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ZBORNIK

5. Mednarodni Kongres Športne Medicine
23.10. – 25.10.2015

BOOK OF ABSTRACTS

5th International Congress of Sports Medicine

23.10. – 25.10.2015

Maribor
Inštitut za športno medicino
Medicinska fakulteta
Univerza v Mariboru

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SPOŠTOVANI!

Skrb za kar najboljše pogoje v katerih delujejo slovenske športnice in športniki ter njihovi trenerji je ena prednostnih nalog Olimpijske komiteja Slovenije – Združenja športnih zvez, ki, med drugim, visoko ceni napore slovenske zdravstvene stroke, in njenih naporov za izboljšanje zdravstvenega varstva športnic in športnikov ter reševanja problemov, s katerimi se srečujemo. Ko razmišljamo o neverjetnih športnih uspehih naših športnic in športnikov, ki v mednarodnem merilu vedno znova opozarjajo na kvaliteto svojega dela in dela športne stroke, vedno znova prihajamo do zaključka, da moramo delati bolje kot drugi. To nam narekuje naša relativna majhnost v kateri nikoli ne sme manjkati velike želje po novih znanjih. Prav v tem se ločimo od mnogih s katerimi tekmujemo.

Prepričan sem, da pomeni 5. mednarodni kongres športne medicine nov korak v to smer. V tem me utrjuje nastop priznanih domačih in tujih strokovnjakov in sijajen odziv številnih, ki delujejo v slovenskem športu. Olimpijski komite Slovenije – Združenje športnih zvez bo tudi v prihodnje podpiral strokovna in zdravstvena srečanja, pri katerih prihaja do poglabljanja obstoječega znanja in spoznanj ter do oblikovanja športno-medicinske doktrine.

Veliko uspeha pri vašem delu!

Bogdan Gabrovec

Predsednik

Olimpijski komite Slovenije – Združenje športnih zvez

SPOŠTOVANI UDELEŽENCI 5. MEDNARODNEGA KONGRESA ŠPORTNE MEDICINE!

V veliko zadovoljstvo nam je, da smo za 5. mednarodni kongres športne medicine uspeli k sodelovanju pritegniti svetovno priznane strokovnjake, kot so profesor Jan Ekstrand iz Švedske, Rod Whiteley in druga zveneča imena.

Poseben poudarek na letošnjem kongresu bomo namenili obravnavi mišičnih poškodb, od diagnostike do najsodobnejših načinov zdravljenja.

Ob tem bomo organizirali tudi učne delavnice, v katerih bomo prikazali najmodernejše načine diagnostike. Kot zanimivost, en od teh načinov, tenziomiografija (TMG), je bil razvit s slovenskim znanjem. Sprva je bila uporabljana samo v Sloveniji, sedaj pa jo uporabljajo številni klubi, nogometne reprezentance in drugi športni kolektivi širom sveta – FC Barcelona, italijanska nogometna reprezentanca, ipd.

Druga učna delavnica bo prikazala načine prevencije športnih poškodb, še posebej pri nogometu, in sicer s t.i. FIFA 11+ preventivnim programom, s katerim so uspeli zmanjšati število poškodb tudi za približno eno tretjino, kar je izjemno izboljšanje.

Drug pomemben poudarek na kongresu bo na t.i. regeneraciji športnikov in pravilen način prehranjevanja ter uporabi prehranskih dodatkov. Tukaj smo izredno zadovoljni, da se je na povabilo odzval profesor Maughan iz Velike Britanije, ki je vodilna svetovna avtoriteta na tem področju, tako v olimpijskih kot tudi nogometnih krogih.

Organizirane bodo učne delavnice, na temo rehidracija in regeneracija na tekmi in po treningu, doping v vrhunskem športu. Na voljo bodo tudi učne delavnice, na katerih bodo lahko udeleženci spoznali temeljne postopke oživljanja na terenu in podobno, saj smo v zadnjem času vse pogosteje priča številnim resnim zapletom na športnih tekmovališčih, od srčnega zastoja, respiratornih sindromov in podobno.

doc. dr. Matjaž Vogrin, dr. med.

Predstojnik Inštituta za športno medicino MF UM

5. Mednarodni kongres športne medicine

Maribor 23.-25. Oktober 2015

Petek, 23. oktober 2015

7:30 – 8:10		Registracija za zdravnike, fizioterapevte, funkcionarje, trenerje itd.
8:10 – 8:45		Registracija za študente
9:00	Gabrovec	Pozdravni nagovor
9:05	Čeferin	Pozdravni nagovor
9:10	Vogrin	Pozdravni nagovor
9:10	Maughan	Športna prehrana: kje se nahajamo?
9:25	Vogrin	Mišične poškodbe v vrhunskem športu
9:40	Ekstrand	UEFA CL Injury study
9:55	Pišot, Šimunič	Vloga tenziomiografije pri mišičnih poškodbah
10:10	Hallen	Vrnitev k športu pri mišičnih poškodbah
10:35	Whiteley	Poškodbe hamstringov pri športnikih: smernice o preventivi, zdravljenju in vrnitvi v šport
10:50 - 11:00	DISKUSIJA	
11:00 – 11:30	ODMOR	
11:30	Djordjević	Poškodbe in treniranje mišice biceps femoris
11:45	Krajnc	Mišično izčrpanje v vrhunskem športu
12:00	Ivković	Tkivni inženiring v športni medicini
12:15	Kacin	Učinkovitost fizioterapije pri zdravljenju atrofije mišice po poškodbi
12:30	Ažman-Juvan	Olympic Movement Medical Code
12.45	Zorko	Posebnosti pri obravnavi mišičnoskeletnih stanj pri mladostnikih
13:00	Kelc	Regeneracija mišice po poškodbi kot izziv športne medicine
13:15 - 13:30	DISKUSIJA	
13:30 – 14:30	ODMOR	
14:30 - 16:00	DELAVNICE	
16:00 – 17:30	DELAVNICE	
Delavnica 1	Vogrin, Nasif	Mišične poškodbe (diagnostika, fizikalna terapija, PRP) (2N18)
Delavnica 2	Djordjević, Pišot	TMG pri mišičnih poškodbah (avditorij)
Delavnica 3	Whiteley, Ipavec	Poškodbe hamstringov (preventiva, zdravljenje in vrnitev v šport) (1N6)
Delavnica 4	Ekstrand, Borko, Kelc	Preventiva športnih poškodb (2N19)
18:00		Voden ogled Hiše Stare trte s pokušino vin
19:00		Vožnja po Dravi z Dravsko vilo
20:00		Druženje za udeležence v vinoteki Rožmarin

Sobota, 24.oktober 2015

9:00	Maughan	Regeneracija v nogometu: slediti smernicam za prehrano pri vzdržljivostnih športih?
9:40	Shirreffs	Rehidracija in regeneracija po treningu in tekmi
10:10	Kozjek	Prehranske smernice pri ostalih športih – je kaj koristnega za nogomet?
10:30 - 11:00	DISKUSIJA	
11:00 – 11:30	ODMOR	
11:30 - 13:00	DELAVNICE	
13:00 – 14:30	DELAVNICE	
Delavnica 1	Maughan, Okorn, Ekart	Rehidracija in regeneracija po treningu in tekmi (2N15)
Delavnica 2	Žiberna	Doping v vrhunskem športu (Olympic Movement Medial Code) (avditorij)
Delavnica 3	Bernhardt, Podlesnikar	Kolaps med vadbo in nenadna srčna smrt (2N19)
Delavnica 4	Topole	Akutna respiratorna stanja pri športnikih (2N18)
Delavnica 5	Plevnik	Temeljni postopki oživljanja na terenu (2N20)
14:30 – 16:00	ODMOR	
16:00	Podlesnikar	Regeneracija pri vzdržljivostnih športih
16:15	Milič	Biokemijski markerji pretreniranosti
16:30	Kozjek	Prehrana in fizioterapija
16:45	Naranđa	Regeneracija v vrhunskem športu (evidence based)
17:00 - 17:30	DISKUSIJA	

Nedelja, 25.oktober 2015

09.00-13.00	Okrogra miza (vsi predavatelji)	Vloga medicine v športu na profesionalnem in rekreativnem nivoju

5TH INTERNATIONAL CONGRESS OF SPORTS MEDICINE

Maribor 23-25 October 2015

Friday, 23rd of October 2015

7:30 – 8:10		Registration for medical doctors, physiotherapists, functionaries, trainers etc.
8:10 – 8:45		Registration for students
9:00	Gabrovec	Welcome speech
9:05	Čeferin	Welcome speech
9:10	Vogrin	Welcome speech
9:10	Maughan	Sports nutrition: where are we?
9:25	Vogrin	Muscle injuries in high-level sports
9:40	Ekstrand	UEFA CL Injury study
9:55	Pišot, Šimunič	Tensiomiography and muscle injuries
10:10	Hallén	Return to play after muscle injuries
10:35	Whiteley	Hamstring injuries in athletes: update on prevention, treatment and return to play
10:50 - 11:00	DISCUSSION	
11:00 – 11:30	COFFEE BREAK	
11:30	Djordjević	Injuries and training of biceps femoris muscle
11:45	Krajnc	Muscle fatigue in professional sport
12:00	Ivković	Bioreactor based tissue engineering in sports medicine
12:15	Kacin	The efficiency of physiotherapy for treating muscle atrophy after lower limb injury or surgery
12:30	Ažman-Juvan	Olympic Movement Medical Code
12.45	Zorko	Management of musculoskeletal conditions in younger athletes
13:00	Kelc	Skeletal muscle regeneration as a challenge in sports medicine
13:15 - 13:30	DISCUSSION	
13:30 – 14:30	LUNCH BREAK	
14:30 - 16:00	WORK SHOPS	
16:00 – 17:30	WORK SHOPS	
Workshop 1	Vogrin	Muscle injuries (2N18)
Workshop 2	Djordjević, Pišot	TMG can we predict muscle injuries, save return to sport? (auditorium)
Workshop 3	Whiteley, Ipavec	Hamstring injuries (prevention, treatment and return to play) (1N6)
Workshop 4	Ekstrand	Sports Injury prevention (2N19)
18:00		Wine tasting at Hiša Stare trte
19:00		River Drava cruise
20:00		Social event in restaurant Rožmarin

Saturday, 24th of October

9:00	Maughan	Recovery after football: should we follow the nutrition guidelines established for endurance athletes?
9:40	Shirreffs	Rehydration and recovery after training and match play
10:10	Kozjek	Nutrition guidelines for strength and power sports, anything useful for football?
10:30 - 11:00	DISCUSSION	
11:00 – 11:30	COFFEE BREAK	
11:30 - 13:00	WORKSHOPS	
13:00 – 14:30	WORKSHOPS	
Workshop 1	Maughan, Okorn, Ekart	Rehydration and recovery after training and match (2N16)
Workshop 2	Žiberna	Doping in elite sport (Olympic Movement Medial Code) (auditorium)
Workshop 3	Bernhardt, Podlesnikar	Collapse during exercise and sudden cardiac death (2N19)
Workshop 4	Topole	Acute respiratory disorders in athletes (2N18)
Workshop 5	Plevnik	Basic life support on the field (2N20)
14:30 – 16:00	DISCUSSION	
	COFFEE BREAK	
16:00	Podlesnikar	Regeneration in endurance sport activities
16:15	Milič	Biochemical markers in fatigue diagnostics
16:30	Kozjek	Nutrition and physical therapy
16:45	Naranđa	Regeneration in high-level sport (evidence based)
17:00 - 17:30	DISCUSSION	

Sunday, October 25th 2015

09.00-13.00	Round table (all speakers)	The role of medicine in professional and recreational sport

SPORT NUTRITION: WHERE ARE WE?

Ron Maughan

Loughborough University, UK

Nutrition has always been an integral part of the preparation and competition strategies of athletes. As sport and science have evolved, so too has the application of scientific principles to the diet of athletes. Food plays a large part in modern lifestyles and, as well as providing the nutrients necessary for life, plays a role in many modern lifestyle diseases. The role of specific nutrients, both macronutrients and micronutrients, in health and disease is the subject of much heated debate, and this debate carries over into sports nutrition. It was Bertrand Russel who said that "The whole problem with the world is that fools and fanatics are always so certain of themselves, and wiser people so full of doubts". This applies very much to sports nutrition, and it is sometimes hard to separate evidence from the loud voices that promulgate nothing more than opinion. Major controversies exist in many important areas: a high carbohydrate diet has been recommended to athletes for several decades, but some (probably mistakenly) promote a diet that is high in fat and/or protein. Accumulated evidence has led to a widespread belief that dehydration is harmful to performance and that athletes will benefit from a planned drinking schedule that will limit incurred hypohydration, but others suggest that simply drinking when thirsty is all the advice that should be given to those engaged in sport. These examples are followed by a long list of important issues where there is little agreement. This situation results in real difficulties for athletes, coaches, team physicians and others who are faced with conflicting advice. Where controversy continues in mainstream nutrition, it is perhaps too much to hope for consensus in sports nutrition and practitioners should make every effort to ensure that their practice is indeed evidence-based.

MUSCLE INJURIES IN HIGH LEVEL SPORT

doc. dr. Matjaž Vogrin, dr. med.

Predstojnik Inštituta za športno medicino MF UM

Terminology and clinical categorization of muscle injuries

Muscle injuries are a heterogeneous group, differing in terms of their type, location, severity and size, and this can make prognoses regarding recovery times and rehabilitation difficult. Recently, however, new approaches have been proposed to improve classification, including an attempt by the Munich Consensus Group to categorize injuries as either functional or structural-mechanical injuries. Functional injuries are minor fatigue-induced or neurogenic injuries causing hardening of the muscle, while structural-mechanical injuries involve tears in muscle fibres.

Classification of acute muscle disorders and injuries

A. Indirect muscle disorder/injury	Functional muscle disorder	Type 1: Overexertion-related muscle disorder	Type 1A: Fatigue-induced muscle disorder
			Type 1B: Delayed-onset muscle soreness (DOMS)
		Type 2: Neuromuscular muscle disorder	Type 2A: Spine-related neuromuscular Muscle disorder
			Type 2B: Muscle-related neuromuscular Muscle disorder
	Structural muscle injury	Type 3: Partial muscle tear	Type 3A: Minor partial muscle tear
			Type 3B: Moderate partial muscle tear
		Type 4: (Sub)total tear	Subtotal or complete muscle tear
			Tendinous avulsion
B. Direct muscle injury		Contusion	
		Laceration	

Terminology and classification of muscle injuries in sport: The Munich consensus statement

Functional muscle disorders Painful muscle disorders with no evidence of muscle fiber damage.

Fatigue-induced painful muscle disorder: Localized longitudinal increase in muscle tone due to over-exertion, a change of playing surface or changes to training patterns. There is pain with activity, but not at rest. Increased muscle tone is noted in the affected muscle area, with mild, dull pain aggravated by palpation or stretching. Imaging typically shows —dry muscle‖ changes, without the formation of an oedema.

Delayed Onset Muscle Soreness (DOMS): More generalized muscle pain following unaccustomed, eccentric deceleration movements, with the possibility of associated ruptures of sarcomeric Z-discs. This presents as an acute inflammatory pain in the affected muscle groups, with stiff and weak muscles plus pain at rest, usually peaking 24 72 hours after the activity that caused it. Images show no signal changes or only edematous signal changes in the muscle.

Spine-related neuromuscular muscle disorder: Localized longitudinal increase in muscle tone owing to a functional or structural spinal disorder (including disorders affecting the sacroiliac joint). There is subjective tightness and pain with intense activity, stretching and palpation. Such disorders are sometimes associated with changes in skin sensation. There is an increase in muscle tone over the entire length of the muscle on palpation. Symptoms improve with rest.

Muscle-related neuromuscular muscle disorder: Localized spindle-shaped area of increased muscle firmness (possibly a result of reciprocal inhibition of synaptic transmission). This presents as a pulling and cramp-like sensation within the muscle. It is aggravated by activity and improved by rest and gentle stretching. A spindle-like longitudinal firmness can be detected within the affected muscle belly on palpation.

Structural muscle disorders: Any acute indirect muscle disorder with macroscopic evidence of muscle fiber damage.

Minor partial muscle injury: Structural muscle injury involving only an intra-fascicle tear. This presents as acute, sharp pain, often at the muscle-tendon junction. There is focal pain on palpation with a possible palpable defect, and often there is no visible hematoma. Pain is aggravated by stretching and palpation. An

intra-muscular hematoma and a focal muscle defect can be observed in images, with the surrounding fascia usually remaining intact.

Moderate partial muscle injury: Structural muscle injury involving an inter-fascicle or muscle bundle tear. This presents as acute, intense, stabbing pain, usually at the muscle-tendon junction, and is often associated with a fall by the player. The player often experiences a snap. There is a palpable, defined defect in the affected muscle, which is painful both to touch and on gentle stretching. A hematoma can often be observed. The defect in the muscle/fascia and the hematoma are visible in images, together with an inter-muscular hematoma.

Subtotal/complete muscle injury/tendon avulsion: Structural muscle injury involving damage to the majority (subtotal) or all (complete) of the diameter of the muscle or a subtotal/complete tendon avulsion. This presents as acute, severe pain and there is often a fall after injury. There is more severe pain with passive motion and palpation, and there is an immediate functional deficit, with the development of larger hematomas. There will be a large palpable defect, often at the muscle-tendon junction, or retraction of the avulsed muscle. An obvious muscle defect or tendon avulsion can be observed in images, as can the formation

Examination procedures

Diagnostic procedures for thigh muscle injuries have been investigated for teams participating in the group and knockout stages of the UEFA Champions League between 2007 and 2012. All of the 1,100 thigh injuries recorded were examined clinically (with clinical examination constituting the basis for diagnosis), but the majority (85%) were also examined using some form of imaging. The majority (54%) were examined by means of an MRI, and one-third were examined using sonography.

Up to 70% of lower-limb muscle injuries are Grade 0 or Grade 1 injuries, showing no signs of muscle fibre disruption in MRIs. However, these injuries account for the majority of lay-offs. This means that, from a club's perspective, these injuries represent a significant problem owing to their high levels of incidence, despite the fact that most hamstring injuries have a favourable prognosis and can be effectively handled conservatively. Surgical repair is normally reserved for total ruptures, such as avulsion injuries. However, these injuries are rarely seen in football, representing only a very small percentage of the hamstring injuries in the UEFA Injury Study.

Radiological grading

Recently, Ekstrand et al. showed that radiological grading of hamstring injuries is strongly correlated with lay-off times. Consequently, an MRI examination conducted 24–48 hours after a muscle injury is sustained could provide information about the expected lay-off time. Accordingly, a negative MRI is associated with a shorter recovery time, normally around six to eight days.

Examination and treatment of muscle injuries

Medical history

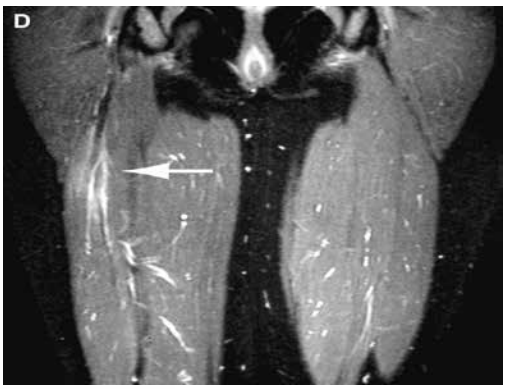
The doctor should start with a precise history of the circumstances surrounding the injury, before then reviewing the player's symptoms and identifying any previous related injury problems. Where the player reports a sharp and sudden onset of pain (for example, the player experiences a —snapll and well- defined, localised pain), a tear must be assumed.

Inspection, clinical examination, functional testing and location of injury

swelling, hematoma, retraction, muscle contours

Palpation is performed with moderate pressure and movement. The fingers should repeatedly slide along the muscle from distal to proximal and across the fibres, but should not only press down on the muscle. When conducting palpation, ask the athlete to demonstrate where the centre of pain is located. Palpation reveals if there is any pressure pain, and whether the pain is localised or covers a larger area. It also helps to detect if the muscle is oedematous, whether there is pain or relief on careful stretching, and if there is a palpable defect.

IMAGING: US, MRI



Hamstrings injury

Treatment of muscle injuries

Immediate management of muscle injuries (RICE)

Standard immediate management of muscle injuries should follow the well-known RICE regimen (rest, ice, compression and elevation) for acute treatment.

Placing the injured extremity at rest immediately after the trauma prevents (in the case of a structural injury) further retraction of the ruptured muscle stumps (i.e. the formation of a large gap within the muscle), reducing the size of the hematoma and, subsequently, the size of the connective tissue scar.

A cooling pressure bandage soaked in ice-cold water is a simple, fast and convenient first-line treatment for athletic injuries, and its liberal use is justified even in the event of uncertainty. The aim of this treatment is to minimize bleeding into the injury site and to control the inflammatory reaction that invariably follows a structural muscle injury. Improper acute treatment (i.e. where RICE is not used) will not only delay the healing process, but also increase the risk of subsequent imaging overestimating the injury owing to the presence of a hematoma or oedema.

Taping It has been shown that early mobilisation fosters more rapid and intensive capillary ingrowth in the injured area, better regeneration of muscle fibres, and a more parallel orientation in the regenerating myofibres. This is in comparison with immobilisation, which used to be the preferred treatment for injured muscles. It has also been shown that the biomechanical strength of the injured muscle returns to normal more rapidly using active mobilisation than if the muscle is immobilised after the trauma. In summary, a short period of immobilisation after a muscle injury is beneficial in certain cases, but it should be limited to the first few days after the injury. After a period of relative immobility, more active use of the injured muscle can gradually begin, to the extent that pain allows it.

Non-steroidal anti-inflammatory drugs (NSAIDs) have commonly been administered to treat muscle injuries in the past, but today clinicians are more sceptical about their use, since both clinical and basic scientific studies have reported conflicting and even negative effects on the healing process. Besides their anti-inflammatory properties, NSAIDs suppress the perception of pain by inhibiting prostaglandin synthesis, which may create problems, as an accurate and undistorted perception of the state of the injured muscle is of great importance for the player‘s rapid or progressive rehabilitation. Thus, NSAIDs are not recommended for the treatment of muscle injuries. Indometacin may be given if there are any signs of calcification/myositis ossificans (e.g. echo-rich particles in ultrasound with a dorsal echo shadow).

Injection therapy is used in many countries, with positive results empirically. However, evidence in the form of prospective randomized studies is still needed in order to verify these results and analyze the long-term effects.

The aim of injecting therapeutic agents directly into affected or injured muscle tissue is twofold:

Local anaesthetics such as mepivacaine or procaine block the voltage-dependent sodium channel on the axon. This keeps the nerve membrane from depolarising at that site, temporarily blocking further conduction of action potentials past the site of action. Thus, an intramuscular injection of mepivacaine will functionally block all of the muscle fibres supplied by that axon (motor unit), causing the treated muscle bundle to become unexcitablell and lose its tone.

Traumeel is composed of several natural ingredients, including arnica, calcium sulfite, hamamelis and many others. Its precise mechanism is unclear, but it has been shown that Traumeel inhibits the secretion of the inflammatory mediators IL-1b, TNF-a and IL-8 from activated human lymphocytes by up to 70%.It has also been found that glycoproteins from certain medicinal plants inhibit the influx of inflammatory cells and their mediators. Traumeel is also utilised for its localised antioedematous, dehydrating effects.

Actovegin One adjuvant agent that has successfully been used clinically to improve muscle regeneration is Actovegin, a deproteinised haemoderivative obtained by means of the ultra-filtration of calves‘ blood. Actovegin is not approved by the US Food and Drug Administration (FDA) and is not available in all countries.

PRP Among new therapeutic options for achieving more efficient healing, autologous thrombo□ cytes have a very important place. Although there is no randomized prospective study con□ firming its value, platelet-rich plasma as a source of autologous growth factors is thought to be used by many sports physicians for treating muscle injuries. The use of platelet-derived preparations was prohibited by WADA until 2011 but was removed from the list after con□ sidering the lack of current evidence concerning the use of the method for the purposes of performance enhancement as current studies did not reveal a potential for performance en□ hancement beyond the therapeutic effect

PHYSIOTHERAPY

Appropriate physiotherapy methods have an important role to play in the management of muscle injuries. Physiotherapy, rehabilitative exercises and training therapy are essential components of the reconditioning of an injured structure, the restoration of coordination and proprioception, the normalisation of movement patterns, the prevention of muscular atrophy and the return to normal force development.

More active treatment of the injured muscle should gradually begin after the initial phase, using the following specific exercises:

- Isometric training. These are muscle contractions in which the length of the muscle remains constant and the tension changes.

- Isotonic training. Here, the muscle length changes, but the tension remains constant during muscle contraction.

- Isokinetic, dynamic training (with minimal loads). This should be started once the abovementioned exercises can be performed without pain. Isokinetic exercises should be performed very carefully in order not to overload the injured muscle.

In athletes with more severe muscle injuries, it is particularly important to conduct regular clinical examinations to evaluate the progress made in terms of healing.Only meticulous palpation by an experienced examiner can supply useful information on muscle tone. A normalisation of the muscle tone signifies that healing is progressing.

In any strengthening programme, the injured muscle must gradually regain a normal functional tone without exhibiting regional or generalised protective reactions. These reactions are generally manifested by palpable, cord-like areas of muscle firmness and should always be taken as a warning sign. In all cases, the injured site itself (oedema, discontinuity, scar tissue, retraction of the muscle bundle, etc.) should be thoroughly evaluated.

Progressive exercising of the injured limb in incremental stages not only retrains the muscles in complex movement patterns, but also provides valuable feedback for doctors and therapists. The player is ready to advance to the next stage only when he/she is free of pain. The recommended technical tool for evaluating progress is ultrasound. Ultrasound scans yield a wealth of diagnostic information and can be repeated as often as necessary. It is not generally feasible to conduct weekly MRI examinations.

A precise rehabilitation plan has to be developed for every athletic muscle injury, including recommendations for sport-specific training with increasing intensity.With a plan of this kind and thorough follow-up examinations, low recurrence rates can be achieved.

SURGERY

Complete avulsions with significant retraction of the muscle (meaning, in biomechanical terms, a total tear in the origin or insertion of the muscle), such as a proximal avulsion of the hamstrings, the rectus femoris or the adductor longus, or a distal avulsion of the semitendinosus muscle, are unlikely to lead to healing at the anatomical origin. Since an adverse effect on muscle strength and function is likely, surgical refixation using suture anchors should be aimed for in these cases. In the case of proximal hamstring avulsions, surgical refixation should definitely be indicated for avulsions with >2cm of retraction. Surgical intervention after contusions or more severe muscle tears is only required when haematomas cause neurovascular compression. This is rare in athletic muscle injuries

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Ekstrand et all: UEFA football doctor education programme: Workshop 2, Injury diagnosis and treatment

THE UEFA ELITE CLUB INJURY STUDY HELPING CLUBS AVOID INJURIES

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Injury study is the first step in injury prevention. The UEFA Champions League injury study is ongoing since 14 years and includes information from 55 elite level clubs in Europe. The database, consisting of 20 000 injuries is the world's largest concerning male elite level football. A large database from a homogenous material provides robust information of the risk of specific injuries, their consequences in form of lay off days and the risk of recurrence etc. Further, injury studies provides an instrument to follow injury rates over time and to evaluate the effect of preventive programs or change of factors such as rules, match frequency or training load.

Important findings from the study:

- The match unavailability due to injury is 14% and has been constant over the last decade
- The injury incidence has been lowered for ligament injuries but injury rates for muscle injuries and severe injuries remain high and are still unaffected by preventive measures.
- On average, a team of 25-28 players can expect around 50 injuries per season.
- Injuries and team success are correlated. Teams with fewer injuries have better results both in UEFA tournaments and in national leagues.
- A period of match congestion can lead to player fatigue, which may result in injury and/or underperformance during the following period
- Injury rates and especially muscle injury rates increase in matches with short recovery period between matches
- The coach/manager is more important than doctors for the injury situation in top class football clubs
- Replacing the head coach during a season increases the injury rate in the team but not as much as replacement of fitness coaches
- Load on players, internal communication in a club and the well being of players are the most important factors for injury rates in top class teams

THE POTENTIAL OF TENSIOMYOGRAPHIC ASSESSMENT IN FOOTBALL PLAYERS

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Abstract

Football (soccer) is one of the most popular sports in the world. Currently FIFA unifies 207 national associations and represents about 265 million active players, of which about 26 million are women. The growth in football is striking, particularly in women. Furthermore, there are already over 1 million futsal players and the number of occasional soccer players is constantly increasing. In soccer, overuse, strain and sprain injuries of the joints in the lower limbs are the most common. The incidence of football injuries is estimated to be 24 to 30 per 1000 match hours in top 17 UEFA teams (Ekstrund, 2008). Furthermore, Admacyzk (2002) concluded that every player will have minimum one performance-limiting injury per year and a team of 25 players can expect 40 to 50 injuries per season, half of them causing absence less than a week but six of them causing absence more than a month (Ekstrund, 2008). Ekstrund (2008) also reported that the most common types of injuries are: overuse (31 %), strain (24 %), sprain (22 %), contusion (15 %), and others. Furthermore, thigh muscle injury is the most common injury (23 %) at top level with an injury incidence of 1.6/1000 hours of exposure, which means that a team can expect 10 such injuries each season. Follows knee (20 %), ankle (13 %), hip/groin (12 %), lower leg (11 %), and others.

To limit or decrease the risk of injury to these joints it is therefore of interest to pay attention to skeletal muscles that provide dynamic joint stability in the lower limbs. From a narrow specter of possibilities, Tensiomiography is a very suitable method for selective and noninvasive assessment of skeletal muscle contractile properties in football players. During our presentation we will present several findings from football studies in Slovenia and abroad. We have found the developmental trends in football players for 11 skeletal muscles, including the ones with the most injuries (e.g. biceps femoris, semitendinosus, rectus femoris, etc.). Tensiommyographic contraction time trends in young players are strongly dependent from their age and tend to become longer in rectus femoris, biceps femoris, and vastus medialis. There are also significant differences between teams of different eliteness, mostly in rectus femoris, biceps femoris, gastrocnemius medialis, tibialis anterior, and adductor longus. It is also evident that during one macro cycle skeletal muscles adapt to football movement specifics, where the largest changes are evident in semitendinosus, tibialis anterior, and gastrocnemius lateralis. To conclude, contraction time derived from tensiomyographic twitch response was recently correlated to muscle composition, where shorter contraction time is related to higher proportion of myosin heavy chain 1 composition in vastus lateralis (Šimunič et al., 2011). Therefore, tensiomyography is well accepted and reliable method for assessment of skeletal muscle's contractile properties.

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RETURN TO PLAY AFTER MUSCLE INJURIES IN PROFESSIONAL FOOTBALLERS

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BACKGROUND

This prospective cohort study described return-to-play (RTP) data for different types of muscle injuries in male elite level football players in Europe. Our hypothesis was that imaging would provide detailed data that would assist the persons working on the football field in answering the common question "When can the player return to ordinary training and matches?" Athletes participating in professional football have a substantial risk of injury, which has been estimated to be about 1000 times higher than for typical industrial occupations that are generally regarded as high-risk (Drawer & Fuller, 2002). Muscle injuries constitute almost one-third of all time-loss injuries among male elite football players, and account for over one-fourth of all injury-related lay-off time (Ekstrand, Hägglund, & Waldén, 2011a; Ekstrand, et al., 2011).

METHOD

This prospective cohort study described return-to-play (RTP) data for different types of muscle injuries in male elite level football players in Europe. Eighty-nine European professional teams were followed between 2001 and 2013. Team medical staff recorded individual player exposure and time-loss injuries. A total of 17,371 injuries occurred, including 5603 (32%) muscle injuries. From 2007, we received results from 386 magnetic resonance imaging (MRI) examinations, and radiological grading was performed.

RESULTS

A negative MRI was associated with shorter recovery time (6 ± 7 days). Lay-off days were correlated with MRI grading of thigh muscle injuries ($P < 0.001$). Among hamstring injuries, 83% occurred to the biceps femoris, 12% affected the semimembranosus, and 5% the semitendinosus. Recurrence rate was higher among biceps femoris injuries (18%) compared to semitendinosus and semimembranosus injuries (2% together). Groin muscle injuries caused shorter median absence (9 days) than hamstring (13 days; $P < 0.001$), quadriceps (12 days; $P < 0.001$), and calf muscle (13 days; $P < 0.001$) injuries.

CONCLUSION

Overall, we found that MRI was valuable for prognosticating RTP, with radiological grading associated with lay-off times after injury. Re-injuries were common in biceps femoris injuries but rare in semitendinosus and semimembranosus injuries.

HAMSTRING INJURIES IN ATHLETES: UPDATE ON PREVENTION, TREATMENT, AND RETURN TO PLAY

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In field sports such as football, hamstring injuries remain one of the most important causes of lost player time with approximately 1 in 11 players suffering an injury every season. Worse, after a player has had an injury, there is a very high chance of recurrence: the figures vary widely, but can be as high as 70% or more depending on the cohort and the management strategies employed. Recently there has been some cause for optimism on several fronts regarding our understanding of these injuries. This paper will briefly address advances in the prevention, treatment, prediction of time-loss after an injury, and prevention of re-injury.

A strong and growing body of evidence has now shown that systematic implementation of eccentric exercise is a worthwhile strategy to reduce the incidence of hamstring injury. Specifically the incidence of first time hamstring injury can be reduced by 75%, while the higher risk group with a previous history of hamstring injury can have their incidence reduced by up to 85%. Surprisingly, despite this information, high level football teams have a low rate of adoption of this prevention strategy. It is suggested that there are 2 main barriers to the wider adoption of this exercise. Firstly, there has been experience of implementing this exercise at too high a level early on in the program which results in significant levels of delayed onset muscle soreness in the players, and likely prevents normal training. As such, both the playing and coaching staff are justifiable in the objection to the intervention. To ameliorate this problem, a more graduated approach has been implemented which resulted in <1/10 pain (VAS) for the duration of the intervention. Secondly, there has been a perception that the Nordic exercise is “non-functional” and even contra-indicated for sprint athletes as it is bilaterally performed, slow moving, knee-dominant while sprinting is a high speed unilateral, and largely hip extension dominant activity. Recent experimental evidence shows that biceps femoris long head fascicle length is strongly associated with hamstring injury likelihood, and that eccentric exercise can positively affect this architectural feature. It is suggested that one of the mechanisms of action for these type of exercises is this induced architectural change, independent of strengthening effects.

Once an athlete has sustained a hamstring injury, a critical question for all involved is “when can the athlete return to play?” Early attempts at predicting return to play centred on the grading of a muscle injury, considering higher grade injury to take longer to return to play. The advent of MRI allowed quantification of many aspects of hamstring injury. When considering the most commonly encountered grade 1 and 2 injuries, recent evidence from well controlled studies suggests that MRI is unhelpful in predicting return to play. Worse, attention to the MRI may be misguiding our return to play efforts if we mistakenly pay attention to these features rather than clinical examination. Analyses of the same well-controlled cohorts show that a clinical examination at day 1 and day 7 can strongly predict return to play outcomes in these athletes. Important features include subjective measures of pain at the time of injury, and sport played, while objective features include changes in strength over the 7 days, time to walk pain free, and length of palpation pain on careful assessment (among other features).

Finally, the results of a progressive, staged, criteria-based rehabilitation program are presented. Using this program (the key features of which will be discussed in the workshop) professional athletes with a grade 1 or 2 hamstring injury were shown to return to sport in a median of 23 days, with 7% recurrence rates. Information will be presented regarding an ongoing randomized controlled trial which seeks to further reduce the recurrence rate.

INJURIES AND TRAINING OF BICEPS FEMORIS MUSCLE

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Background of biceps femoris Injuries

Professional sports and top-level many sport performances are extreme and risky activities. The overall injury rate of professional footballers is approximately 1000 times higher than that of typical industrial occupations, generally regarded as high risk.(Br J Sports Med 2013;47:759–762)

Injuries of the hamstring muscles are the most common type of injury in sports events where running is the basic movement pattern (Br J Sports Med. 2005 Jun;39(6):319-23). The biceps femoris (BF) is the most commonly injured of the hamstring muscles(Sports Med 2012; 42 (3): 209-226), with the muscle-tendon junction and adjacent muscle fibres being the most common sites of disruption (Sports Med 2012; 42 (3): 209-226).

Typically, BF injuries occurred in sprinting, jumping, kicking and tackling during high-force/high-speed movement tasks.

Studies involving recordings of EMG activity have found the hamstrings to be active from mid-swing until terminal stance (Med Sci Sports Exerc. 2012 Apr;44(4):647-58).

In literature, we can find few different explanations about the most probable moment of the BF injury initiations/development during high speed running. Common for all arguments is that hamstring strain occurred during eccentric loading/muscle contraction.

Some most popular working hypotheses based on studies published after 2000 are:

- “The potential for hamstring muscle strain injury exists during the late stance phase as well as during the late swing phases of overground sprinting.” (Journal of Biomechanics. 41, 2008; 3121–3126)

- “As peak musculotendon force and strain for BF, ST, and SM occurred around the same time during terminal swing, it is suggested that this period in the stride cycle may be when the biarticular hamstrings are at greatest injury risk”.(Med Sci Sports Exerc. 2012 Apr;44(4):647-58).

No such direct evidence is available for hamstring strains (Br J Sports Med 2012;46:88–89). Cases that claim to show a hamstring strain occurring in late swing 9,10 use indirect evidence. There have been no studies measuring the in vivo forces of hamstring muscles or tendons in human sprinting (Br J Sports Med 2012;46:88–89), but we have some preliminary results measuring mechanical tension of BF and vastus medialis during high speed running(see video recording). Risk factors for BF injuries are age, previous injury, strength imbalance, flexibility, and competition density…

Nevertheless, major reason for hamstrings/biceps femoris injuries is non-appropriately adapted muscle-tendon complex for maximal sprinting or high-force/high-speed movement tasks(BF peak tension forces). There are also possibilities of non-sufficient neuromuscular adaptation for maximal sprinting.

Training – pre/post BF injuries

The main purpose of any rehabilitation strategy and procedures following the operative or nonoperative treatment of a biceps femoris injury is to restore the preinjury function level.

The basic condition and challenge to reach this goal is appropriate, functional muscle diagnostics and monitoring during different rehabilitation tasks or specific movement patterns. Important for understanding adaptation strategy is the detail that BF spans two joints, the hip and the knee, and so contributes to the net moments exerted on both joints simultaneously.

Adaptation/specific training protocols for BF muscle tendon complex should be developed in three directions: knee-hip-biarticular exercises, different condition of length-tension load and different dynamics of load/exercise (different activation/speed level and rate of force development)

Practical applications of specific adaptation/exercises for BF muscle tendon complex should be:

- Isolating exercises for knee flexion (preferably single leg) eccentric and concentric contraction

- Isolating exercise for hip extension (preferably single leg) eccentric and concentric contraction

- Combining knee flexion/extension and hip extension movements with a different type of load (ballistic, inertial resistance devices and resistance using elastic).

All mentioned exercises should be done in 4 different modalities: load, amplitude, speed and external / internal leg rotation.

Next step is specific multiple jumps (hops) with different speed and knee/hip amplitudes.

The last step is specific high-speed run like exercises (running with extreme frequency, forward trunk position…).

An important point for specific training and rehabilitation of BF is the fact that preferential damage on the injured muscle part is on the type II muscle fibres (Med Sci Sports Exerc. 1992 May; 24(5):521-30, Physiol Rep. 2014 Nov; 2(11): e12213.).

In Figure 1 we can see different regions of BF injury location. Training and rehabilitation for regions 1 and 6 is different compared with 3 and 5.

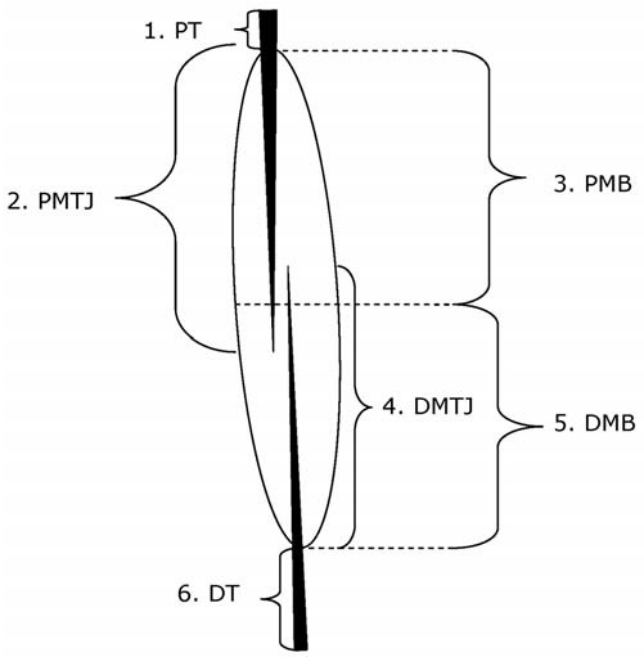

Figure 1. Schematic drawing in the frontal plane of the muscle-tendon complex of the long head of biceps femoris showing the 6 different regions used when analyzing the injury location and tissues involved: 1. proximal tendon (PT), ie, free tendon proximal to muscle fiber attachment; 2. proximal muscle-tendon junction (PMTJ), defined as the proximal intra-muscular tendon and attached muscle fibers; 3. proximal muscle-belly (PMB), ie, muscle proximal to the midpoint of the whole muscle-belly; 4. distal muscle-tendon junction (DMTJ), defined as the distal intramuscular tendon and attached muscle fibers; 5. distal muscle-belly (DMB), ie, muscle distal to the midpoint of the whole muscle-belly; and 6. distal tendon (DT), ie, free tendon distal to muscle fiber attachment. (from Am. J. Sports Med. 2007; 35; 197-206)

Using new sensor technologies can be useful for training/adaptation efficiency and monitoring the long-term influence of practicing/training as well as for early functional diagnostics.

MUSCLE EXHAUSTION IN ELITE SPORTS

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Muscle fatigue or physical fatigue is a decrease in the muscle‘s ability to generate force. Muscle fatigue or muscle exhaustion is a normal and expected effect of training in professional athletes or beginners as it may have an impact on the athlete’s further progress, will, routine, habits, and motivation. The condition is mostly present in cases of incorrect exercise and athlete’s expectations at a time, when muscle exhaustion is already present. Exercise can result in exhaustion; however, abnormal fatigue can also be a result of obstructions or disturbances at different stages of muscle contraction. There are two main causes of muscle fatigue: limited nerve’s ability to generate a sustained signal (neural fatigue) and reduced ability of the muscle fibre to contract (metabolic fatigue). The latter is more commonly known and responsible for most cases of exhaustion among athletes. It usually develops in the late stages of training and is typically conditioned by the reduced input of nutritional substances to/into the muscle and excessive accumulation of metabolic waste products in muscles (H^+, Pi, lactic acid). In addition to the already mentioned muscle fatigue factors, the impaired muscle function is also affected by reduced stock of energy sources (glycogen, phosphocreatine), body temperature, inappropriate hydration, blood circulation or its redistribution in the body during certain exercise stages.

It is of great importance to identify the signs of muscle fatigue and to adopt further exercise with sufficient and proper cause-oriented recovery (substitution of energy sources, rest, rehydration…). We need to be aware that only a well prepared muscle and body can be exposed to intense activity in order to progress. Muscles are therefore exposed to minor risk of injury and unexpected exhaustion leading to better results and improve of motivation.

BIOREACTOR-BASED TISSUE ENGINEERING IN SPORTS MEDICINE

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The restoration of damaged tissues remains one of the biggest challenges in modern clinical orthopaedics. This is especially true for the athletic population and the more expeditious and efficient recovery is imperative. One the most difficult clinical scenarios for a treating surgeon is damaged articular cartilage which results in pain, swelling and restricted range of motion of the affected joint. There is no pharmacological treatment that promotes the repair of the cartilage, and the non-operative treatment inevitably leads to the development of premature osteoarthritis.

Current treatment modalities include bone marrow stimulating techniques (microfracture), autologous chondrocyte implantation (ACI), and transplantation of ostechondral grafts, each having their own benefits and shortcomings. Although effective in relieving pain and improving joint function, original versions of these modalities have failed to regenerate true hyaline cartilage, and it is necessary to introduce improvements to the existing methods, as well as to develop new and innovative approaches.

The in vitro production of osteochondral grafts starting from autologous cells combined with three-dimensional porous biomaterials, is a promising approach for the treatment of osteochondral defects. However, the quality of ex vivo generated cartilage and bone-like tissues is currently restricted by a limited understanding of the regulatory role of physicochemical culture parameters on tissue development.

By allowing reproducible and controlled changes in specific biochemical and biomechanical factors, bioreactor systems provide the technological means to reveal fundamental mechanisms of cell function in a three-dimensional environment and the potential to improve the quality of engineered tissues. In addition, by automating and standardizing the manufacturing process in controlled closed systems, bioreactors could reduce production costs and thus facilitate broader clinical impact of engineered osteochondral grafts.

EFFICIENCY OF PHYSIOTHERAPEUTIC MODALITIES FOR ATTENUATION OF MUSCLE ATROPHY AFTER INJURY OR SURGERY IN LOWER LIMBS

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Skeletal muscle weakness is inevitable negative effect of injury, disease or surgery of joints. Key factors of muscle deconditioning are 1) muscle atrophy and 2) arthrogenic muscle inhibition (AMI); however their interaction and underlying mechanisms are still poorly understood. The AMI peaks few days after injury or surgery; thereafter a minor attenuation takes place which plateaus for up to 6 months. Further and more progressive attenuation of AMI sets in only after this period and is completely abolished within 2 to 4 years after the event 1. The AMI has been demonstrated to affect Quadriceps Femoris (QF), but is absent in hamstring muscles 2. However, the role of AMI in development of muscle weakness, especially after ACL injury or reconstruction, remains equivocal. Recent studies showed that muscle atrophy nevertheless attributes more to QF strength deterioration than AMI 3,4. Physiotherapeutic modalities aim to reduce one or both key factors of muscle weakness through various physiological pathways. Therefore the efficiency of each modality depends on the primary cause of muscle weakness in a given individual. In case where AMI is predominantly caused by reflex neural inhibition, peripheral neuromuscular electric 5,6 and magnetic 7 stimulation used in conjunction with voluntary muscle contraction proved efficient. The inhibitory neural inflow from the swollen joint can be attenuated prior to muscle activation by application of criotherapy 8,9, TENS 9,10 or non-loaded continuous movement of the affected joint 11. If AMI is primarily driven by inhibition of upper motor neurons, transcranial magnetic stimulation of motor cortex has been shown effective 12,13, however technical and economic limitations of the modality hinder more widespread clinical use. In case of predominant muscle atrophy, the range of effective modalities is substantially narrowed due to contraindications for standard high-load resistance exercise. Low-load resistance exercise with blood flow restriction in active muscles (ischemic exercise), has been proven as effective alternative to conventional high-load exercise in improving muscle strength and hypertrophy 14,15, as well as augmenting muscle endurance and oxygenation 16,17. Given that disuse muscle atrophy affects primarily Type I fibres and adjacent muscle capillary network 18, there is a lot of therapeutic potential in this novel modality. Efficiency and safety of ischemic exercise in various pathologic conditions is currently under investigation worldwide.

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SKELETAL MUSCLE REGENERATION AS A CHALLENGE IN SPORTS MEDICINE

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Musculoskeletal injuries that result in the necrosis of muscle fibres are frequently encountered in clinical and sports medicine. Despite the clinical significance, current therapeutic options remain rather conservative and include the R.I.C.E. (rest, ice, compression, elevation) principle or the controversial therapy using corticosteroids as well as non-steroidal anti-inflammatory drugs.

Injured skeletal muscle has regenerative capacities and can repair spontaneously; however, this process is often incomplete because of overgrowth of the extracellular matrix and deposition of collagen, which leads to significant fibrous scarring. Fibrotic remodelling further limits the functionality of the muscle and represents a significant risk factor for the injury to recur.

Fibrotic effects of TGF-β are balanced by decorin, a component of the extracellular matrix of all collagen-containing tissues. It has been shown that decorin inhibits both TGF-β as well as myostatin (MSTN), which is another skeletal muscle-specific member of the TGF-β superfamily. Both cytokines up-regulate the expression of each other and inhibit the activation of satellite cells, myoblast proliferation as well as their myogenic differentiation. Alternatively they promote fibroblast commitment.

It has been shown in in vitro and in vivo studies that drugs with anti-fibrotic properties that can prevent or minimize scar formation have potential as standalone or as adjuvant therapies. In the next chapters different agents are being described for which has been reported to have beneficial effect in muscle healing after injury.

Although none of the antifibrotic agents to improve skeletal muscle regeneration have to date been tested on humans its clinical implications are potentially far-reaching and include not only sports-related injuries, but also diseases such as the muscular dystrophies and trauma- and surgery-related injury. However, before being applied in clinical practice, more in vitro and in vivo studies will probably have to take place. With emerging novel therapeutic targets this is an important area of research and presents basis for further possibilities to study different mechanisms of action and effects drug combinations for improving muscle regeneration.

MANAGEMENT OF MUSCULOSKELETAL CONDITIONS IN YOUNG ATHLETES

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INTRODUCTION

Participation in youth sports is increasing in Western countries. It is not uncommon nowadays for teens or even preteens to train for more than three hours daily or more than 20 hours each week. Engaging in sports activities at a young age certainly has many health benefits but involves also risk of injuries. On one hand they are prone to injury due to nonlinearity of growth, maturity associated variation, the adolescent growth spurt and unique response to skeletal injury. On the other hand the immature coordination, skills and perception (incl. vision and attention) may impose additional injury risksspecially in the situation of very frequent and intense training and competition. Therefore, knowledge about specific physiologic characteristics, information regarding orthopaedic and non-orthopaedic conditions and injury prevention guidelines is necessary for all individuals involved in the care of young sportspeople.

The uniqueness of the musculosceletal system of young athlete is described, the brief overview of the commonest tipes of injuries is presented and finally, the chronic injury of distal radial growth plate is described in more details.

NONLINEARITY OF GROWTH

Children are not miniature adults. The normal growth pattern is nonlinear. At birth the relative contribution of head and trunk to total stature is highest and this declines through childhood into adolescence. Although the data are lacking it seems logical to presume that a »top-heavy« child would be at increased risk of falling, head first, off a bike or a horse. In combination with weaker neck muscles and thinner frontal and temporal boneschildren and adolescents may also be more vulnerable to head injury and concussion.

MATURITY-ASSOCIATED VARIATION

Children of the same chronological age may vary considerably in biological maturity status, particularly during adolescence. Consequently teh functional and performance advantages of early-maturing boys in sports requiring size, strength and power are well known. Similarly late maturing girls tend to exel in sports like gimnastics, where small stature is beneficial. Additionally, chronological age per se may add yet another dimension of individual variation given that most youth sports are categorized by chronological age. Within a single age group, for example, the child who is 12.9 years of age is likely taller, heavier and stronger than the one who is 12.0 years of age, even though both are classified within the same age group. The studies confirmed that late maturing boys sustained a significantly greater incidence rate of major injury in football than their early maturing counterparts.

UNIQUE RESPONSE TO SKELETAL INJURY

There are some significant differences in the type of injuries sustained by children and adolescents because of the differences in the structure of growing bone compared with adult bone. 1. The metaphysis of long bones is more elastic . Thus, children tend to suffer incomplete fractures of the greenstick type. 2. The junction between the epiphyseal plate and the metaphysis is vulnerable to disruption. During the adolescent growth spurt, additional structural changes in physeal cartilage occur that result in more fragile epiphyseal plate. The incidence of physeal fracture is therefore increased during pubescence. 3. Tendon attachment sites – apophyses – provide a relatively weak cartilaginous attachment, predisposing to the development of avulsion injuries. 4. The cartilage of growing bone is thicker and can remodel.

As a result of these differences, a particular mechanism of injury may result in different pathological conditions in the younger athlete compared with the mature adult. The younger athlete is more likely to injure cartilage and bone, or completely avulse an apophysis than to have a significant ligament sprain. Some typical injuries/conditions of the younger athletes are: apophyseal avulsion of anterior inferior iliac spine or ischial tuberosity, fractured distal femoral or proximal tibial epiphysis, slipped capital femoral epiphysis, Perthes‘ disease, osteochondritis dissecans, Osgood-Schlatter lesion and Sever‘s lesion.

AVULSION FRACTURES

Avulsion fractures most often occur at the apophyseal attachment of large musculotendinous units or at the ligament attachments. The common sites in the lower extremity are at the attachments of sartorius to the anterior superior iliac spine, rectus femoris to the anterior inferior iliac spine, hamstring to the ischial tuberosity and iliopsoas to the lesser trochanter. In the upper extremity the most common injuries involve the olecranon and medial epicondyle of the humerus.In the younger athlete, apophyseal fractures are the equivalent of acute muscle strains in the adult. Instead of a tear of the muscle fibers in the midsubstance of the muscle or at the musculotendinous junction, the tendon is pulled away with its apophyseal attachment. Management is identical to that for grade III tears of the muscle. It involves initial reduction of the pain and swelling, restoration of full

range of motion and active range of motion exercises as symptoms settle, as well as graduated program of muscle strengthening. Any biomechanical abnormalities that may have predisposed the athlete to this injury should be corrected. Reattachment of the avulsed fragment is rarely necessary.

PHYSEAL FRACTURES

Both acute and chronic physeal injuries related to participation in sports occur. Most acute physeal injuries appeared to resolve with treatment and rest. However, there is also evidence of growth disturbance and deformity. The example of chronic growth plate injury that appears to occur through repetitive loading is described in the next section.

Distal radial epiphyseal plate injury

Dorsal wrist pain is commonly seen in young gymnasts. The most common cause is chronic distal radial epiphyseal plate injury. The epiphyseal blood supply compromise is probably the common cause of the condition. Other causes of dorsal wrist pain in gymnasts include scaphoid impaction syndrome, dorsal impingement syndrome, tear of the triangular fibrocartilage complex, stress fractures and osteochondrosis of the lunate bone.

When longstanding, the radial epiphyseal plate injury is associated with radiographic changes that include widening, irregularity, haziness, or cystic changes of the growth plate. The pain is aggravated by weight-bearing with the wrist extended. The longstanding condition may lead to premature closure of distal radial growth plate leading to positive ulnar variance and possibly to further injuries such as triangular fibrocartilage complex tear. The high level gymnasts who are taller, heavier and with higher muscular mass tend to eventually present more positive ulnar variance. The pommel horse and floor exercises expose the wrist to most unfavourable repeated loads with relative large compressive static and dynamic forces. However, the distraction forces at vault exercise may be harmful as well. The negative ulnar variance in young age might be the predisposing factor for premature closure of the distal radial physis. As the strong handgrip and forearm pronation results in proximal migration of the radius and an increase in ulnar variance these two factors may be beneficial in avoiding the injury. The other preventive measures are reducing the training loads and delaying some skill progressions for young gymnasts during growth spurts. Coaches should also use a variety of drills to avoid excessively repetitive movements and emphasis should be on quality of workouts rather than training volume. During the sensitive phases of rapid growth foam beam covers and padding vault should be used to absorb the shock of impact. Finally, training and skill development should be individualized in accordance with the maturation status of the gymnasts.

Management of the younger gymnasts with dorsal wrist pain includes relative rest,electrotherapeutuc modalities and nonsteroidal anti-inflammatory drugs. Strengthening of the wrist flexors may also be useful inassociation of tape or splints to decrease hyperextension of the wrist.

General strategies for growth plate injuries prevention

Beside the measures already mentioned there are some additional considerations that apply to acute and chronic physeal injuries in general. Periodic physical examinationshould be carried out so that injuries can be diagnosed at early stage and modification made to the training programme. Careful measurement of height (preferably in the morning and not after a workout) at three months interval could provide coaches with data to estimate growth rate.When indicated, radiographs of symptomatic physeal areas should be administered. Physical conditioning, including strengthening, range of motion and proprioceptive exercises may help to reduce both acute and chronic physeal injury. Periodisation of training with well defined rest periods may also help to reduce stress related physeal injuries and prevent overtraining. After acute epiphyseal injury involves a joint, it is recommended that the child not participate in contact sports for at least four to six months. Finally, in the case of pain around the joint, a child should never be allowed or expected to »work through the pain.«

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RECOVERY AFTER FOOTBALL: SHOULD WE FOLLOW THE NUTRITION GUIDELINES ESTABLISHED FOR ENDURANCE ATHLETES?

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Recovery is important whenever an exercise task has to be repeated: for athletes, this means that they are in almost constant recovery mode due to the short interval between training sessions and competitions. Most football players train daily, with two sessions per day being common in the pre-season. Matches typically occur once or twice per week, limiting the training load that can be tolerated. The established recommendations for recovery have focused on replenishment of the body's carbohydrate stores and on restoration of water and electrolyte balance. This assumes that a substantial depletion of the muscle and liver glycogen stores has taken place and that substantial sweat losses have occurred. It also assumes that a conscious effort and specific nutrition plan are necessary to achieve effective recovery rather than eating normal meals and relying on sensations of hunger and thirst. These recommendations, however, are generally based on extreme running or cycling exercise carried out in a temperate environment. The limited evidence available suggests that glycogen depletion does not occur to the same extent in typical football activities, so players may be more relaxed about the timing and amount of their dietary carbohydrate intake after training and match play. Sweat losses vary greatly between individuals and also with environmental conditions suggesting that general recommendations have little value for individual players. Recovery nutrition must also take account of the need for intake of protein to promote metabolic adaptations in muscle and other tissues, to minimise muscle damage and to promote good immune function.

REHYDRATION AND RECOVERY AFTER FOOTBALL TRAINING AND MATCH PLAY

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Abstract

Sweat rates in the order of up to 2 litres per hour with total losses amounting to 3 litres have been seen in football players when training and playing in warm environmental conditions. At the other extreme, when conditions are cool or cold, some players will lose very little sweat. But this is not the case for all, particularly if significant amounts of clothing are worn. The hydration needs of individual players are different and will vary with the weather over the season, thus an individualized drinking/hydration strategy may be desirable.

If possible, most players should limit dehydration during training and matches by drinking. Water or a sports drink are the most common choices. Obvious opportunities to drink during a match include the warm-up and at half time. During training, the coach or manager should organise drink breaks according to the weather and intensity of the session.

Training allows opportunities for players to get a feel for their sweat rates and fluid needs so that drink practices can be established. It is not necessary to drink enough to match sweat loss, but the amount of dehydration should normally be limited to a loss of less than about 2% of body weight (ie, 1.0 kg for 50 kg person, 1.5 kg for a 75 kg person, and 2 kg for a 100 kg person).

The negative effects of dehydration on high intensity performance are greater in warm environments, so drinking practices in these conditions should be of particular importance. This may include drinking at the side-line when match play is interrupted, or having extra drink breaks during training sessions.

There should never be a need to drink more than the sweat loss so that weight is gained during exercise. This will not help performance and is likely to cause gut discomfort.

Depletion of the body's carbohydrate stores can be an issue for football matches, especially for players who do a significant amount of running. These players may want to choose a drink containing some CHO to help provide this fuel source at the same time as providing water for hydration. Sodium should be included in fluids consumed during exercise lasting longer than 1-2 hours or by individuals during any event that stimulates high salt losses. You can recognise "salty sweaters" by the salt rings on their clothes at the end of a hard session on a hot day. Players who lose a lot of salt may be more prone to muscle cramps. Adding a little extra salt to food and drinks and using the higher sodium version of sports drinks may reduce the risk of cramping for these players, but probably does not benefit other players.

Recovery after a training session or match is usually part of the preparation for the next exercise session, and replacement of sweat losses is an essential part of this process. Both water and salts lost in sweat must be replaced. Drinking about 1.2-1.5 litres of fluid for each kg of weight lost in training or matches should promote full rehydration. Drinks should contain sodium (the main salt lost in sweat) if no food is eaten at this time, but most meals will contain adequate amounts of salt. Sports drinks that contain electrolytes can be helpful, but many foods can also supply the salt that is needed.

NUTRITION GUIDELINES FOR STRENGTH AND POWER SPORTS, ANYTHING USEFUL FOR FOOTBALL?

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Abstract

Introduction

Scientific findings about the underlying mechanisms of various physiological phenomena induced by exercise, including the recovery process, are the basis for nutritional strategies adjusted to the specific demands of every athlete and to specific sports discipline. The strategically adjusted consumption of key nutrients, depending on the specific needs of an individual, aims to enhance athletic performance and regeneration, thus allowing an athlete to reach his or her full genetic potential and benefit from physical activities. This is even more important for complex and demanding sports as is football, which alternate in duration and intensity.

Nutritional strategy for football

An appropriate strategy for nutritional support in football can be developed as a combination of general recommendations from the field of clinical sports nutrition for energy intake, amounts and composition of nutrients and fluid intake, and recommendations specific for the power and strength sports. Despite football is from the point of duration basically the endurance type of sport activity, many elements of strength and power sports are included also, as acyclic movements such as sprints, jumps, and hits.

For these intense exercise events during football game the high power output is required and nutritional support should be adapted to this high metabolic demands.

Table1. represents key elements of nutritional periodization during different training periods for power and strength sports (adapted from 2). Basic nutritional principles from this strategy are useful also for football training.

Training phase	**General preparation**	**Specific preparation**	**Taper / Competition**	**Transition**
Training/ competition goal	High training volume (~5-12 h/week)	Moderate training volume (~4-10+ h/week)	Low training volume (~3-10+ h/week)	Very low training volume
	Aerobic energy system development Lower training intensity	Anaerobic system development Race specific pace Training competitions	Race specific intensities Neuromuscular power	Very low intensity
	Mixed training modalities	Specialized training/ altitude camps	Competitions	Recovery training to prevent over-reaching
Resistance training periodization	High-volume, high-force, low velocity training	More explosive, lower force, low repetition training	Competitions	
Nutritional goals	High energy intake to support training ~ 50-70kcal/kg/d	Nutrition to support high intensity training ~ 42-64 kcal/kg/d	Nutrition to support high intensity racing ~ 40-60 kcal/kg/d	Nutrition for active individuals ~ 28-42 kcal/kg/d
	Recovery after training	Specific support/recovery for key training sessions	Support recovery after races	
Daily target	To reach optimal body composition	Preparing specific nutritional strategy for competition period	Avoiding weight gain with lower training volume	Minor weight gain
(g/kg BW/d) **CHO**** **PRO***** **fat**	~ 6-12 (4-7)* ~ 1.5-1.7 ~ 1.5-2	~ 6–10 (4-7)* ~ 1.5-1.7 ~ 1-1.5	~ 6–10 (4-7)* ~ 1.5-1.7 ~ 0.8-1.2	~ 4-6 ~ 0.8-1.2 ~ 1–1.2

strength sports, CHO** carbohydrates, PRO protein**

Table1. Nutritional periodization

Table2. represents recommendations for recovery nutrition in different training situations (adapted from 3). For recovery after football play the nutritional recommendation for CHO and PROT intake after long/aerobic and intensive short duration can be applied.

	Long aerobic/ endurance training	**Intensive short duration or prolonged resistance training**	**Technical drills/ short duration resistance training**	**Situations of short recovery (<4h)**
Exercise characteristics	Prolonged aerobic exercise (>1h)	High intensity exercise (20-40min)	Low volume of explosive movements	Multiple races or training sessions on the same day
Primary metabolism	Oxidative metabolism (fat,CHO)	Non-oxidative glycolytic (CHO)	Glycolytic and phosphagen (PCr+CHO)	
Training objective	Enhance oxidative enzymes, fat metabolism, endurance Energy replacement (fat, CHO)	Enhance: glycolytic enzymes, buffering capacity, lactate tolerance, muscle power Energy replacement (CHO)	Submaximal and maximal muscular strength, technique and economy development Energy needs are low	Specific to training and racing demands Some energy replacement (CHO)
Specific recovery needs	Carbohydrate intake of primary importance for glycogen re-synthesis Protein for muscle recovery and re-modelling	Carbohydrate intake of primary importance for glycogen re-synthesis Protein for muscle recovery and re-modelling	Lower carbohydrate needs (some glycogen re-synthesis) Protein for muscle recovery and re-modelling	Carbohydrate intake of primary importance for glycogen re-synthesis Focus on foods that are GI tolerable for subsequent exercise (minimize Fat, PRO intake)
Macronutrients recommendations (within 2 hours) **(g/kg BW)**	CHO* ~ 1.2-1.5 PRO** ~ 0.3 fat ~ 0.2- 0,3	CHO ~ 1.2-1,5 PRO ~ 0.3 fat minimal requirements	CHO ~ 0.5-1,0 PRO ~ 0.3 fat minimal requirements	CHO ~ 1.2-1.5 PRO minimal requirements fat minimal requirements

CHO* carbohydrates, PRO protein**

Table2. Recommendations for recovery nutrition

Conclusion

Ensuring strategic energy and nutrient availability at critical training points is important for optimal training, regeneration and competitive performance but is also essential for immune system protection and injury prevention, and prevention of over-reaching and over training.

The intake of energy and macronutrients must be personalized according to athletes' training periodization and individual responses to specific training stimuli and characteristics.

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REGENERATION IN ENDURANCE SPORTS – PHYSIOLOGICAL MARKERS OF OVERTRAINING SYNDROME

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Athletic training aims to improve physical performance to its upper limit, which necessitates a large training load, both in terms of high training volumes and intensities. In turn, for the optimal athletic training sufficient recovery to restore homeostasis and induce training adaptations is required. The usual mismatch in athletic training involves too large training load with insufficient recovery. This results in the state of nonfunctional overreaching and, when continued, in overtraining syndrome (OTS). Most research on OTS has focused on endurance sports.

OTS represents the sum of multiple life stressors, not only the physical training, but also sleep loss, exposure to environmental stresses (heat, high humidity, cold, and high altitude), occupational pressures and interpersonal difficulties. Functional alterations of pituitary-adrenal axis and autonomic nervous system play a critical role in the development of OTS and in manifestation of its symptoms. The definitive diagnosis of OTS always requires the exclusion of an organic disease, e.g., endocrinological disorders, iron deficiency with anaemia, infectious diseases or feeding behaviours.

Several potential biochemical, hormonal, physiological, psychological and immunological markers have been proposed to indicate OTS. A decreased sport-specific and ergometric performance (decreased VO2 max) is a hallmark feature of OTS. A small decrease in maximal heart rate and maximal blood lactate production as well as an increased heart rate at rest have been reported. However the latter was not confirmed in more recent prospective studies. Heart rate variability (HRV) – the variability in beat-to-beat changes of the heart rate – is another physiological variable that has been studied extensively.

HRV reflects cardiac autonomic balance and disappearance of variations between consecutive heart beats was shown to be associated with neurological, cardiovascular and psychiatric disease states. A large body of evidence is reporting that higher variability of heart rhythm is associated with reduced mortality, improved quality of life and better physical fitness. A number of studies have therefore examined the effects of training on indices of HRV, but to date only a few have investigated HRV in overreaching and OTS. They showed either no change, inconsistent changes or changes in parasympathetic modulation. This inconsistency is evidently dependent on the severity and duration of overloading as well as on different methodologies of assessing the HRV and future studies are needed to shed light on the field.

Because it is speculated that a continuum exists between training fatigue, overreaching and OTS, it would be invaluable to identify tools which can lead to an early diagnosis of overreaching/OTS Although at present no single marker can be taken as an indicator of impending OTS, the regular monitoring of a combination of performance, physiological, biochemical, immunological, and psychological variables seems to be the best strategy to identify athletes who are failing to cope with the stress of training.

NUTRITION AND PHYSICAL THERAPY

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Abstract

Physical therapy in health profession is the treatment or management of physical disability, malfunction, or pain by exercise, massage, hydrotherapy, etc., without the use of medicines, surgery, or radiation.

Methods which are used in physical therapy are in the tight connection with metabolic processes in the body. Therefore their optimal effect demands adequate intake of energy and other metabolic substrates regarding the person's/patient's nutritional and metabolic status, and the type, intensity and duration of physical therapy. Proper nutritional support during physical therapy can make a difference in the treatment outcome.

When physical therapy is performed in patients, the physiotherapist must be familiar with the basic features of his medical condition which may have a direct effect on metabolic processes. For nutritional strategies during physical therapy the dietary recommendations for specific population must be considered. The population with highest risk represent children, elderly and patients with polytrauma or other serious medical condition. Top athletes are also nutritionally high risk group because their highly trained body can have higher metabolic demands as average person. They also need fast and the most effective recovery to return back to professional sports. Individuals with special diets are another group which frequently needs special attention regarding energy and nutrients intake.

The initial level of nutritional treatment is a nutritional screening, which is carried out with a suitable tool. For assessing the nutritional risk in patients we can use the questionnaire NRS 2002, for elderly MNA (mini nutritional assessment) and in the general population MUST (a malnutrition universal tool). It is particularly important to detect nutritional risk in all risk groups where appropriate nutritional support is crucial to the success of many procedures of physical therapy.

The basis for an adequate nutritional strategy is normal food intake with emphasize on sufficient protein intake. For example, when the purpose of the physiotherapy is to improve muscle function in the elderly, it is necessary to understand and know the basic dietary recommendations for power and strength sports. It is also necessary to know when there is an indication for using specific nutritional supplements as amino acids, β-hydroxyl β-methyl butyrate, creatine, omega-3 fatty acids, and vitamin D.

Nutritional support and physical therapy are important therapeutic tools to improve functional status and health. Therefore, it is important to combine knowledge of the two areas: sports clinical nutrition and physical therapy.

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REGENERATION IN HIGH-LEVEL SPORT (EVIDENCE BASED)

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INTRODUCTION

The carefully selected and high-quality nutrition brings many advantages for athlete and help to support consistent intensive training and regeneration, while limiting the risks of illness or injury. The amount of energy intake from each macronutrient (carbohydrate, protein, fat), micronutrients (especially vitamins, minerals, antioxidants) and water should be balanced and individually assessed, based on: sex, age, type of training (frequency, intensity and duration), environmental factors, genetic factors, etc. In addition, it is necessary to take into account the athlete‘s body composition, athletes‘ performance and complex situations, such as extreme long lasting effort and competition, which may distort gastrointestinal absorption. Top athletes should follow individually designed food intake plan, which contains an appropriate amount of each nutrient and energy according to the specific requirements of their sport.

The energy needs of athletes consist of basic metabolic requirements, such as: the energy that is required for cellular function, regulation of temperature and the immune system, growth, development, and physical activity. The intensity, duration, frequency of training sessions and competitions significantly determine the daily energy needs of the athlete. When the daily energy intake (carbohydrates, fats, proteins) matches to the energy consumption, we talk about “energy balance”. Another term used in sport nutrition “energy availability” refers to the amount of energy left over and available for the body‘s functions after (energy expended for training is subtracted from the energy consumed). In the young and health adult energy availability is approximately 45 kcal/kg BM.

Nutrition and metabolic changes during exercise

Food represents a source of nutrients that allow the physiological response of the body during exercise, including: increase in energy metabolism, supply of oxygen and substrates, muscles contractions, removal of metabolites and heat, and maintainance of fluid and electrolyte balance in the body. Two main metabolic processes are present in the body: anabolism (building process, crucial for the growth and development of the organism) and catabolism (decomposition process, crucial for the production of energy), which is more intense during the sports activity. Energy is generated in two main ways: an aerobic mode, where energy is released in the presence of oxygen (processes involving glucose, fatty acids and less protein metabolism - gluconeogenesis), and anaerobic mode, where energy is released without the presence of oxygen (part of adenosine triphosphate (ATP), kreatinfosfat (CP) and glucose - lactic anaerobic glycolysis). In the most metabolic conditions two pathways are simultaneously active and the rate of energy generation depends upon the intensity and effort. Carbohydrates are especially important in intensive efforts since fat can not be used in the anaerobic metabolic processes. However, fats have an important role in aerobic metabolism, since they may ensure important role in fat metabolism of the aerobic glycogen supplies for longer time periods during long-lasting training. Besides, their adequate supply may prevent fatigue.

ENERGY AND BODY FAT

It is essential to assure adequate amount of energy, which is determined with the baseline metabolism (on average 2500 kcal or 10 MJoules per day for a young healthy adult), and the additional energy due of training, which may reach to about 1500 kcal (6 MJ) in the case of hard training session in top professional football players. The variation between individuals is large, and daily energy demand may also reach 5000 kcal in the pre-season training in some players. However, the usual daily energy demand is much less during the year, therefore players should be aware to balance the energy consumed based on their schedule. The energy demand is influenced by many factors, therefore it is difficult to make recommendations for individuals without assessing activity patterns. In practice, it is almost impossible to prescribe energy intake from estimates of energy expenditure. Stable body weight and body fat content are reliable indicators of the adequate energy intake. It should be also noted, that there is no single value of body fat content, which is appropriate for all individuals. Some players will perform at their best with values that are higher than the average. In addition, some players might be over-concerned with their physique and appearance (ideal body image) and if this compromises performance or health, staff must intervene. If there is a need to reduce body fat, this is usually apparent at the start of pre-season, and necessary changes to diet and training are performed to achieve the desired body constitution without affecting playing performance. Weight loss supplements and “fat burners” to achieve the target weight is strongly discouraged since most of these supplements are not beneficial and carry the risk of illness, especially liver damage.

CARBOHYDRATES

Carbohydrates (CH) are essential but short-lived energy source that need to be constantly replaced mostly in the form of glycogen in muscles and the liver. Recommendations for CH consumption should not be interpreted as a percentage of daily energy intake, as this do not relate to the real needs of the athlete. Adequate intake of CH is determined based on the player’s body size and the demands of their training program. However, actual needs are individually specific, and must be fine-tuned to assure adequate energy needs and specific training goals. It is important to get feedback from performance in training and match play to assess whether there is a lack of CH consumption. A high CH intake is essential during periods of hard training, but less is needed for

most of the season and in the off-season. CH can only be stored for the requirements of one day of hard training, therefore each player's everyday eating and drinking plan needs to be regulated to provide enough CH prior and during their training program and to optimize the recovery of muscle glycogen stores between workouts. General recommendations regarding sugars (CH) intake: low effort (0 to 4 hours) : 1 to 2 g / kg body weight / h, low intensity or day of regeneration : 5-7 g / kg body weight / day, moderate to intense training : 7-10 (12) g / kg body weight / day, extreme exercise, which lasts from 4-6 or more hours of 10-12 g / kg body weight / day.

There is reasonable evidence to suggest that appropriate CH intake strategies may help to maintain high CH availability during exercise and prevent its depletion with enhanced endurance and performance. Strategies were conducted to ensure high levels of muscle and liver glycogen prior to exercise, the intake of a CH-rich meal in the hours before training or match play, the intake of CH during games, and the intake of CH in the recovery period. The primary source of CH comes from the diet, and sugar-rich and starch-rich foods can contribute to energy as well as providing other useful nutrients for health and performance. Special sports products containing substantial amounts of carbohydrate provide a valuable nutrition aid in some situations (exercise sessions (low-bulk, conveniently packaged) or in the athlete's lifestyle: portable, non-perishable, minimal preparation).

Strategies to ensure the availability of CH before, during and after training

Strategy	Event / Endurance	Recommendations
General strategy	Preparation for the event, 45 min	7-12 g / kg / in 24 h
Loading of glycogen storage	Preparation, 90 min, endurance	36- 48 g / kg / in 24 h
Rapid regeneration of glycogen storage	Less than 8 hours between two events	1,0 – 1,2 g/kg/hour (4 hours), then regular
Loading of glycogen storage one hour before training/match	> 60 min prior to event	1-4 g / kg (1-4 hours before)

When the period between training sessions is less than about 8 hours (as in twice daily pre-season training for elite players) CH intake, in the form of solids or liquids, should start as soon as possible after the first session to maximize the effective recovery time. In addition, a series of snacks with a high Glycaemic Index during the early recovery phase may also be beneficial. Examples of carbohydrate foods with moderate-high Glycaemic Index include: most breakfast cereals, most forms of rice, white and brown breads, sports drinks and soft drinks, sugar, jam and honey, potatoes, tropical fruits and juices, etc.

During longer recovery periods (24 hours), the pattern and timing of CH-rich meals and snacks do not appear to be critical, and can be organized individually and CH reach food can be balanced over the full 24 hours. It is valuable to choose nutrient-rich CH and to add other foods to recovery meals and snacks, such as protein and other nutrients. These nutrients along with adequate energy intake assist in recovery processes and promote glycogen recovery.

Similar strategies apply to recovery after games, which can be especially challenging after matches that finish late and if there is immediate homeward journey after. Neglecting an adequate CH intake after the game will delay recovery, therefore it is crucial that CH is already consumed before setting off. Low-CH diets have been promoted for athletes in recent years without clear evidence of benefits in performance. Training or playing with low CH availability may increase the risk of injury and illness. When CH consumption do not allow for optimal regeneration, the addition of protein may improve the restoration and storage of glycogen. CH should be substituted during the sport activity if it least more than 60 minutes (CH oxidation during exercise is about 1 g / kg body weight / h). When the exercise is less intense and less than 45 minutes, additional CH is usually not required.

Simple CH, such as table sugar, jam, honey, fruit syrups, sports drinks, sports gels and energy bars, belong to the group of foods with a high glycemic index, which is suitable as a source of quick food preparation (1-2 hours before exercise), an additional source of energy during exercise and for the rapid restoration of glycogen storages. Complex CH, such as fresh and dried fruit, bread, pasta, rice, starchy vegetables (potatoes, corn, legumes), less greasy biscuits, pretzels, breadsticks, biscuits, etc., should represent an all-day nutrition of and athlete, since they are nutritionally richer sources of vitamins, minerals and dietary fiber. They are suitable meal 3-4 hours before exercise, but can cause bloating and cramps due a large amount of fibers.

PROTEIN

Amino acids from proteins are the building blocks for the manufacture of new tissue, including muscle, and the repair of old or damaged tissue. They are also structural precursors for hormones and enzymes that regulate metabolism and other body functions. Protein provides only a small source of fuel for the exercising muscle. However, any excess in the protein consumed will be immediately used as a fuel for energy supply, therefore there is no advantage in eating more protein than it is necessary. High protein diets are not usually harmful, but eating too much protein will displace CH from the diet. The average person needs about 0.6 grams of protein per kg body mass per day (g/kg/d). To ensure adequate amount, the recommendations are set with the safety margin of about 0.8-0.9 g/kg/d. The data about an increased requirement for dietary protein in hard exercise is controversial. Some scientists have suggested that combined endurance and resistance training exercise will increase daily protein needs up to a maximum of 1.2-1.6 g/kg, but some recommend even higher amounts. However, dietary surveys show that most players who eat enough to meet their energy needs already consume diets that provide protein intakes above 1.2-1.6 g/kg/d, even without the use of protein supplements. Therefore,

most players do not need to be encouraged to increase their protein intakes, rather they should be aware that an adequate energy intake is important in promoting protein balance.

Some resistance-trained athletes and body builders consume very large amounts of protein (as much as 3-4 g/kg/d), but there is no evidence that such dietary patterns enhance the response to training or increase muscle mass and strength. Although these diets are not necessarily harmful, in extreme cases it can cause an impairment of other nutritional goals, such as compromising the fuel needed for training and performance. The timing and the total amount of the protein intake seem to have an important consequence for the overall protein synthesis. Studies have found that the intake of small amounts (about 20-25 g) of high quality protein enhances protein synthesis during the recovery period in addition to the CH regeneration. A beneficial effect is already achieved if at least 10 g of protein is consumed after a workout, and is up-regulated when biologically high-quality animal protein (milk, meat, eggs, fish) is consumed in the hours after exercise. It is also important that a positive daily protein balance is assured and that protein food is consumed in all three main meals (breakfast, lunch, dinner). Each main meal should contain at least 20 grams of protein.

The best practice should focus on the total balance of the diet and the timing of protein-CH meals and snacks in relation to training. Special sports nutrition supplements (sports bars and liquid meal supplements) can provide a compact and convenient way to consume CH and protein in several circumstances. There is a little evidence for using protein-only powders or amino acid supplements since everyday diet is likely to be sufficient and perhaps even better because of the wide range of additional nutrients they contain. Each of the following food choices will provide 10 g of high quality protein: 2 small eggs, 300 ml cow's milk, 20 g skim milk powder, 30 g cheese, 200 g yoghurt, 35-50 g meat, fish or chicken.

HYDRATION STRATEGIES

On a hot day and intensive training or in a game sweat losses may reach 3 liters in some players, but usually 1-2 liters with an enormous inter-individual variability. Every player's hydration needs are different and may vary during the season. Recommendations should be specified for each individual athlete in accordance with their unique needs and preferences. Players should aim to limit dehydration during training and matches by drinking water or a sports drink. It is not necessary to drink enough to match sweat loss, but the amount of dehydration should normally be limited to a loss of less than about 2% of body weight (e.g. 1.5 kg for a 75 kg person). However, dehydration, if sufficiently severe, will impair both physical and mental performance, especially in warm environments. The rate of sweating can be estimated by calculating body weight difference (before, after, clothes weighting) and note the volume consumed during the exercise.

Recovery after exercise is part of the preparation for the next exercise session, and replacement of sweat losses is an essential part of this process. Both water and salts lost in sweat must be replaced. By performing regular weighting before and after training or matches players became aware of their typical sweat losses in different environmental conditions. They should aim to drink about 1.2-1.5 liters of fluid for each kg of weight lost in training or matches. Sports drinks that contain electrolytes can be helpful, though the amounts they contain are generally very small and a little extra salt may be added to meals when sweat losses are high, but salt tablets should be used with caution. For most players, some sodium might be included in fluids consumed during matches or in training sessions lasting longer than 1 hour.

It is useful to restore fuel depletion along with rehydration, since it was shown that consuming extra carbohydrate during the match enhances performance and may increase the total distance covered (in total and in sprinting speed). Better intake of fluid and fuel during a game may not only keep players running further and faster in the second half of a match, but it can also help to maintain skills and judgement when players would otherwise become fatigued. The use of commercial sports drinks with a carbohydrate content of about 4-8% (4-8 g/100 ml) allows carbohydrate and fluid needs to be met simultaneously in most events. The intake of carbohydrate that is generally associated with performance benefits is ~ 20-60 g per hour.

CONCLUSION

Carbohydrate is the key energy-providing nutrient that must be optimized during the days leading up to and including the day of competition. Players who start a game with low glycogen stores are likely to end up being substituted before the end of the game. Attention should also be given to optimizing water and salt levels in the body. During the 2-4 days prior to a competition, a player's need for protein and fat, as well as most other nutrients, typically does not increase above the levels that are recommended for normal moderate level training. Players who train and compete intensely may benefit from reduced training loads and ‚carbohydrate- loading' for a few days before a big game. This practice is common in endurance sports, but is less so in football. Very high glycogen levels may not be beneficial, but players starting a game with an inadequate glycogen store are unlikely to perform at their best, therefore glycogen storage should be at least moderate to high. In addition, a varied diet that meets energy needs and is based largely on nutrient-rich choices such as vegetables, fruits, beans, legumes, cereals, lean meats, fish and dairy foods should ensure an adequate intake of vitamins and minerals. The use of dietary supplements is widespread in football at all levels, but the indiscriminate use of dietary supplements is strongly discouraged. A few supplements may bring some benefits to some players in specific situations, but supplements also carry risks to health and performance as well as the possibility of an ADRV.

Naranđa Jakob

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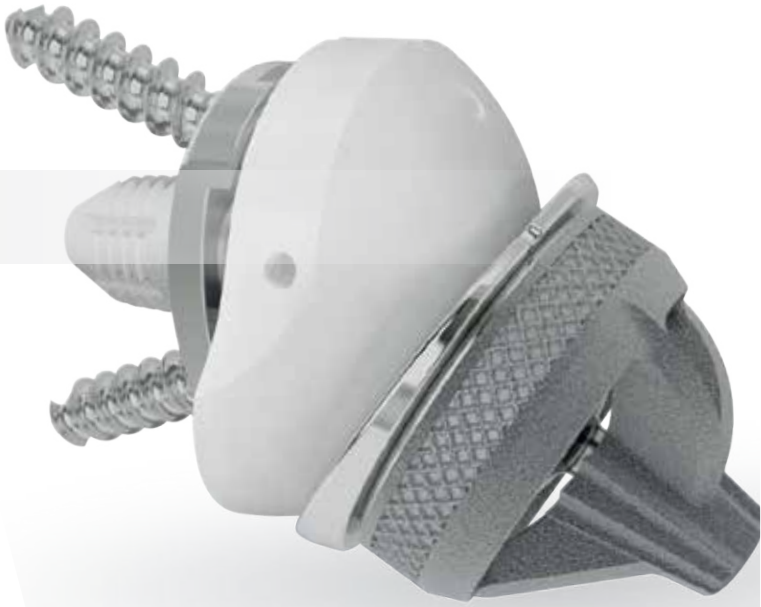

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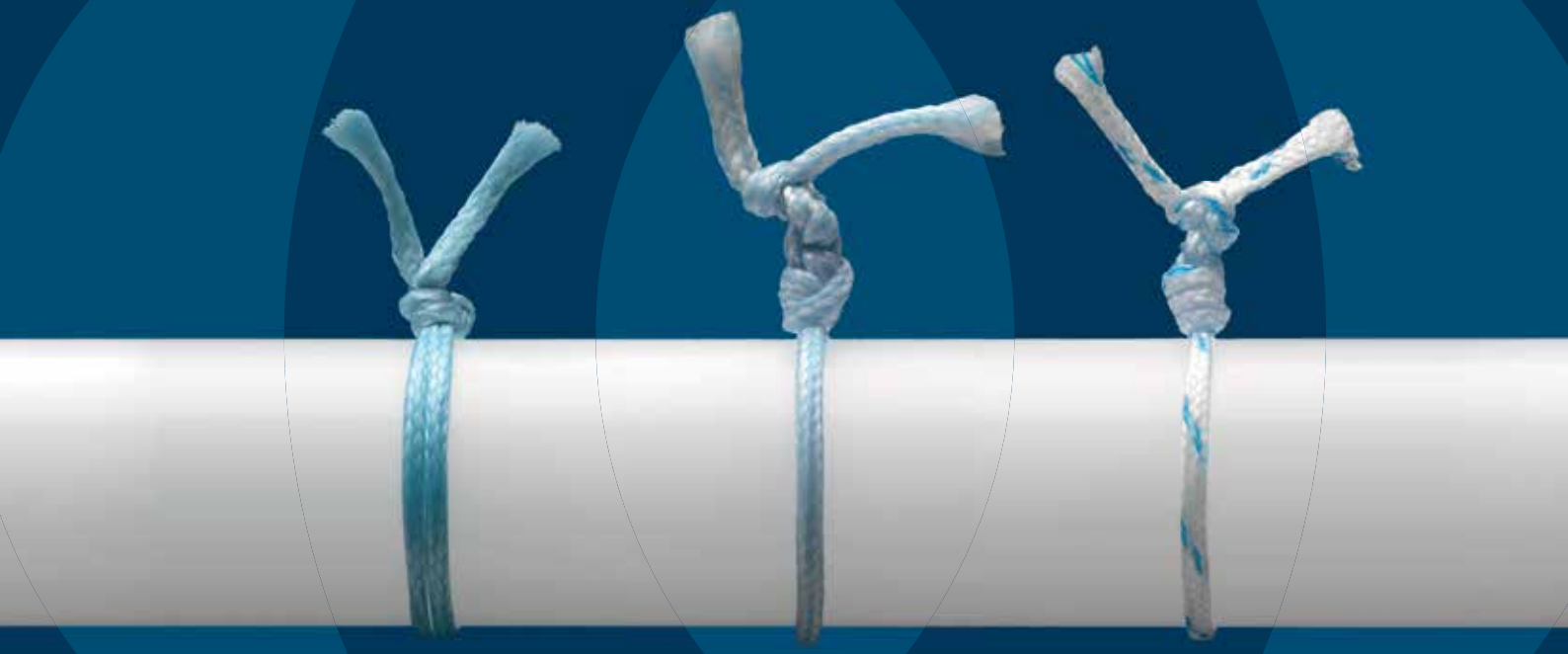

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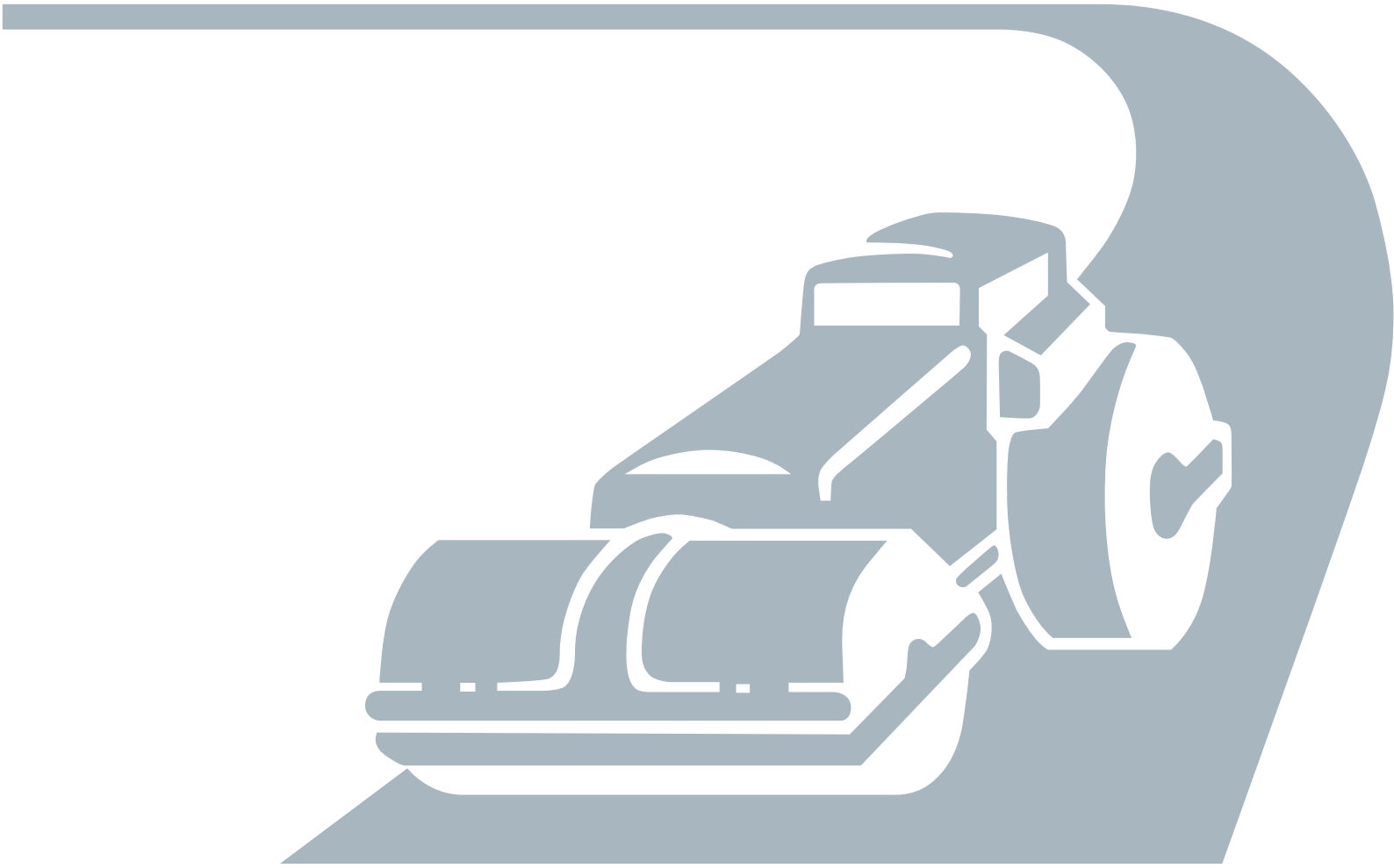

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