žalost, ne postoji, a definitivna dijagnoza moguća je tek na obdukciji (26).

6. DIJAGNOSTIKA I ZDRAVSTVENI PREGLED SPORTAŠA

Kad se dogodi ozljeda na terenu, protokol je takav da se prvo na terenu radi evaulacija nastale ozljede. Najviše pažnje posvećuje se anamnezi, kognitivnim testovima i testovima ravnoteže (27). Treba isključiti cervikalnu ozljedu, ozljedu lubanje, mogućnost intrakranijalnog krvarenja, a u težim slučajevima napraviti i kardiopulmonalnu resuscitaciju , ako je potrebno (8). Ako postoji ozljeda vrata, radi se imobilizacija i vožnja do centra koji ima mogućnost dijagnostike naprednim slikovnim pretraga mozga. Bilo bi poželjno kada bi liječnik imao rezultate neuroloških, kognitivnih, i testova ravnoteže koji bi se uzimali tokom sezone, tzv. *baseline test*. Igrač koji pokazuje jasne znakove PMPS-a (gubitak svijesti, tonička postura ili problemi s ravnotežom), odmah se uklanja s terena (27). U ozlijeđenih u kojih se sumnja na PMPS ili imaju znatnu ozlijedu glave, radi se evaulacija pokraj terena, tzv. *sideline evaluation*. Najčešće se radi evaluacija *SCAT-5* upitnikom za odrasle (Prilog 1.) ili *CHILD SCAT* za djecu (Prilog 2.) . *SCAT-5* upitnikom ispituje se postoji li amnezija (Koje je poluvrijeme?, Koji je rezultat?, Koji je tjedan?), gleda se ima li znakova konfuzije (tup pogled, neodgovaranje na pitanje). U sklopu *SCAT-A 5* provjerava se i ravnoteža, i to tako da ozlijeđeni prvo stoji na dvije na noge pa na jednoj , pa sa zatvorenim očima u tandem stajanju (dominantna noga naprijed). Isto tako od ispitanika se traži da zapamte redoslijed od pet riječi, ili izgovaraju slijed znamenki obrnutim redoslijedom. Radi se i Glasgowska ljestvica kome, *GCS* (28).

Ono što je bitno znati jest da *SCAT-5* upitnik ne služi za postavljanje dijagnoze potresa mozga povezanoga sa sportom, već usmjerava liječnika ili osposobljenoga zdravstvenog radnika da prepozna koji ozlijeđeni bi ga sportaš mogao imati. Konačna odluka donosi se na temelju kliničke procjene. *SCAT-5* se pokazao korisnim unutar 3 do 5 dana, nakon toga, više se ne primjenjuje . Pregled se nakon evaluacije na terenu treba nastaviti u nekoj „mirnoj“

prostoriji (npr. svlačionica). Gleda se postoji li regresija ili progresija simptoma prisutnih pri pregledu na terenu, kao i pojava novih simptoma. Uzima se detaljnija anamneza od trenera, suigrača i obitelji (hetereoanamneza), kao i procjena mentalnog statusa, kognicije, ravnotežne, okularne i vestibularne funkcije. Takvi se podatci mogu unositi u računalni softver, a preporuča se izobrazba neuropsihologa kako bi u budućnosti evaluacija ovakvih testova bila pouzdanija (4).

Mogu se raditi i slikovne pretrage mozga, no pokazalo se da se na neuroradiološkim slikovnim prikazima, u pravilu ne , nalaze nikakve promjene (5). NA CTu nikakve, na MR-u akutnoj fazi u 80 do 90% slučajeva ne nalaze se promjene, a u KPKS-u uopće ne, ako je riječ o nekompliciranoj ozlijedi mozga.

Nakon što prođu simptomi, najnovije preporuke idu u smjeru strategije povratka sportu koje su prikazane u Tablici 4., a prilagođene su prema Hobbsu i sur. (2016). Strategija se sastoji od postupnoga napretka unutar minimalno tjedan dana. Nakon svake faze napretka treba proći 24 sata bez simptoma da bi se prešlo na iduću fazu. Ako se pojave simptomi , ne ide se dalje s napretkom, nego osoba ponavlja proteklu fazu (8).

Tablica 4. Strategija povratka sportu

Preduvjet : bez simptoma
Prvi korak u strategiji je da sportaš obavi tjelesne i kognitivne testove i da bude bez simptoma bar 24 sata. Za mlađe sportaše mogu vrijediti restriktivniji uvjeti.
1. korak: lagana aerobna aktivnost
5 do10 minuta izvođenja lagane aerobne aktivnosti poput hodanja, laganog joggiranje ili vožnja na sobnom biciklu, a s ciljem povišenja srčanog ritma.
2. korak: umjerena aktivnost
Umjereno joggiranje, kratko trčanje jačim intenzitetom, dizanje utega težine manje od uobičajene prije ozljede, s naglaskom na limitiranje kretnji glave i tijela.
3. korak: intenzivnija, nekontakna aktivnost
Intenzivnija aktivnost koja je blizu intenziteta rutinske aktivnosti, ali bez kontakta. Za vrijeme ovog koraka mogu se raditi i kognitivne vježbe
4. korak:trening, puni kontakt
Povratak na trening s punim kontaktom
5. korak: natjecanje
Povratak natjecanju.

7. OCJENA SPORTSKE SPOSOBNOSTI

Temeljem antropometrijskih mjerenja, anamneze, povijesti bolesti, kliničkoga pregleda, funkcionalnih i laboratorijskih pregleda te vrsti sporta i bavi li se osoba rekreativno ili profesionalno, specijalist medicine rada i sporta donosi odluku u sportskoj sposobnosti pregledane osobe. U obzir se uzima je li riječ o kontaktnome sportu, nekontaktnome sportu izdržljivosti ili ostalima. Prema preporukama američkih autora kod kontaktnih sportova (29), trebalo bi uzeti u obzir ima li osoba u anamnezi ili simptome nedavno doživljene traume glave ili česte udarce u glavu, što može biti kriterij za zabranu sportske natjecateljske aktivnosti (30). Sportašima se ne preporuča povratak uobičajenim sportskim aktivnostima dok oporavak nije potpun. Kao što je već navedeno, nakon što se simptomi potpuno povuku, preporučuje se postupan povratak sportskim aktivnostima. Ocjena sportske sposobnosti nakon ozljede mozga, jedna je od najkompleksnijih i najosjetljivijih. Prije konačnoga povratka sportu, potreban je detaljan liječnički pregled. Ako se prilikom pregleda pojavi smetnja ili simptom, savjetuje se ponovno mirovanje i nakon određenog vremena ponovni liječnički pregled (30).

Temeljem svih navedenih podataka ocjena sportske sposobnosti nakon ozljede glave može biti:

1. sposoban (bez ograničenja) za trening i natjecanje – u slučaju potpuno zdravog organizma. Primjerice, sportaš kontaktnog sporta je primio udarac u glavu, nije gubio svijest, bez neuroloških, kognitivnih, emotivnih poteškoća kao i poteškoća spavanja.
2. privremeno nesposoban – kada je zbog akutnih bolesti ili nejasnih zdravstvenih stanja osoba upućena na daljnje dijagnostičko-terapijske postupke bez kojih se ne može donijeti ocjena sportske sposobnosti. Primjer – sportaš kontaktnoga sporta nedavno je

doživio traumu glave te se zbog neuroloških simptoma traže dodatni dijagnostički postupci.

3. ograničeno sposoban – što znači da je sposoban za umjereni trening, nesposoban za natjecanje ili je sposoban samo za određeni/e sport/ove, za ostale nesposoban. Primjer – sportaš kontaktnog sporta je zbog ponavljanih trauma glave u rehabilitacijskom postupku.
4. nesposoban za trening i natjecanje

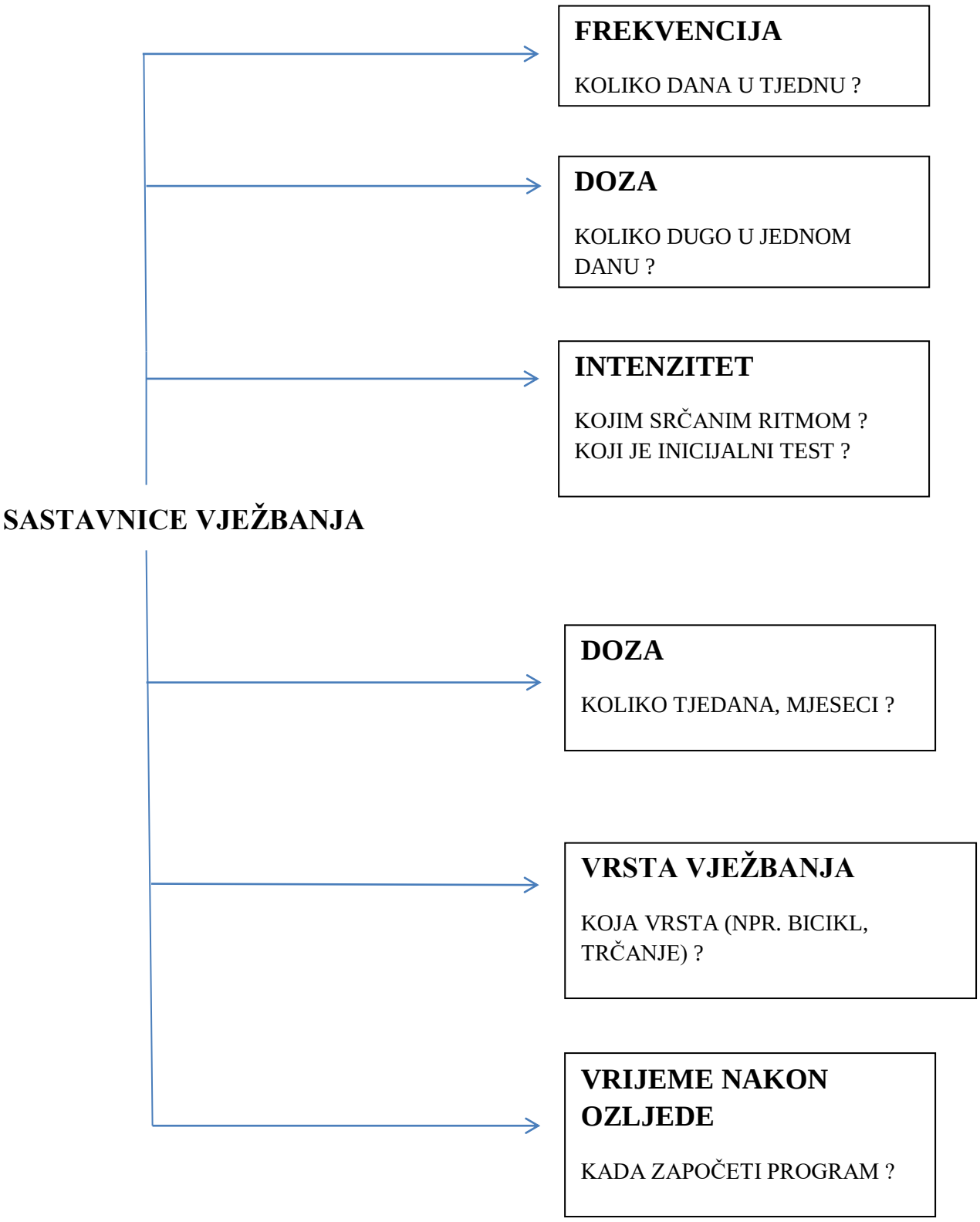
8. UČINCI AEROBNOG VJEŽBANJA

Aerobno vježbanje je vježbanje koje zahtjeva oksidativni metabolizam kako bi se stvorila energija. Riječ je o vježbama koje ne izazivaju naglo otpuštanje energije i anaerobni metabolizam, već je naglasak na dužem otpuštanju energije, pa se uglavnom govori o vježbama i sportovima niskog do umjerenog intenziteta kao što su hodanje,trčanje, bicikliranje, plivanje (31).

Cilj aerobnoga vježbanja jest vratiti normalnu osjetljivost receptora za CO_2 u produženoj moždini i povratiti autoregulaciju moždanoga protoka krvi. Kroz program aerobnog vježbanja želi se doći do one maksimalne frekvencije srčanog ritma (FS) kada ispitanik ne osjeća simptome,a koja je primjerena dobi i bavljenju sportom prije ozljede. To se postiže polaganim privikavanjem receptora vježbanjem koje ne izaziva simptome, tj. vježbanjem pri submaksimalnoj srčanoj frekvenciji.Vraćanjem normalne osjetljivosti receptora, smanjuje se vazodilatacija krvnih žila u mozgu i smanjuje se moždani protok krvi koji izaziva simptome poput glavobolje i omaglice (5).

Kao što je već navedeno, ovaj patofiziološki mehanizam pokazao se bitnim, jer se na temelju srčanog ritma može procijeniti smanjena tolerancija vježbanja i napraviti program za brži povratak sportskoj aktivnosti. Kraljni cilj je povratak uobičajenim životnim navikama, školi i sportskim aktivnostima. Ipak, klinički parametri i terapijski algoritmi još uvijek su nepotpuni i nisu stratificirani.

Howell naglašava kako je šest bitnih sastavnica koje treba imati u dizajniranju studija i programa aerobnog vježbanja: doza, frekvencija,intenzitet,trajanje, vrijeme nakon ozljede i vrsta vježbanja (32). Podatci prilagođeni prema Howellu i sur. (2018) prikazani su na Slici 2.



Slika 2. Sastavnice programa aerobnog vježbanja

Kako nema još jasno definiranih kriterija, razne studije su rabile različite modele aerobnog vježbanja. Podatci su prikazani prilagođeni prema Howellu i sur. (2018) u Tablici 5.

Tablica 5. Različiti pristupi aerobnom vježbanju

AUTOR	FREKVENCIJA	TRAJANJE	INTENZITET	DULJINA	NAČIN	POČETAK VJEŽBANJA
Dobney i sur.	Dnevna	20 do 30 min.	Ispitanik sam određuje	Nije definirano	Bicikl, traka	3-4 tj.
Chan i sur.	Nije definirano	15 min.	60% maksimalnog FS predviđen za dob	6 tj.	Bicikl, traka	>4tj.
Chrisman i sur.	Nije definirano	Maksimalmo 20 min.	80% FS-a pri pojavi simptoma	>1 tj.	Nije definirano	<4 tj. i <300 dana
Grool i sur.	Nije definirano	Nije navedeno	Ispitanik sam određuje	7 dana	Nije definirano	Unutar 7 dana
Moore i sur.	3do 5 dana/tj.	20 do 30 min	60 do 80% FS-a pri pojavi simptoma	6 mj.	Bicikl	Medijan = 107 dana
Grabowski i sur.	5 do 6 dana/tj.	Ovisno o incijalnom testu	80% FS-a pri pojavi simptoma	Medijan = 84 dana, raspon 7-266 dana	Ispitanik odlučuje	>3 tj i <36 tj.
Cordingley i sur.	5 do 6 dana/tj.	20 min.	80% FS-a pri pojavi simptoma	Nije definirano	Nije definirano	>1 tj.
Kurowski i sur.	5 do 6 dana/tj.	80% trajanja inicijalnog testiranja	Do pojave simptoma na Borg RPE skali	6 tj.	Bicikl	4-16 tj.
Clausen i sur.	5 do 6 dana/tj.	20 min.	80% FS-a pri pojavi simptoma	12 tj.	Traka	6-12 tj.
Gagnon i sur.	Dnevna	20 do 30 min.	60% maksimalnog FS-a predviđen za dob	Medijan = 5,5 tj.	Bicikl ,traka	>4 tj.
Leddy i sur.	6 dana/tj.	20 min.	80% FS-a pri pojavi simptoma	12 tj.	Nije definirano	>6 tj. i <12 mj.

Kako bi se mogao procijeniti točan učinak aerobnog vježbanja, bitno je dobro dizajnirati studiju. Uz grupu koja provodi određeni tretman vježbanja, bitno je u dizajn uvrstiti i kontrolnu grupu kako bi se isključili čimbenici zabune. Isto tako, bitan je i dizajn po gore navedenih 6 Howellovih kriterija, kako bi svi ispitanici prolazi kroz isti ili sličan tretman. Vrlo važno je pratit koliko se ispitanici pridržavaju programa vježbanja, tj. koliki je *compliance* . Od u tablici navedenih studija , četiri studije imaju točno definirani program vježbanja kao i kontrolnu grupu uključenu u dizajn studiije : Leddy i sur.(33), Kurowski i sur. (33), Clausen i sur.(35) i Chan i sur. (36). U studijama Kurowski i sur. i Chan i sur. program je trajao 6 tjedana, a u studijama Leddy i sur. i Clausen i sur. 12 tjedana. Razlike su intenzitetu vježbanja i postignutome FS-u, pa tako mjera intenziteta iznosi 60% maksimalnog FS-a predviđenog za tu dob, ili 80% maksimalnog FS-a pri kojem se pojavljuju simptomi pri inicijalnom testu, a trajanje vježbanja je 15 do 30 min svakih 5 ili 6 dana u tjednu. Kontrolne grupe su radili ili program vježbi istezanja (33,34) il su mirovale (36).

Gagnon i sur. (37,38) uvode program od četiri dijela : lagano aerobno vježbanje (trčanje, bicikl) na 60% maksimalnog FS-a u trajanju od maksimalno 15 min, lagane koordinacijske vježbe ovisno o preferencijama i sportu (npr. hokejaši izvode pokrete palicom), tehnike pozitivne vizualizacije i rad sa psihologom te posebni individuslizirani kućni trening. Ovakav trening je visoko personaliziran u odnosu na dosadašnje metode.

Najviše istraživanja na tematiku dosad su proveli Leddy i suradnici koji tvrde kako se suboptimalnim vježbanjem, tj, vježbanjem ispod granice u kojoj pacijent počinje osjećati simptome (engl. *treshold*), može skratiti vrijeme oporavka, tj. smanjiti učestalost KPKS-a (5).

U svrhu određivanja te granice rabi se inicijalni test *The Buffalo Concussion Treadmill Test* (*BCTT*). Ukoliko pacijent ne može izvesti *BCTT*, zbog problema s ravnotežom ili

muskuloskeletalnih problema, može izvesti *The Buffalo Concussion Bicycle Test* (BCBT). Testovi su istovjetni a razlika je u spravi na kojoj se vježba. Kod *BCTT-a* riječ je o traci za trčanje, a kod *BCBT-a* vježba se na sobnom biciklu. Prije početka testa pacijent mora rangirati svoje simptome na vizualno-analognoj skali , VAS (0-10). Zatim pacijent hoda na traci za hodanje/trčanje brzinom 5-6 km/h. Stupanj nagiba povećava se prvih 15 minuta, po jedan stupanj po minuti, a zatim se se brzina povećava za 0,6km/h. Prate se srčana frenkvencija (FS),VAS skala i Borg RPE ljestvica sve do egzarcebacije simptoma ili iscrpljenja. Pacijenti obično osjećaju glavobolju, vrtoglavicu, mučninu ili probleme s vidom što je posljedica relativne hipoventilacije u odnosu na povišenje parcijalnog tlaka ugljikovog dioksida i povećanog moždanog portoka krvi kroz mozak (5).

Nakon što je određena granica srčanog ritma pri kojoj se javljaju simptomi , kreće se sa svakodnevnim vježbanjem po 20min dnevno dozom intenziteta 80% FS-a. Prvi tjedan se vježba na biciklu, a kasnije na traci za trčanje. Pacijent se prati putem monitora koji prati srčanu frenkvenciju. *BCTT/BCBT* mogu biti ponavljani svaka 2-3 tjedna kako bi se odredio *treshold*. Sportaši brže odgovaraju na ovakav tip vježbanja, i povećavaju svoj FS za 10 otkucaja po minuti svaka 2 tjedna, dok nesportaši povisuju za 5 otkucaja po minuti u 2 tjedna.

Osim učinka na srčani ritam, slikovne metode direktno pokazuju kako aerobno vježbanje može utjecati na autoregulaciju CBF-a i uzorke moždane aktivnosti na *fMRI*-u prilikom izvođenja jednostavnih matematičkih zadataka (39). Uspoređivane su tri grupe: dvije grupe sa KPKS-om od kojih je jedna primjenjivala gore opisani postupak vježbanja, a druga je radila samo vježbe, istezanja, i kontrolna grupa. Osobe u obje grupe sa simptomima kroničnoga poslijekomocjskog sindroma u su prikazivale invividualan uzorak moždane aktivnosti, dok je u kontrolnoj grupi uzorak bio uniforman i prikazivao je povećanu možanu aktivnost u području cerebeluma, stražnjeg dijela lijevog cingularnog girusa te desnog kuneusa.

Pokazalo se kako su oni pacijenti koji su aerobno vježbali pokazali moždanu aktivnost koja je bila slična zdravoj kontrolnoj grupi pri izvođenju jednostavnih matematičkih zadataka. Razlika između subjektivnog doživljaja simptoma nakon provedenih tretmana, bila je veća u grupe koja se bavila aerobnim vježbanjem u odnosu na grupu koja je radila samo vježbe istezanja.

Većina studija istraživala je učinke aerobnog vježbanja na one ispitanike koji simptome osjećaju duže od mjesec dana. *CISG* konferencija govori o akutnom periodu 24-48 sati nakon ozljede kada se preporuča striktni odmor (4), a i studije govore o postojanju neurometaboličkog prozora kada je mozak susceptibilnija na ozljedu (23).

No, najnoviji podatci pokazuju kako aerobno vježbanje unutar 10 dana od ozljede po gore navedenom Leddyjevom protokolu ne utječe na pogoršanje postojećih, kao i na pojavu novih simptoma (34). Isto tako, standardizirani program aerobnog vježbanja nije izazvao pogoršanje ili izazivanje novih simptoma unutar 6 dana od ozljede, a zamijećeno je veće smanjenje doživljaja simptoma kroz vrijeme u takvih ispitanika (40). Ovakvi podatci su bitni jer govore kako bi se s vježbanjem moglo krenuti ranije, unutar 10 dana od ozljede, i moglo bi se spriječiti razvijanje KPKS-a.

Isto tako osim poboljšanja najčešćih simptoma poput glavobolje, vrtoglavice i problema s vidom, podatci pokazuju kako aerobno vježbanje smanjuje jačinu i dužinu ostalih simptoma : facilitira sintezu markera neuroplasticiteta i neurogeneze (41,42), poboljšava kognitivno funkioniranje (43,44), bolji rezultat na memorijskom testu koji se slikovnim metodama vidi kao bilateralno povećanje hipokampalne mase (45), povišeno je samopouzdanje (46) i poboljšava kvalitetu spavanja (47). U odraslih reducirani su simptomi depresije (48),

anksioznosti (49), umora (50) i migrene (51). Isto odrasle osobe koje redovito vježbaju, a prekinu vježbanje na dva tjedna, prijavljuju više depresivnih i poremećaja raspoloženja (52).

9. ZAKLJUČAK

Aerobno vježbanje sigurna je metoda za ispitanika pri terapiji kroničnog poslijekomocijskog sindroma jer ne pogoršava postojeće simptome i ne dolazi do nastanka novih. Isto tako, aerobno vježbanje sigurna je metoda u prvih 10 dana od ozljede, tj. u akutnoj fazi. Najbolji pokazatelj fiziološkog napretka je mjerenje srčane frekvencije pri vježbanju, a zasad se receptori u produljenoj moždini kondicioniraju aerobnim vježbanjem 60-80% maksimalnog FS-a, u trajanju od 6-12 tjedana. Osim djelovanja na glavobolju i omaglicu, aerobno vježbanje reducira i simptome depresije,anksioznosti, migrene i poboljšava opće raspoloženje. Iako su rezultati obećavajući, potrebna su daljnja istraživanja kako bi se uspostavili točni parametri i modaliteti liječenja.

10. ZAHVALE

Zahvaljujem se svojoj mentorici doc.dr.sc. Hani Brborović na smirenosti i vođenju kroz pisanje ovog diplomskog rada. Zahvaljujem se svojim kolegama na pomoći i prijateljstvu . Hvala mome djedu i baki što su proživljavali sve moje ocjene tijekom ovih šest godina studiranja. Najveća hvala mojim roditeljima, sestri i braći koji su mi pomogli premostiti još jednu životnu stepenicu.

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12. ŽIVOTOPIS

Rođen sam 10.09.1995 u Zagrebu. Osnovnu školu Retfala završio sam u Osijeku, kao i III. Gimnaziju Osijek. Studij završavam 2020. Godine. Tijekom studiranja pjevam u studentskom zboru Lege Artis s kojim osvajam Dekanovu nagradu i sudjelujem na obljetnici 100. godišnjice osnutka Medicinskog fakulteta Sveučilišta u Zagrebu.

PRILOG 1. *SCAT-5* UPITNIK

BJSM Online First, published on April 26, 2017 as 10.1136/bjsports-2017-097506SCAT5

To download a clean version of the SCAT tools please visit the journal online (http://dx.doi.org/10.1136/bjsports-2017-097506SCAT5)

SCAT5©

SPORT CONCUSSION ASSESSMENT TOOL – 5TH EDITION

DEVELOPED BY THE CONCUSSION IN SPORT GROUP

FOR USE BY MEDICAL PROFESSIONALS ONLY

supported by

FIFA

Patient details

Name: _____

DOB: _____

Address: _____

ID number: _____

Examiner: _____

Date of Injury: _____ Time: _____

WHAT IS THE SCAT5?

The SCAT5 is a standardized tool for evaluating concussions designed for use by physicians and licensed healthcare professionals[1]. The SCAT5 cannot be performed correctly in less than 10 minutes.

If you are not a physician or licensed healthcare professional, please use the Concussion Recognition Tool 5 (CRT5). The SCAT5 is to be used for evaluating athletes aged 13 years and older. For children aged 12 years or younger, please use the Child SCAT5.

Preseason SCAT5 baseline testing can be useful for interpreting post-injury test scores, but is not required for that purpose.Detailed instructions for use of the SCAT5 are provided on page 7. Please read through these instructions carefully before testing the athlete. Brief verbal instructions for each test are given in italics. The only equipment required for the tester is a watch or timer.

Recognise and Remove

A head impact by either a direct blow or indirect transmission of force can be associated with a serious and potentially fatal brain injury. If there are significant concerns, including any of the red flags listed in Box 1, then activation of emergency procedures and urgent transport to the nearest hospital should be arranged.

Key points

- Any athlete with suspected concussion should be REMOVED FROM PLAY, medically assessed and monitored for deterioration. No athlete diagnosed with concussion should be returned 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 to a medical facility for urgent assessment.
- Athletes with suspected concussion should not drink alcohol, use recreational drugs and should not drive a motor vehicle until cleared to do so by a medical professional.
- Concussion signs and symptoms evolve over time and it is important to consider repeat evaluation in the assessment of concussion.
- The diagnosis of a concussion is a clinical judgment, made by a medical professional. The SCAT5 should NOT be used by itself to make, or exclude, the diagnosis of concussion. An athlete may have a concussion even if their SCAT5 is "normal".

Remember:

- The basic principles of first aid (danger, response, airway, breathing, circulation) should be followed.
- Do not attempt to move the athlete (other than that required for airway management) unless trained to do so.
- Assessment for a spinal cord injury is a critical part of the initial on-field assessment.
- Do not remove a helmet or any other equipment unless trained to do so safely.

1

IMMEDIATE OR ON-FIELD ASSESSMENT

The following elements should be assessed for all athletes who are suspected of having a concussion prior to proceeding to the neurocognitive assessment and ideally should be done on-field after the first first aid / emergency care priorities are completed.

If any of the "Red Flags" or observable signs are noted after a direct or indirect blow to the head, the athlete should be immediately and safely removed from participation and evaluated by a physician or licensed healthcare professional.

Consideration of transportation to a medical facility should be at the discretion of the physician or licensed healthcare professional.

The GCS is important as a standard measure for all patients and can be done serially if necessary in the event of deterioration in conscious state. The Maddocks questions and cervical spine exam are critical steps of the immediate assessment; however, these do not need to be done serially.

STEP 1: RED FLAGS

RED FLAGS:

- **Neck pain or tenderness**
- **Double vision**
- **Weakness or tingling/ burning in arms or legs**
- **Severe or increasing headache**
- **Seizure or convulsion**
- **Loss of consciousness**
- **Deteriorating conscious state**
- **Vomiting**
- **Increasingly restless, agitated or combative**

STEP 2: OBSERVABLE SIGNS

Witnessed ☐ Observed on Video ☐

Lying motionless on the playing surface	Y	N
Balance / gait difficulties / motor incoordination: stumbling, slow / laboured movements	Y	N
Disorientation or confusion, or an inability to respond appropriately to questions	Y	N
Blank or vacant look	Y	N
Facial injury after head trauma	Y	N

STEP 3: MEMORY ASSESSMENT MADDOCKS QUESTIONS[2]

"I am going to ask you a few questions, please listen carefully and give your best effort. First, tell me what happened?"

Mark Y for correct answer / N for incorrect

What venue are we at today?	Y	N
Which half is it now?	Y	N
Who scored last in this match?	Y	N
What team did you play last week / game?	Y	N
Did your team win the last game?	Y	N

Note: Appropriate sport-specific questions may be substituted.

Name: _____

DOB: _____

Address: _____

ID number: _____

Examiner: _____

Date: _____

STEP 4: EXAMINATION GLASGOW COMA SCALE (GCS)[3]

Time of assessment			
Date of assessment			
Best eye response (E)			
No eye opening	1	1	1
Eye opening in response to pain	2	2	2
Eye opening to speech	3	3	3
Eyes opening spontaneously	4	4	4
Best verbal response (V)			
No verbal response	1	1	1
Incomprehensible sounds	2	2	2
Inappropriate words	3	3	3
Confused	4	4	4
Oriented	5	5	5
Best motor response (M)			
No motor response	1	1	1
Extension to pain	2	2	2
Abnormal flexion to pain	3	3	3
Flexion / Withdrawal to pain	4	4	4
Localizes to pain	5	5	5
Obeys commands	6	6	6
Glasgow Coma score (E + V + M)			

CERVICAL SPINE ASSESSMENT

Does the athlete report that their neck is pain free at rest?	Y	N
If there is NO neck pain at rest, does the athlete have a full range of ACTIVE pain free movement?	Y	N
Is the limb strength and sensation normal?	Y	N

In a patient who is not lucid or fully conscious, a cervical spine injury should be assumed until proven otherwise.

OFFICE OR OFF-FIELD ASSESSMENT

Please note that the neurocognitive assessment should be done in a distraction-free environment with the athlete in a resting state.

STEP 1: ATHLETE BACKGROUND

Sport / team / school: _____

Date / time of injury: _____

Years of education completed: _____

Age: _____

Gender: M / F / Other

Dominant hand: left / neither / right

How many diagnosed concussions has the athlete had in the past?: _____

When was the most recent concussion?: _____

How long was the recovery (time to being cleared to play) from the most recent concussion?: _____ (days)

Has the athlete ever been:

Hospitalized for a head injury?	Yes	No
Diagnosed / treated for headache disorder or migraines?	Yes	No
Diagnosed with a learning disability / dyslexia?	Yes	No
Diagnosed with ADD / ADHD?	Yes	No
Diagnosed with depression, anxiety or other psychiatric disorder?	Yes	No

Current medications? If yes, please list:

_____

_____

_____

_____

_____

_____

Name: _____

DOB: _____

Address: _____

ID number: _____

Examiner: _____

Date: _____

2

STEP 2: SYMPTOM EVALUATION

The athlete should be given the symptom form and asked to read this instruction paragraph out loud then complete the symptom scale. For the baseline assessment, the athlete should rate his/her symptoms based on how he/she typically feels and for the post injury assessment the athlete should rate their symptoms at this point in time.

Please Check: ☐ **Baseline** ☐ **Post-Injury**

Please hand the form to the athlete

	none	mild		moderate		severe	
Headache	0	1	2	3	4	5	6
"Pressure in head"	0	1	2	3	4	5	6
Neck Pain	0	1	2	3	4	5	6
Nausea or vomiting	0	1	2	3	4	5	6
Dizziness	0	1	2	3	4	5	6
Blurred vision	0	1	2	3	4	5	6
Balance problems	0	1	2	3	4	5	6
Sensitivity to light	0	1	2	3	4	5	6
Sensitivity to noise	0	1	2	3	4	5	6
Feeling slowed down	0	1	2	3	4	5	6
Feeling like "in a fog"	0	1	2	3	4	5	6
"Don't feel right"	0	1	2	3	4	5	6
Difficulty concentrating	0	1	2	3	4	5	6
Difficulty remembering	0	1	2	3	4	5	6
Fatigue or low energy	0	1	2	3	4	5	6
Confusion	0	1	2	3	4	5	6
Drowsiness	0	1	2	3	4	5	6
More emotional	0	1	2	3	4	5	6
Irritability	0	1	2	3	4	5	6
Sadness	0	1	2	3	4	5	6
Nervous or Anxious	0	1	2	3	4	5	6
Trouble falling asleep (if applicable)	0	1	2	3	4	5	6

Total number of symptoms:	of 22
Symptom severity score:	of 132
Do your symptoms get worse with physical activity?	Y N
Do your symptoms get worse with mental activity?	Y N
If 100% is feeling perfectly normal, what percent of normal do you feel?	

If not 100%, why?

_____

_____

_____

Please hand form back to examiner

STEP 3: COGNITIVE SCREENING

Standardised Assessment of Concussion (SAC)[4]

Name: _____

DOB: _____

Address: _____

ID number: _____

Examiner: _____

Date: _____

ORIENTATION

What month is it?	0	1
What is the date today?	0	1
What is the day of the week?	0	1
What year is it?	0	1
What time is it right now? (within 1 hour)	0	1
Orientation score		of 5

IMMEDIATE MEMORY

The Immediate Memory component can be completed using the traditional 5-word per trial list or optionally using 10-words per trial to minimise any ceiling effect. All 3 trials must be administered irrespective of the number correct on the first trial. Administer at the rate of one word per second.

Please choose EITHER the 5 or 10 word list groups and circle the specific word list chosen for this test.

I am going to test your memory. I will read you a list of words and when I am done, repeat back as many words as you can remember, in any order. For Trials 2 & 3: I am going to repeat the same list again. Repeat back as many words as you can remember in any order, even if you said the word before.

List	Alternate 5 word lists					Score (of 5) Trial 1	Trial 2	Trial 3
A	Finger	Penny	Blanket	Lemon	Insect			
B	Candle	Paper	Sugar	Sandwich	Wagon			
C	Baby	Monkey	Perfume	Sunset	Iron			
D	Elbow	Apple	Carpet	Saddle	Bubble			
E	Jacket	Arrow	Pepper	Cotton	Movie			
F	Dollar	Honey	Mirror	Saddle	Anchor			
					Immediate Memory Score			of 15
					Time that last trial was completed			

List	Alternate 10 word lists					Score (of 10) Trial 1	Trial 2	Trial 3
G	Finger Candle	Penny Paper	Blanket Sugar	Lemon Sandwich	Insect Wagon			
H	Baby Elbow	Monkey Apple	Perfume Carpet	Sunset Saddle	Iron Bubble			
I	Jacket Dollar	Arrow Honey	Pepper Mirror	Cotton Saddle	Movie Anchor			
					Immediate Memory Score			of 30
					Time that last trial was completed			

CONCENTRATION

DIGITS BACKWARDS

Please circle the Digit list chosen (A, B, C, D, E, F). Administer at the rate of one digit per second reading DOWN the selected column.

I am going to read a string of numbers and when I am done, you repeat them back to me in reverse order of how I read them to you. For example, if I say 7-1-9, you would say 9-1-7.

Concentration Number Lists (circle one)					
List A	List B	List C			
4-9-3	5-2-6	1-4-2	Y	N	0
6-2-9	4-1-5	6-5-8	Y	N	1
3-8-1-4	1-7-9-5	6-8-3-1	Y	N	0
3-2-7-9	4-9-6-8	3-4-8-1	Y	N	1
6-2-9-7-1	4-8-5-2-7	4-9-1-5-3	Y	N	0
1-5-2-8-6	6-1-8-4-3	6-8-2-5-1	Y	N	1
7-1-8-4-6-2	8-3-1-9-6-4	3-7-6-5-1-9	Y	N	0
5-3-9-1-4-8	7-2-4-8-5-6	9-2-6-5-1-4	Y	N	1
List D	List E	List F			
7-8-2	3-8-2	2-7-1	Y	N	0
9-2-6	5-1-8	4-7-9	Y	N	1
4-1-8-3	2-7-9-3	1-6-8-3	Y	N	0
9-7-2-3	2-1-6-9	3-9-2-4	Y	N	1
1-7-9-2-6	4-1-8-6-9	2-4-7-5-8	Y	N	0
4-1-7-5-2	9-4-1-7-5	8-3-9-6-4	Y	N	1
2-6-4-8-1-7	6-9-7-3-8-2	5-8-6-2-4-9	Y	N	0
8-4-1-9-3-5	4-2-7-9-3-8	3-1-7-8-2-6	Y	N	1
		Digits Score:			of 4

MONTHS IN REVERSE ORDER

Now tell me the months of the year in reverse order. Start with the last month and go backward. So you'll say December, November. Go ahead.

Dec - Nov - Oct - Sept - Aug - Jul - Jun - May - Apr - Mar - Feb - Jan	0 1
Months Score	of 1
Concentration Total Score (Digits + Months)	of 5

4

STEP 4: NEUROLOGICAL SCREEN

See the instruction sheet (page 7) for details of test administration and scoring of the tests.

Can the patient read aloud (e.g. symptom check-list) and follow instructions without difficulty?	Y	N
Does the patient have a full range of pain-free PASSIVE cervical spine movement?	Y	N
Without moving their head or neck, can the patient look side-to-side and up-and-down without double vision?	Y	N
Can the patient perform the finger nose coordination test normally?	Y	N
Can the patient perform tandem gait normally?	Y	N

BALANCE EXAMINATION

Modified Balance Error Scoring System (mBESS) testing[5]

Which foot was tested (i.e. which is the non-dominant foot) ☐ Left ☐ Right

Testing surface (hard floor, field, etc.) _____

Footwear (shoes, barefoot, braces, tape, etc.) _____

Condition	Errors
Double leg stance	of 10
Single leg stance (non-dominant foot)	of 10
Tandem stance (non-dominant foot at the back)	of 10
Total Errors	of 30

Name: _____

DOB: _____

Address: _____

ID number: _____

Examiner: _____

Date: _____

5

STEP 5: DELAYED RECALL:

The delayed recall should be performed after 5 minutes have elapsed since the end of the Immediate Recall section. Score 1 pt. for each correct response.

Do you remember that list of words I read a few times earlier? Tell me as many words from the list as you can remember in any order.

Time Started _____

Please record each word correctly recalled. Total score equals number of words recalled.

_____

_____

_____

Total number of words recalled accurately: of 5 or of 10

6

STEP 6: DECISION

	Date & time of assessment:		
Domain			
Symptom number (of 22)			
Symptom severity score (of 132)			
Orientation (of 5)			
Immediate memory	of 15 of 30	of 15 of 30	of 15 of 30
Concentration (of 5)			
Neuro exam	Normal Abnormal	Normal Abnormal	Normal Abnormal
Balance errors (of 30)			
Delayed Recall	of 5 of 10	of 5 of 10	of 5 of 10

Date and time of injury: _____

If the athlete is known to you prior to their injury, are they different from their usual self?
☐ **Yes** ☐ **No** ☐ **Unsure** ☐ **Not Applicable**
(If different, describe why in the clinical notes section)

Concussion Diagnosed?
☐ **Yes** ☐ **No** ☐ **Unsure** ☐ **Not Applicable**

If re-testing, has the athlete improved?
☐ **Yes** ☐ **No** ☐ **Unsure** ☐ **Not Applicable**

I am a physician or licensed healthcare professional and I have personally administered or supervised the administration of this SCAT5.

Signature: _____

Name: _____

Title: _____

Registration number (if applicable): _____

Date: _____

SCORING ON THE SCAT5 SHOULD NOT BE USED AS A STAND-ALONE METHOD TO DIAGNOSE CONCUSSION, MEASURE RECOVERY OR MAKE DECISIONS ABOUT AN ATHLETE'S READINESS TO RETURN TO COMPETITION AFTER CONCUSSION.

CLINICAL NOTES:

Name: _____

DOB: _____

Address: _____

ID number: _____

Examiner: _____

Date: _____

CONCUSSION INJURY ADVICE

(To be given to the person monitoring the concussed athlete)

This patient has received an injury to the head. A careful medical examination has been carried out and no sign of any serious complications has been found. Recovery time is variable across individuals and the patient will need monitoring for a further period by a responsible adult. Your treating physician will provide guidance as to this timeframe.

If you notice any change in behaviour, vomiting, worsening headache, double vision or excessive drowsiness, please telephone your doctor or the nearest hospital emergency department immediately.

Other important points:

Initial rest: Limit physical activity to routine daily activities (avoid exercise, training, sports) and limit activities such as school, work, and screen time to a level that does not worsen symptoms.

1) Avoid alcohol

2) Avoid prescription or non-prescription drugs without medical supervision. Specifically:

   a) Avoid sleeping tablets

   b) Do not use aspirin, anti-inflammatory medication or stronger pain medications such as narcotics

3) Do not drive until cleared by a healthcare professional.

4) Return to play/sport requires clearance by a healthcare professional.

Clinic phone number: _____

Patient's name: _____

Date / time of injury: _____

Date / time of medical review: _____

Healthcare Provider: _____

Contact details or stamp

INSTRUCTIONS

Words in *Italics* throughout the SCAT5 are the instructions given to the athlete by the clinician

Symptom Scale

The time frame for symptoms should be based on the type of test being administered. At baseline it is advantageous to assess how an athlete "typically" feels whereas during the acute/post-acute stage it is best to ask how the athlete feels at the time of testing.

The symptom scale should be completed by the athlete, not by the examiner. In situations where the symptom scale is being completed after exercise, it should be done in a resting state, generally by approximating his/her resting heart rate.

For total number of symptoms, maximum possible is 22 except immediately post injury, if sleep item is omitted, which then creates a maximum of 21.

For Symptom severity score, add all scores in table, maximum possible is 22 x 6 = 132, except immediately post injury if sleep item is omitted, which then creates a maximum of 21x6=126.

Immediate Memory

The Immediate Memory component can be completed using the traditional 5-word per trial list or, optionally, using 10-words per trial. The literature suggests that the Immediate Memory has a notable ceiling effect when a 5-word list is used. In settings where this ceiling is prominent, the examiner may wish to make the task more difficult by incorporating two 5–word groups for a total of 10 words per trial. In this case, the maximum score per trial is 10 with a total trial maximum of 30.

Choose one of the word lists (either 5 or 10). Then perform 3 trials of immediate memory using this list.

Complete all 3 trials regardless of score on previous trials.

"I am going to test your memory. I will read you a list of words and when I am done, repeat back as many words as you can remember, in any order." The words must be read at a rate of one word per second.

Trials 2 & 3 MUST be completed regardless of score on trial 1 & 2.

Trials 2 & 3:

"I am going to repeat the same list again. Repeat back as many words as you can remember in any order, even if you said the word before."

Score 1 pt. for each correct response. Total score equals sum across all 3 trials. Do NOT inform the athlete that delayed recall will be tested.

Concentration

Digits backward

Choose one column of digits from lists A, B, C, D, E or F and administer those digits as follows:

Say: *"I am going to read a string of numbers and when I am done, you repeat them back to me in reverse order of how I read them to you. For example, if I say 7-1-9, you would say 9-1-7."*

Begin with first 3 digit string.

If correct, circle "Y" for correct and go to next string length. If incorrect, circle "N" for the first string length and read trial 2 in the same string length. One point possible for each string length. Stop after incorrect on both trials (2 N's) in a string length. The digits should be read at the rate of one per second.

Months in reverse order

"Now tell me the months of the year in reverse order. Start with the last month and go backward. So you'll say December, November ... Go ahead"

1 pt. for entire sequence correct

Delayed Recall

The delayed recall should be performed after 5 minutes have elapsed since the end of the Immediate Recall section.

"Do you remember that list of words I read a few times earlier? Tell me as many words from the list as you can remember in any order."

Score 1 pt. for each correct response

Modified Balance Error Scoring System (mBESS)[5] testing

This balance testing is based on a modified version of the Balance Error Scoring System (BESS)[6]. A timing device is required for this testing.

Each of 20-second trial/stance is scored by counting the number of errors. The examiner will begin counting errors only after the athlete has assumed the proper start position. The modified BESS is calculated by adding one error point for each error during the three 20-second tests. The maximum number of errors for any single condition is 10. If the athlete commits multiple errors simultaneously, only one error is recorded but the athlete should quickly return to the testing position, and counting should resume once the athlete is set. Athletes that are unable to maintain the testing procedure for a minimum of five seconds at the start are assigned the highest possible score, ten, for that testing condition.

OPTION: For further assessment, the same 3 stances can be performed on a surface of medium density foam (e.g., approximately 50cm x 40cm x 6cm).

Balance testing – types of errors

1. Hands lifted off iliac crest
2. Opening eyes
3. Step, stumble, or fall
4. Moving hip into > 30 degrees abduction
5. Lifting forefoot or heel
6. Remaining out of test position > 5 sec

"I am now going to test your balance. Please take your shoes off (if applicable), roll up your pant legs above ankle (if applicable), and remove any ankle taping (if applicable). This test will consist of three twenty second tests with different stances."

(a) Double leg stance:

"The first stance is standing with your feet together with your hands on your hips and with your eyes closed. You should try to maintain stability in that position for 20 seconds. I will be counting the number of times you move out of this position. I will start timing when you are set and have closed your eyes."

(b) Single leg stance:

"If you were to kick a ball, which foot would you use? [This will be the dominant foot] *Now stand on your non-dominant foot. The dominant leg should be held in approximately 30 degrees of hip flexion and 45 degrees of knee flexion. Again, you should try to maintain stability for 20 seconds with your hands on your hips and your eyes closed. I will be counting the number of times you move out of this position. If you stumble out of this position, open your eyes and return to the start position and continue balancing. I will start timing when you are set and have closed your eyes."*

(c) Tandem stance:

"Now stand heel-to-toe with your non-dominant foot in back. Your weight should be evenly distributed across both feet. Again, you should try to maintain stability for 20 seconds with your hands on your hips and your eyes closed. I will be counting the number of times you move out of this position. If you stumble out of this position, open your eyes and return to the start position and continue balancing. I will start timing when you are set and have closed your eyes."

Tandem Gait

Participants are instructed to stand with their feet together behind a starting line (the test is best done with footwear removed). Then, they walk in a forward direction as quickly and as accurately as possible along a 38mm wide (sports tape), 3 metre line with an alternate foot heel-to-toe gait ensuring that they approximate their heel and toe on each step. Once they cross the end of the 3m line, they turn 180 degrees and return to the starting point using the same gait. Athletes fail the test if they step off the line, have a separation between their heel and toe, or if they touch or grab the examiner or an object.

Finger to Nose

"I am going to test your coordination now. Please sit comfortably on the chair with your eyes open and your arm (either right or left) outstretched (shoulder flexed to 90 degrees and elbow and fingers extended), pointing in front of you. When I give a start signal, I would like you to perform five successive finger to nose repetitions using your index finger to touch the tip of the nose, and then return to the starting position, as quickly and as accurately as possible."

References

1. McCrory et al. Consensus Statement On Concussion In Sport – The 5th International Conference On Concussion In Sport Held In Berlin, October 2016. British Journal of Sports Medicine 2017 (available at www.bjsm.bmj.com)
2. Maddocks, DL; Dicker, GD; Saling, MM. The assessment of orientation following concussion in athletes. Clinical Journal of Sport Medicine 1995; 5: 32-33
3. Jennett, B., Bond, M. Assessment of outcome after severe brain damage: a practical scale. Lancet 1975; i: 480-484
4. McCrea M. Standardized mental status testing of acute concussion. Clinical Journal of Sport Medicine. 2001; 11: 176-181
5. Guskiewicz KM. Assessment of postural stability following sport-related concussion. Current Sports Medicine Reports. 2003; 2: 24-30

CONCUSSION INFORMATION

Any athlete suspected of having a concussion should be removed from play and seek medical evaluation.

Signs to watch for

Problems could arise over the first 24-48 hours. The athlete should not be left alone and must go to a hospital at once if they experience:

- Worsening headache
- Drowsiness or inability to be awakened
- Inability to recognize people or places
- Repeated vomiting
- Unusual behaviour or confusion or irritable
- Seizures (arms and legs jerk uncontrollably)
- Weakness or numbness in arms or legs
- Unsteadiness on their feet.
- Slurred speech

Consult your physician or licensed healthcare professional after a suspected concussion. Remember, it is better to be safe.

Rest & Rehabilitation

After a concussion, the athlete should have physical rest and relative cognitive rest for a few days to allow their symptoms to improve. In most cases, after no more than a few days of rest, the athlete should gradually increase their daily activity level as long as their symptoms do not worsen. Once the athlete is able to complete their usual daily activities without concussion-related symptoms, the second step of the return to play/sport progression can be started. The athlete should not return to play/sport until their concussion-related symptoms have resolved and the athlete has successfully returned to full school/learning activities.

When returning to play/sport, the athlete should follow a stepwise, **medically managed exercise progression, with increasing amounts of exercise.** For example:

Graduated Return to Sport Strategy

Exercise step	Functional exercise at each step	Goal of each step
1. Symptom-limited activity	Daily activities that do not provoke symptoms.	Gradual reintroduction of work/school activities.
2. Light aerobic exercise	Walking or stationary cycling at slow to medium pace. No resistance training.	Increase heart rate.
3. Sport-specific exercise	Running or skating drills. No head impact activities.	Add movement.
4. Non-contact training drills	Harder training drills, e.g., passing drills. May start progressive resistance training.	Exercise, coordination, and increased thinking.
5. Full contact practice	Following medical clearance, participate in normal training activities.	Restore confidence and assess functional skills by coaching staff.
6. Return to play/sport	Normal game play.	

In this example, it would be typical to have 24 hours (or longer) for each step of the progression. If any symptoms worsen while exercising, the athlete should go back to the previous step. Resistance training should be added only in the later stages (Stage 3 or 4 at the earliest).

Written clearance should be provided by a healthcare professional before return to play/sport as directed by local laws and regulations.

Graduated Return to School Strategy

Concussion may affect the ability to learn at school. The athlete may need to miss a few days of school after a concussion. When going back to school, some athletes may need to go back gradually and may need to have some changes made to their schedule so that concussion symptoms do not get worse. If a particular activity makes symptoms worse, then the athlete should stop that activity and rest until symptoms get better. To make sure that the athlete can get back to school without problems, it is important that the healthcare provider, parents, caregivers and teachers talk to each other so that everyone knows what the plan is for the athlete to go back to school.

Note: If mental activity does not cause any symptoms, the athlete may be able to skip step 2 and return to school part-time before doing school activities at home first.

Mental Activity	Activity at each step	Goal of each step
1. Daily activities that do not give the athlete symptoms	Typical activities that the athlete does during the day as long as they do not increase symptoms (e.g. reading, texting, screen time). Start with 5-15 minutes at a time and gradually build up.	Gradual return to typical activities.
2. School activities	Homework, reading or other cognitive activities outside of the classroom.	Increase tolerance to cognitive work.
3. Return to school part-time	Gradual introduction of school-work. May need to start with a partial school day or with increased breaks during the day.	Increase academic activities.
4. Return to school full-time	Gradually progress school activities until a full day can be tolerated.	Return to full academic activities and catch up on missed work.

If the athlete continues to have symptoms with mental activity, some other accomodations that can help with return to school may include:

- Starting school later, only going for half days, or going only to certain classes
- More time to finish assignments/tests
- Quiet room to finish assignments/tests
- Not going to noisy areas like the cafeteria, assembly halls, sporting events, music class, shop class, etc.
- Taking lots of breaks during class, homework, tests
- No more than one exam/day
- Shorter assignments
- Repetition/memory cues
- Use of a student helper/tutor
- Reassurance from teachers that the child will be supported while getting better

The athlete should not go back to sports until they are back to school/learning, without symptoms getting significantly worse and no longer needing any changes to their schedule.

PRILOG 2. CHILD SCAT UPITNIK

BJSM Online First, published on April 26, 2017 as 10.1136/bjsports-2017-097492childscat5

To download a clean version of the SCAT tools please visit the journal online (http://dx.doi.org/10.1136/bjsports-2017-097492childscat5)

Child SCAT5©

SPORT CONCUSSION ASSESSMENT TOOL
FOR CHILDREN AGES 5 TO 12 YEARS
FOR USE BY MEDICAL PROFESSIONALS ONLY

supported by

FIFA

Patient details

Name: _____

DOB: _____

Address: _____

ID number: _____

Examiner: _____

Date of Injury: _____ Time: _____

WHAT IS THE CHILD SCAT5?

The Child SCAT5 is a standardized tool for evaluating concussions designed for use by physicians and licensed healthcare professionals[1].

If you are not a physician or licensed healthcare professional, please use the Concussion Recognition Tool 5 (CRT5). The Child SCAT5 is to be used for evaluating Children aged 5 to 12 years. For athletes aged 13 years and older, please use the SCAT5.

Preseason Child SCAT5 baseline testing can be useful for interpreting post-injury test scores, but not required for that purpose. Detailed instructions for use of the Child SCAT5 are provided on page 7. Please read through these instructions carefully before testing the athlete. Brief verbal instructions for each test are given in italics. The only equipment required for the tester is a watch or timer.

Recognise and Remove

A head impact by either a direct blow or indirect transmission of force can be associated with a serious and potentially fatal brain injury. If there are significant concerns, including any of the red flags listed in Box 1, then activation of emergency procedures and urgent transport to the nearest hospital should be arranged.

Key points

- Any athlete with suspected concussion should be REMOVED FROM PLAY, medically assessed and monitored for deterioration. No athlete diagnosed with concussion should be returned to play on the day of injury.
- If the child is suspected of having a concussion and medical personnel are not immediately available, the child should be referred to a medical facility for urgent assessment.
- Concussion signs and symptoms evolve over time and it is important to consider repeat evaluation in the assessment of concussion.
- The diagnosis of a concussion is a clinical judgment, made by a medical professional. The Child SCAT5 should NOT be used by itself to make, or exclude, the diagnosis of concussion. An athlete may have a a concussion even if their Child SCAT5 is "normal".

Remember:

- The basic principles of first aid (danger, response, airway, breathing, circulation) should be followed.
- Do not attempt to move the athlete (other than that required for airway management) unless trained to do so.
- Assessment for a spinal cord injury is a critical part of the initial on-field assessment.
- Do not remove a helmet or any other equipment unless trained to do so safely.

1

IMMEDIATE OR ON-FIELD ASSESSMENT

The following elements should be assessed for all athletes who are suspected of having a concussion prior to proceeding to the neurocognitive assessment and ideally should be done on-field after the first first aid / emergency care priorities are completed.

If any of the "Red Flags" or observable signs are noted after a direct or indirect blow to the head, the athlete should be immediately and safely removed from participation and evaluated by a physician or licensed healthcare professional.

Consideration of transportation to a medical facility should be at the discretion of the physician or licensed healthcare professional.

The GCS is important as a standard measure for all patients and can be done serially if necessary in the event of deterioration in conscious state. The cervical spine exam is a critical step of the immediate assessment, however, it does not need to be done serially.

STEP 1: RED FLAGS

RED FLAGS:

- **Neck pain or tenderness**
- **Double vision**
- **Weakness or tingling/ burning in arms or legs**
- **Severe or increasing headache**
- **Seizure or convulsion**
- **Loss of consciousness**
- **Deteriorating conscious state**
- **Vomiting**
- **Increasingly restless, agitated or combative**

STEP 2: OBSERVABLE SIGNS

Witnessed ☐ Observed on Video ☐

Lying motionless on the playing surface	Y	N
Balance / gait difficulties / motor incoordination: stumbling, slow / laboured movements	Y	N
Disorientation or confusion, or an inability to respond appropriately to questions	Y	N
Blank or vacant look	Y	N
Facial injury after head trauma	Y	N

STEP 3: EXAMINATION
GLASGOW COMA SCALE (GCS)[2]

Time of assessment			
Date of assessment			
Best eye response (E)			
No eye opening	1	1	1
Eye opening in response to pain	2	2	2
Eye opening to speech	3	3	3
Eyes opening spontaneously	4	4	4
Best verbal response (V)			
No verbal response	1	1	1
Incomprehensible sounds	2	2	2
Inappropriate words	3	3	3
Confused	4	4	4
Oriented	5	5	5
Best motor response (M)			
No motor response	1	1	1
Extension to pain	2	2	2
Abnormal flexion to pain	3	3	3
Flexion / Withdrawal to pain	4	4	4
Localizes to pain	5	5	5
Obeys commands	6	6	6
Glasgow Coma score (E + V + M)			

Name: _____

DOB: _____

Address: _____

ID number: _____

Examiner: _____

Date: _____

CERVICAL SPINE ASSESSMENT

Does the athlete report that their neck is pain free at rest?	Y	N
If there is NO neck pain at rest, does the athlete have a full range of ACTIVE pain free movement?	Y	N
Is the limb strength and sensation normal?	Y	N

In a patient who is not lucid or fully conscious, a cervical spine injury should be assumed until proven otherwise.

OFFICE OR OFF-FIELD ASSESSMENT
STEP 1: ATHLETE BACKGROUND

Please note that the neurocognitive assessment should be done in a distraction-free environment with the athlete in a resting state.

Sport / team / school: _____

Date / time of injury: _____

Years of education completed: _____

Age: _____

Gender: M / F / Other

Dominant hand: left / neither / right

How many diagnosed concussions has the athlete had in the past?: _____

When was the most recent concussion?: _____

How long was the recovery (time to being cleared to play) from the most recent concussion?: _____ (days)

Has the athlete ever been:

Hospitalized for a head injury?	Yes	No
Diagnosed / treated for headache disorder or migraines?	Yes	No
Diagnosed with a learning disability / dyslexia?	Yes	No
Diagnosed with ADD / ADHD?	Yes	No
Diagnosed with depression, anxiety or other psychiatric disorder?	Yes	No

Current medications? If yes, please list: _____

STEP 2: SYMPTOM EVALUATION

The athlete should be given the symptom form and asked to read this instruction paragraph out loud then complete the symptom scale. For the baseline assessment, the athlete should rate his/her symptoms based on how he/she typically feels and for the post injury assessment the athlete should rate their symptoms at this point in time.

To be done in a resting state

Please Check: ☐ **Baseline** ☐ **Post-Injury**

2

Name: _____

DOB: _____

Address: _____

ID number: _____

Examiner: _____

Date: _____

Child Report[3]

	Not at all/ Never	A little/ Rarely	Somewhat/ Sometimes	A lot/ Often
I have headaches	0	1	2	3
I feel dizzy	0	1	2	3
I feel like the room is spinning	0	1	2	3
I feel like I'm going to faint	0	1	2	3
Things are blurry when I look at them	0	1	2	3
I see double	0	1	2	3
I feel sick to my stomach	0	1	2	3
My neck hurts	0	1	2	3
I get tired a lot	0	1	2	3
I get tired easily	0	1	2	3
I have trouble paying attention	0	1	2	3
I get distracted easily	0	1	2	3
I have a hard time concentrating	0	1	2	3
I have problems remembering what people tell me	0	1	2	3
I have problems following directions	0	1	2	3
I daydream too much	0	1	2	3
I get confused	0	1	2	3
I forget things	0	1	2	3
I have problems finishing things	0	1	2	3
I have trouble figuring things out	0	1	2	3
It's hard for me to learn new things	0	1	2	3
Total number of symptoms:				of 21
Symptom severity score:				of 63
Do the symptoms get worse with physical activity?			Y	N
Do the symptoms get worse with trying to think?			Y	N

Overall rating for child to answer:

	Very bad									Very good
On a scale of 0 to 10 (where 10 is normal), how do you feel now?	0	1	2	3	4	5	6	7	8	9	10

If not 10, in what way do you feel different?:

Parent Report

The child:

	Not at all/ Never	A little/ Rarely	Somewhat/ Sometimes	A lot/ Often
has headaches	0	1	2	3
feels dizzy	0	1	2	3
has a feeling that the room is spinning	0	1	2	3
feels faint	0	1	2	3
has blurred vision	0	1	2	3
has double vision	0	1	2	3
experiences nausea	0	1	2	3
has a sore neck	0	1	2	3
gets tired a lot	0	1	2	3
gets tired easily	0	1	2	3
has trouble sustaining attention	0	1	2	3
is easily distracted	0	1	2	3
has difficulty concentrating	0	1	2	3
has problems remembering what he/she is told	0	1	2	3
has difficulty following directions	0	1	2	3
tends to daydream	0	1	2	3
gets confused	0	1	2	3
is forgetful	0	1	2	3
has difficulty completing tasks	0	1	2	3
has poor problem solving skills	0	1	2	3
has problems learning	0	1	2	3
Total number of symptoms:				of 21
Symptom severity score:				of 63
Do the symptoms get worse with physical activity?			Y	N
Do the symptoms get worse with mental activity?			Y	N

Overall rating for parent/teacher/coach/carer to answer

On a scale of 0 to 100% (where 100% is normal), how would you rate the child now?

If not 100%, in what way does the child seem different?

3

STEP 3: COGNITIVE SCREENING

Standardized Assessment of Concussion - Child Version (SAC-C)[4]

Name: _____

DOB: _____

Address: _____

ID number: _____

Examiner: _____

Date: _____

IMMEDIATE MEMORY

The Immediate Memory component can be completed using the traditional 5-word per trial list or optionally using 10-words per trial to minimise any ceiling effect. All 3 trials must be administered irrespective of the number correct on the first trial. Administer at the rate of one word per second.

Please choose EITHER the 5 or 10 word list groups and circle the specific word list chosen for this test.

I am going to test your memory. I will read you a list of words and when I am done, repeat back as many words as you can remember, in any order. For Trials 2 & 3: I am going to repeat the same list again. Repeat back as many words as you can remember in any order, even if you said the word before.

List	Alternate 5 word lists					Score (of 5) Trial 1	Trial 2	Trial 3
A	Finger	Penny	Blanket	Lemon	Insect			
B	Candle	Paper	Sugar	Sandwich	Wagon			
C	Baby	Monkey	Perfume	Sunset	Iron			
D	Elbow	Apple	Carpet	Saddle	Bubble			
E	Jacket	Arrow	Pepper	Cotton	Movie			
F	Dollar	Honey	Mirror	Saddle	Anchor			
					Immediate Memory Score			of 15
					Time that last trial was completed			

List	Alternate 10 word lists					Score (of 10) Trial 1	Trial 2	Trial 3
G	Finger Candle	Penny Paper	Blanket Sugar	Lemon Sandwich	Insect Wagon			
H	Baby Elbow	Monkey Apple	Perfume Carpet	Sunset Saddle	Iron Bubble			
I	Jacket Dollar	Arrow Honey	Pepper Mirror	Cotton Saddle	Movie Anchor			
					Immediate Memory Score			of 30
					Time that last trial was completed			

CONCENTRATION

DIGITS BACKWARDS

Please circle the Digit list chosen (A, B, C, D, E, F). Administer at the rate of one digit per second reading DOWN the selected column.

I am going to read a string of numbers and when I am done, you repeat them back to me in reverse order of how I read them to you. For example, if I say 7-1-9, you would say 9-1-7.

Concentration Number Lists (circle one)					
List A	List B	List C			
5-2	4-1	4-9	Y	N	0
4-1	9-4	6-2	Y	N	1
4-9-3	5-2-6	1-4-2	Y	N	0
6-2-9	4-1-5	6-5-8	Y	N	1
3-8-1-4	1-7-9-5	6-8-3-1	Y	N	0
3-2-7-9	4-9-6-8	3-4-8-1	Y	N	1
6-2-9-7-1	4-8-5-2-7	4-9-1-5-3	Y	N	0
1-5-2-8-6	6-1-8-4-3	6-8-2-5-1	Y	N	1
7-1-8-4-6-2	8-3-1-9-6-4	3-7-6-5-1-9	Y	N	0
5-3-9-1-4-8	7-2-4-8-5-6	9-2-6-5-1-4	Y	N	1
List D	List E	List F			
2-7	9-2	7-8	Y	N	0
5-9	6-1	5-1	Y	N	1
7-8-2	3-8-2	2-7-1	Y	N	0
9-2-6	5-1-8	4-7-9	Y	N	1
4-1-8-3	2-7-9-3	1-6-8-3	Y	N	0
9-7-2-3	2-1-6-9-	3-9-2-4	Y	N	1
1-7-9-2-6	4-1-8-6-9	2-4-7-5-8	Y	N	0
4-1-7-5-2	9-4-1-7-5	8-3-9-6-4	Y	N	1
2-6-4-8-1-7	6-9-7-3-8-2	5-8-6-2-4-9	Y	N	0
8-4-1-9-3-5	4-2-7-3-9-8	3-1-7-8-2-6	Y	N	1
		Digits Score:			of 5

DAYS IN REVERSE ORDER

Now tell me the days of the week in reverse order. Start with the last day and go backward. So you'll say Sunday, Saturday. Go ahead.

Sunday - Saturday - Friday - Thursday - Wednesday - Tuesday - Monday	0 1
Days Score	of 1
Concentration Total Score (Digits + Days)	of 6

4

STEP 4: NEUROLOGICAL SCREEN

See the instruction sheet (page 7) for details of test administration and scoring of the tests.

Can the patient read aloud (e.g. symptom check-list) and follow instructions without difficulty?	Y	N
Does the patient have a full range of pain-free PASSIVE cervical spine movement?	Y	N
Without moving their head or neck, can the patient look side-to-side and up-and-down without double vision?	Y	N
Can the patient perform the finger nose coordination test normally?	Y	N
Can the patient perform tandem gait normally?	Y	N

BALANCE EXAMINATION

Modified Balance Error Scoring System (BESS) testing[5]

Which foot was tested (i.e. which is the non-dominant foot) ☐ Left ☐ Right

Testing surface (hard floor, field, etc.) _____

Footwear (shoes, barefoot, braces, tape, etc.) _____

Condition	Errors	
Double leg stance		of 10
Single leg stance (non-dominant foot, 10-12 y/o only)		of 10
Tandem stance (non-dominant foot at back)		of 10
Total Errors	5-9 y/o of 20	10-12 y/o of 30

Name: _____

DOB: _____

Address: _____

ID number: _____

Examiner: _____

Date: _____

5

STEP 5: DELAYED RECALL:

The delayed recall should be performed after 5 minutes have elapsed since the end of the Immediate Recall section. Score 1 pt. for each correct response.

Do you remember that list of words I read a few times earlier? Tell me as many words from the list as you can remember in any order.

Time Started _____

Please record each word correctly recalled. Total score equals number of words recalled.

_____

_____

_____

Total number of words recalled accurately: _____ of 5 or _____ of 10

6

STEP 6: DECISION

Domain	Date & time of assessment:		
Symptom number Child report (of 21) Parent report (of 21)			
Symptom severity score Child report (of 63) Parent report (of 63)			
Immediate memory	of 15 of 30	of 15 of 30	of 15 of 30
Concentration (of 6)			
Neuro exam	Normal Abnormal	Normal Abnormal	Normal Abnormal
Balance errors (5-9 y/o of 20) (10-12 y/o of 30)			
Delayed Recall	of 5 of 10	of 5 of 10	of 5 of 10

Date and time of injury: _____

If the athlete is known to you prior to their injury, are they different from their usual self?

☐ **Yes** ☐ **No** ☐ **Unsure** ☐ **Not Applicable**

(If different, describe why in the clinical notes section)

Concussion Diagnosed?

☐ **Yes** ☐ **No** ☐ **Unsure** ☐ **Not Applicable**

If re-testing, has the athlete improved?

☐ **Yes** ☐ **No** ☐ **Unsure** ☐ **Not Applicable**

I am a physician or licensed healthcare professional and I have personally administered or supervised the administration of this Child SCAT5.

Signature: _____

Name: _____

Title: _____

Registration number (if applicable): _____

Date: _____

SCORING ON THE CHILD SCAT5 SHOULD NOT BE USED AS A STAND-ALONE METHOD TO DIAGNOSE CONCUSSION, MEASURE RECOVERY OR MAKE DECISIONS ABOUT AN ATHLETE'S READINESS TO RETURN TO COMPETITION AFTER CONCUSSION.

For the Neurological Screen (page 5), if the child cannot read, ask him/her to describe what they see in this picture.

Name: _____

DOB: _____

Address: _____

ID number: _____

Examiner: _____

Date: _____

CLINICAL NOTES:

_____

_____

_____

_____

_____

_____

Concussion injury advice for the child and parents/carergivers

(To be given to the person monitoring the concussed child)

This child has had an injury to the head and needs to be carefully watched for the next 24 hours by a responsible adult.

If you notice any change in behavior, vomiting, dizziness, worsening headache, double vision or excessive drowsiness, please call an ambulance to take the child to hospital immediately.

Other important points:

Following concussion, the child should rest for at least 24 hours.

- The child should not use a computer, internet or play video games if these activities make symptoms worse.
- The child should not be given any medications, including pain killers, unless prescribed by a medical doctor.
- The child should not go back to school until symptoms are improving.
- The child should not go back to sport or play until a doctor gives permission.

Clinic phone number: _____

Patient's name: _____

Date / time of injury: _____

Date / time of medical review: _____

Healthcare Provider: _____

Contact details or stamp

INSTRUCTIONS

Words in *Italics* throughout the Child SCAT5 are the instructions given to the athlete by the clinician

Symptom Scale

In situations where the symptom scale is being completed after exercise, it should still be done in a resting state, at least 10 minutes post exercise.

At Baseline	On the day of injury	On all subsequent days
• The child is to complete the Child Report, according to how he/she feels today, and • The parent/carer is to complete the Parent Report according to how the child has been over the previous week.	• The child is to complete the Child Report, according to how he/she feels now. • If the parent is present, and has had time to assess the child on the day of injury, the parent completes the Parent Report according to how the child appears now.	• The child is to complete the Child Report, according to how he/she feels today, and • The parent/carer is to complete the Parent Report according to how the child has been over the previous 24 hours.

For Total number of symptoms, maximum possible is 21

For Symptom severity score, add all scores in table, maximum possible is 21 x 3 = 63

Standardized Assessment of Concussion Child Version (SAC-C)

Immediate Memory

Choose one of the 5-word lists. Then perform 3 trials of immediate memory using this list.

Complete all 3 trials regardless of score on previous trials.

"I am going to test your memory. I will read you a list of words and when I am done, repeat back as many words as you can remember, in any order." The words must be read at a rate of one word per second.

OPTION: The literature suggests that the Immediate Memory has a notable ceiling effect when a 5-word list is used. (In younger children, use the 5-word list). In settings where this ceiling is prominent the examiner may wish to make the task more difficult by incorporating two 5–word groups for a total of 10 words per trial. In this case the maximum score per trial is 10 with a total trial maximum of 30.

Trials 2 & 3 MUST be completed regardless of score on trial 1 & 2.

Trials 2 & 3: *"I am going to repeat the same list again. Repeat back as many words as you can remember in any order, even if you said the word before."*

Score 1 pt. for each correct response. Total score equals sum across all 3 trials. Do NOT inform the athlete that delayed recall will be tested.

Concentration

Digits backward

Choose one column only, from List A, B, C, D, E or F, and administer those digits as follows:

"I am going to read you some numbers and when I am done, you say them back to me backwards, in reverse order of how I read them to you. For example, if I say 7-1, you would say 1-7."

If correct, circle "Y" for correct and go to next string length. If incorrect, circle "N" for the first string length and read trial 2 in the same string length. One point possible for each string length. Stop after incorrect on both trials (2 N's) in a string length. The digits should be read at the rate of one per second.

Days of the week in reverse order

"Now tell me the days of the week in reverse order. Start with Sunday and go backward. So you'll say Sunday, Saturday ... Go ahead"

1 pt. for entire sequence correct

Delayed Recall

The delayed recall should be performed after at least 5 minutes have elapsed since the end of the Immediate Recall section.

"Do you remember that list of words I read a few times earlier? Tell me as many words from the list as you can remember in any order."

Circle each word correctly recalled. Total score equals number of words recalled.

Neurological Screen

Reading

The child is asked to read a paragraph of text from the instructions in the Child SCAT5. For children who can not read, they are asked to describe what they see in a photograph or picture, such as that on page 6 of the Child SCAT5.

Modified Balance Error Scoring System (mBESS)[5] testing

These instructions are to be read by the person administering the Child SCAT5, and each balance task should be demonstrated to the child. The child should then be asked to copy what the examiner demonstrated.

Each of 20-second trial/stance is scored by counting the number of errors. The This balance testing is based on a modified version of the Balance Error Scoring System (BESS)[5].

A stopwatch or watch with a second hand is required for this testing.

"I am now going to test your balance. Please take your shoes off, roll up your pants above your ankle (if applicable), and remove any ankle taping (if applicable). This test will consist of two different parts."

OPTION: For further assessment, the same 3 stances can be performed on a surface of medium density foam (e.g., approximately 50cm x 40cm x 6cm).

(a) Double leg stance:

The first stance is standing with the feet together with hands on hips and with eyes closed. The child should try to maintain stability in that position for 20 seconds. You should inform the child that you will be counting the number of times the child moves out of this position. You should start timing when the child is set and the eyes are closed.

(b) Tandem stance:

Instruct or show the child how to stand heel-to-toe with the non-dominant foot in the back. Weight should be evenly distributed across both feet. Again, the child should try to maintain stability for 20 seconds with hands on hips and eyes closed. You should inform the child that you will be counting the number of times the child moves out of this position. If the child stumbles out of this position, instruct him/her to open the eyes and return to the start position and continue balancing. You should start timing when the child is set and the eyes are closed.

(c) Single leg stance (10-12 year olds only):

"If you were to kick a ball, which foot would you use? [This will be the dominant foot] *Now stand on your other foot. You should bend your other leg and hold it up (show the child). Again, try to stay in that position for 20 seconds with your hands on your hips and your eyes closed. I will be counting the number of times you move out of this position. If you move out of this position, open your eyes and return to the start position and keep balancing. I will start timing when you are set and have closed your eyes."*

Balance testing – types of errors

1. Hands lifted off iliac crest
2. Opening eyes
3. Step, stumble, or fall
4. Moving hip into > 30 degrees abduction
5. Lifting forefoot or heel
6. Remaining out of test position > 5 sec

Each of the 20-second trials is scored by counting the errors, or deviations from the proper stance, accumulated by the child. The examiner will begin counting errors only after the child has assumed the proper start position. The modified BESS is calculated by adding one error point for each error during the 20-second tests. The maximum total number of errors for any single condition is 10. If a child commits multiple errors simultaneously, only one error is recorded but the child should quickly return to the testing position, and counting should resume once subject is set. Children who are unable to maintain the testing procedure for a minimum of five seconds at the start are assigned the highest possible score, ten, for that testing condition.

Tandem Gait

Instruction for the examiner - Demonstrate the following to the child:

The child is instructed to stand with their feet together behind a starting line (the test is best done with footwear removed). Then, they walk in a forward direction as quickly and as accurately as possible along a 38mm wide (sports tape), 3 metre line with an alternate foot heel-to-toe gait ensuring that they approximate their heel and toe on each step. Once they cross the end of the 3m line, they turn 180 degrees and return to the starting point using the same gait. Children fail the test if they step off the line, have a separation between their heel and toe, or if they touch or grab the examiner or an object.

Finger to Nose

The tester should demonstrate it to the child.

"I am going to test your coordination now. Please sit comfortably on the chair with your eyes open and your arm (either right or left) outstretched (shoulder flexed to 90 degrees and elbow and fingers extended). When I give a start signal, I would like you to perform five successive finger to nose repetitions using your index finger to touch the tip of the nose as quickly and as accurately as possible."

Scoring: 5 correct repetitions in < 4 seconds = 1

Note for testers: Children fail the test if they do not touch their nose, do not fully extend their elbow or do not perform five repetitions.

References

1. McCrory et al. Consensus Statement On Concussion In Sport – The 5th International Conference On Concussion In Sport Held In Berlin, October 2016. British Journal of Sports Medicine 2017 (available at www.bjsm.bmj.com)
2. Jennett, B., Bond, M. Assessment of outcome after severe brain damage: a practical scale. Lancet 1975; i: 480-484
3. Ayr, L.K., Yeates, K.O., Taylor, H.G., Brown, M. Dimensions of postconcussive symptoms in children with mild traumatic brain injuries. Journal of the International Neuropsychological Society. 2009; 15:19–30
4. McCrea M. Standardized mental status testing of acute concussion. Clinical Journal of Sports Medicine. 2001; 11: 176-181
5. Guskiewicz KM. Assessment of postural stability following sport-related concussion. Current Sports Medicine Reports. 2003; 2: 24-30

CONCUSSION INFORMATION

If you think you or a teammate has a concussion, tell your coach/trainer/parent right away so that you can be taken out of the game. You or your teammate should be seen by a doctor as soon as possible. YOU OR YOUR TEAMMATE SHOULD NOT GO BACK TO PLAY/SPORT THAT DAY.

Signs to watch for

Problems can happen over the first 24-48 hours. You or your teammate should not be left alone and must go to a hospital right away if any of the following happens:

- New headache, or headache gets worse
- Neck pain that gets worse
- Becomes sleepy/drowsy or can't be woken up
- Cannot recognise people or places
- Feeling sick to your stomach or vomiting
- Acting weird/strange, seems/feels confused, or is irritable
- Has any seizures (arms and/or legs jerk uncontrollably)
- Has weakness, numbness or tingling (arms, legs or face)
- Is unsteady walking or standing
- Talking is slurred
- Cannot understand what someone is saying or directions

Consult your physician or licensed healthcare professional after a suspected concussion. Remember, it is better to be safe.

Graduated Return to Sport Strategy

After a concussion, the child should rest physically and mentally for a few days to allow symptoms to get better. In most cases, after a few days of rest, they can gradually increase their daily activity level as long as symptoms don't get worse. Once they are able to do their usual daily activities without symptoms, the child should gradually increase exercise in steps, guided by the healthcare professional (see below).

The athlete should not return to play/sport the day of injury.

NOTE: An initial period of a few days of both cognitive ("thinking") and physical rest is recommended before beginning the Return to Sport progression.

Exercise step	Functional exercise at each step	Goal of each step
1. Symptom-limited activity	Daily activities that do not provoke symptoms.	Gradual reintroduction of work/school activities.
2. Light aerobic exercise	Walking or stationary cycling at slow to medium pace. No resistance training.	Increase heart rate.
3. Sport-specific exercise	Running or skating drills. No head impact activities.	Add movement.
4. Non-contact training drills	Harder training drills, e.g., passing drills. May start progressive resistance training.	Exercise, coordination, and increased thinking.
5. Full contact practice	Following medical clearance, participate in normal training activities.	Restore confidence and assess functional skills by coaching staff.
6. Return to play/sport	Normal game play.	

There should be at least 24 hours (or longer) for each step of the progression. If any symptoms worsen while exercising, the athlete should go back to the previous step. Resistance training should be added only in the later stages (Stage 3 or 4 at the earliest). The athlete should not return to sport until the concussion symptoms have gone, they have successfully returned to full school/learning activities, and the healthcare professional has given the child written permission to return to sport.

If the child has symptoms for more than a month, they should ask to be referred to a healthcare professional who is an expert in the management of concussion.

Graduated Return to School Strategy

Concussion may affect the ability to learn at school. The child may need to miss a few days of school after a concussion, but the child's doctor should help them get back to school after a few days. When going back to school, some children may need to go back gradually and may need to have some changes made to their schedule so that concussion symptoms don't get a lot worse. If a particular activity makes symptoms a lot worse, then the child should stop that activity and rest until symptoms get better. To make sure that the child can get back to school without problems, it is important that the health care provider, parents/caregivers and teachers talk to each other so that everyone knows what the plan is for the child to go back to school.

Note: If mental activity does not cause any symptoms, the child may be able to return to school part-time without doing school activities at home first.

Mental Activity	Activity at each step	Goal of each step
1. Daily activities that do not give the child symptoms	Typical activities that the child does during the day as long as they do not increase symptoms (e.g. reading, texting, screen time). Start with 5-15 minutes at a time and gradually build up.	Gradual return to typical activities.
2. School activities	Homework, reading or other cognitive activities outside of the classroom.	Increase tolerance to cognitive work.
3. Return to school part-time	Gradual introduction of school-work. May need to start with a partial school day or with increased breaks during the day.	Increase academic activities.
4. Return to school full-time	Gradually progress school activities until a full day can be tolerated.	Return to full academic activities and catch up on missed work.

If the child continues to have symptoms with mental activity, some other things that can be done to help with return to school may include:

- Starting school later, only going for half days, or going only to certain classes
- More time to finish assignments/tests
- Quiet room to finish assignments/tests
- Not going to noisy areas like the cafeteria, assembly halls, sporting events, music class, shop class, etc.
- Taking lots of breaks during class, homework, tests
- No more than one exam/day
- Shorter assignments
- Repetition/memory cues
- Use of a student helper/tutor
- Reassurance from teachers that the child will be supported while getting better

The child should not go back to sports until they are back to school/learning, without symptoms getting significantly worse and no longer needing any changes to their schedule.