

FM 1

Effects of eccentric cycle ergometry training in competitive alpine skiersMicah Gross¹, Hans Hoppeler¹, and Michael Vogt¹¹Institute for Anatomy, University of Bern, Switzerland

Introduction: Eccentric cycling allows high muscle forces to be maintained repeatedly due to the a low metabolic cost. Given that this exercise method has led to significant increases in muscle fiber size and isometric strength in untrained subjects [9] and in patients following knee surgery [16,17], it could also present a lucrative alternative or supplement to weight training in athletes [18-20]. We investigated the effects of replacing a portion of regular weight training with eccentric cycling in elite junior alpine skiers. We hypothesized that this would enhance hypertrophy, strength, power, and muscle stiffness, compared with weight training alone.

Methods: 7 control subjects (CON) executed 3 one-hour weight training sessions per week, which included four leg exercises. The 8 subjects in the experimental group (ECC) performed 3 similar weight sessions per week, however of only 40 min, and of 3 instead of 5 sets of 30 repetitions. For the remaining 20 minutes, ECC trained on the eccentric cycle ergometer. Before and after training, subjects were tested for various anthropometric, strength, and jump performance variables.

Results: Lean mass in the right and left legs of ECC increased by 140.9 ± 107.3 g ($2.1 \pm 1.6\%$, $p=0.008$) and 101.2 ± 98.2 g ($1.5 \pm 1.4\%$, $p=0.02$), respectively but CON experienced no change. CON and ECC improved relative isometric one-leg press strength (knee-angle 85°) by 12.2 ($p=0.02$, $N=6$) and 9.9% ($p=0.04$), respectively, whereas CON (10.1% , $p=0.02$), but not ECC (9.2% , $p=0.07$), did so in absolute terms. Isometric knee-flexion (knee-angle 120°) decreased in both CON (-10.5% , $p=0.02$, $N=6$) and ECC (-5.5% , $p=0.05$). Squat-jump height (SJ) decreased 4.3% ($p=0.03$) in CON but remained unchanged in ECC. Countermovement jump height increased in ECC (6.5% , $p=0.005$), but not in CON. The only significant group \times time effect was found in SJ ($p=0.02$), for which ECC improved on average 1.9% ($p=0.27$). Precision scores for power modulation based on the area under the curve of absolute deviation from the prescribed power during variable eccentric cycling improved $50.4 \pm 19.0\%$ ($p=0.004$) in ECC but remained unchanged in CON.

Conclusions: Eccentric cycling enhanced jump performance more than additional endurance weight training, but not isometric leg strength. Thus, the greatest benefit yielded alpine skiers by this training method seems to be largely related to dynamic factors of performance such as reactivity, neural coordination or possibly muscle stiffness.

FM 2

Altered molecular metabolism of knee joint tissues in a botox induced quadriceps muscle weakness model in the rabbitLeumann Andre^{1,2}, Fortuna Rafael², Longino David², Hart David², Valderrabano Victor¹, Herzog Walter²¹Orthopaedische Universitaetsklinik, Universitaetsspital Basel, ²Human Performance Laboratory, University of Calgary, Canada

Introduction: Knee injuries (e.g. ACL rupture or tibial plateau fracture) occur frequently in sports. Despite good surgical treatments, quadriceps muscle weakness may persist for months. Biomechanically, muscle weakness leads to altered joint homeostasis. So far, only little data are available on the influence of quadriceps muscle weakness on biological adaptations of joint structures, such as ligaments and menisci. Therefore, the purpose of this study was to measure molecular metabolism changes of ligaments and menisci in a quadriceps weakness model. **Methods:** Chronic quadriceps muscle weakness was induced in six one-year old New Zealand White rabbits through monthly injections of Botox (botulinum toxin A) for six months. Five age- and sex-matched rabbits served as controls and were injected with saline using the same injection protocol as for the test group rabbits. Muscle weakness was assessed by measuring muscle weight, isometric quadriceps force, and histologic muscle degeneration for the vastus lateralis muscle. Molecular metabolism was measured in the patellar tendon, medial and lateral collateral ligaments, and medial and lateral menisci by measuring total RNA yields, and nine tissue specific RNA yields (e.g. Collagen I, MMP-III). All analyses were performed using students t-tests with a pre-set level of significance of $\alpha=0.05$. **Results:** Muscle weights were decreased by 46.6% , muscle forces by 58.6 to 61.3% depending on the knee flexion angle, and cross sectional areas of the contractile apparatus by 54.7% (all results $p<0.001$) for the test- compared to the control group animals. Molecular analysis showed significantly decreased overall turn over (MMP-I), and significantly decreased metabolism for anabolic factors (Collagen I, MMP-III, MMP-XIII, TGF β) and reduced injury response (Collagen III, MMP-XIII).

Discussion: Quadriceps muscle weakness leads to adaptive changes in knee joint structures by slowing their overall metabolism, and by adjusting specific RNA activities. In the concept of the joint as an organ, this may reflect a new functional steady-state. Muscular unloading of the knee might impair the biomechanical function of the knee joint and its component structures. This could describe an underlying pathomechanism of the fact, that injured athletes are more susceptible to additional overuse injuries than healthy athletes. Therefore, we suggest that weaknesses of muscles and component joint structures being considered in injury treatment and rehabilitation.

FM 3

Pain in Osteochondral Lesions of the Ankle Joint^{1,2}Wiewiorski, M.; ¹Jacob, A L.; ¹Kretzschmar, M.; ¹Leumann, A.; ¹Horisberger, M;¹Rasch, H.; ¹Bilecen, D.; ¹Valderrabano, V¹University Hospital of Basel, Basel, Switzerland²University Hospital of Bochum, Bochum, Germany

INTRODUCTION: Pain is the key symptom of athletes suffering of osteochondral lesion (OCL) of the ankle. However, its tissue origin and the pain inducing and modulating mechanisms remain controversial. Cartilage is aneural and unlikely causing pain. Contrary soft and bone tissue show rich nociceptive innervations. Routine radiographic imaging of OCL fails to visualize the pain inducing structure. SPECT-CT is a new hybrid imaging technique allowing perfect overlay of functional and anatomical images. In OCL, SPECT-CT identifies the exact location of an OCL and determines the spatial extent of pathological bone remodeling.

METHODS: 15 athletes (7 female, 8 male; mean age 39, range 20-61 years) were assessed for unilateral OCL of the talus (13 joints) or distal tibia (2 joints). Plain radiographs, MRI and SPECT-CT were conducted. Pain status was measured by visual analogue scale (VAS). All patients underwent CT-guided ankle joint injection with local anesthetics and iodine contrast medium. Exact location of the deposit was documented. VAS score was assessed immediately post-infiltration and compared to pre-interventional VAS score. Pain relief was defined as a reduction of VAS score of more than 50% of the pre-intervention score immediately after infiltration.

RESULTS: All infiltrations were technically successful. Pre-interventional VAS score was 5.3 (range 2 - 10; SD 2.33). Post-interventional VAS score was 1.1 (range 2 - 4; SD 1.45). This difference was statistically significant ($p < 0.01$).

DISCUSSION: The results of our study show a highly significant correlation between pain in OCL and pathological uptake seen on SPECT-CT, indicating bone as a major contributor to pain in this disease. Hybrid SPECT-CT technique is a new and powerful approach to diagnosis and staging of osteochondral lesions and provides important data for adequate treatment.

FM 4

Vibration training elicits a mixed aerobic and resistance-type exercise in sedentary subjectsB. Gojanovic¹, F. Feihl², G. Gremion¹, B. Waeber²¹Sports Medicine Unit, Department for locomotor apparatus (DAL), University Hospital (CHUV), Lausanne²Clinical Pathophysiology, Department of medicine, University Hospital (CHUV), Lausanne

Objective. Vibration training (VT) is a new exercise method, with good acceptance among sedentary subjects, due to its passive principle: the machine moves the subject, not the opposite. We hypothesize that untrained subjects can benefit from a greater cardiovascular and metabolic stimulation than trained athletes, resembling classical aerobic-type activity, in addition of eliciting strength gains shown in diverse studies.

Methods. 3 group of male subjects, inactive (SED), endurance trained athletes (END) and strength trained athletes (STR) underwent fitness (VO₂max) and lower-body strength tests (isokinetic). Subjects were submitted to a session of oscillating VT, composed of 3 exercises (isometric half-squat, dynamic squat, dynamic squat with added load), each of 3 minutes duration, and repeated at 3 frequencies. VO₂, heart rate and Borg scale were monitored.

Results. 27 healthy subjects (10 SED, 9 END and 8 STR), mean age 24.5 (SED), 25.0 (STR) and 29.8 (END) were included. VO₂max was significantly different as expected (47.9 vs. 52.9 vs. 63.9 ml/kg/min, resp. for SED, STR and END). Isokinetic dominant leg extensors strength was higher in STR (3.32 Nm/kg vs. 2.60 and 2.74 in SED and END). During VT, peak oxygen consumption (% of VO₂max) attained was 59.3 in SED, 50.8 in STR and 48.0 in END ($P<0.001$ between SED and other subjects). Peak heart rate (% of heart rate max) was 82.7 in SED, 80.4 in STR and 72.4 in END. In SED, dynamic exercises without extra load elicited 51.0% of VO₂max and 72.1% of heart rate max, and perceived effort reached $15.1/20$.

Conclusions. VT is an unconventional type of exercise, which has been shown to enhance strength, bone density, balance and flexibility. Users are attracted by the relative passivity. In SED, we show that VT elicits sufficient cardiovascular response to benefit overall fitness in addition to the known strength effects. VT's higher acceptance as an exercise in sedentary people, compared to jogging or cycling for example, can lead to better adherence to physical activity. Although long-term effects of VT on health are not available, we believe this type of combination of aerobic and resistance-type exercise can be beneficial on multiple health parameters, especially cardiovascular health.

FM 5

Risk factors for the Use of Medication in Elite Athletes¹⁻³P Tscholl^{1,2}, JM Alonso^{3,4}, A Junge^{1,5}, G Dolle³, J Dvorak^{1,5,6}¹F-MARC, Schulthess Klinik, Zurich, Switzerland; ²sportclinic Villa Linde, SOMC Magglingen-Biel, Biel, Switzerland; ³International Association of Athletics Federations, Monaco; ⁴Medical Department, Royal Spanish Athletics Federation, Madrid, Spain; ⁵Schulthess Clinic, Zurich, Switzerland; ⁶Fédération Internationale de Football Association (FIFA), Zurich, Switzerland

Legal and illegal use of medical substances is widespread in international elite sports. Current literature mainly focuses on illegal, hence doping substances. However, concerns about the ample use of painkilling medications, β_2 -agonists, and antibiotics in top-level athletes have been raised by several authors, since their use, not only when administered in excess, may potentially be harmful under certain circumstances or for certain individuals.

Our research shows that as much as 31 – 51% of the athletes are taking some sort of medication, and 20 – 35% are taking nonsteroidal anti-inflammatory drugs (NSAIDs) prior to competition. Although evidence-based guidelines do not exist for the use of medication and NSAIDs in athletes, the reported results are alarming and might suggest an abuse of legal substances. Further analysis of different sports disciplines highlights several risk factors for the high use of medication in athletes. Team physician and geographic origin have the highest influence. African and Asian athletes were found using half of the medication reported by European and North American track and field athletes. Female athlete – without considering contraceptive medication –, physical demands, age, and competition were other parameters related to increased use of medication. No correlation was found between the intake of medication and success. In professional football players, no difference was found between players participating in the match and substitutes. The reported use of medication and the gender and geographic differences are difficult to interpret, since current literature does not provide any conclusive evidence. Whether some athletes are overmedicated or undersupplied with medical substances can not be elucidated and therefore need special regard in the future for equal chances in the competition. However, differentiation between indication, wrong application and misuse of prescribed medication is difficult to ascertain. Therefore, it is absolutely essential to establish evidence-based guidelines for the use of medication, especially of painkilling substances in sport.

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FM 6

Structured running training program for health and performance promotion in hospital employeesC. Daucourt¹, B. Gojanovic¹, G. Gremion¹¹Sports Medicine Unit, Department for locomotor apparatus (DAL), University Hospital (CHUV), Lausanne

Introduction. Our institution (University hospital) is encouraging physical activities for health through various popular sporting events in the city of Lausanne, the biggest of which is a road race of 2, 4, 10 and 20km.

Objective. To create an efficient and sustainable training program in preparation of the race for a group of motivated hospital employees without any prior experience with structured training and to identifying the benefits and limitations encountered.

Methods. Subjects of various fitness levels were recruited by add and agreed to undergo lab and field testing before a 12-week 3 times/week running program, based on maximal aerobic speed (MAS-30/30 sec intervals), running technique exercises and endurance training. The interval session was the only one supervised. Their goal was the 10km (11 subjects) and the 20km (6 subjects).

Results. A group of 17 subjects (7 male and 10 female), mean age 36.6±7.3 years, VO₂max 44.0±5.5 ml/kg/min, field test interval MAS 15.1±2.4 km/h started the program. 2 were lost because of injury (while skiing). Adherence to interval sessions was excellent, although 3 weekly training sessions proved to be difficult for most of the subjects. Performance in the race was satisfying for all of them, 6/7 subjects having improved their running time from the previous year, the others participated for the first time and 7/8 completed the race satisfyingly, one DNF-ed because of sinusitis. Repeat MAS field test was available for 6 subjects, who improved by 5.9% (p<0.01). Subjectively, all of the participants were very satisfied with improvement, interaction with colleagues from various professions, and with self achievement and confidence.

Conclusions. Implementation of a structured training program for recreational or non-athletes can be very successful in creating a better self-confidence, a better working environment inside a hospital facility and obviously in improvement of physical fitness and athletic performance. Above all, it can only encourage health institutions to promote the health of their own employees through physical activity, which can allow people to connect through sports. As a result, subjects in this study tend to encourage other employees to be more active and are hungry for more advice and continued offers for physical activities benefiting both them and the institution through better efficiency at work and less absenteeism common to more active people.

P 1

Arrhythmic Right Ventricular Cardiomyopathy diagnosed by Cardiac Magnetic Resonance Imaging

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Introduction: Arrhythmic Right Ventricular Cardiomyopathy / Dysplasia (ARVC/D) is a progressive cardiomyopathy primarily affecting the right ventricle that accounts for a considerable amount of exercise-related sudden death in young athletes.

Clinical report: We present the case of a 35-year-old man with no relevant precedent medical history and no family history of sudden cardiac deaths, that presented to our hospital due to persistent palpitations following a syncope with loss of consciousness for about ten seconds. The ECG at admission showed a ventricular tachycardia with left bundle branch block morphology and superior leftward axis at a frequency of 223 beats per minute that was not responsive to medical interventions and needed to be terminated electrically. After cardioversion the ECG showed an AV-block I°, epsilon waves and T-wave inversion in the precordial leads, typical features of ARVC/D. The ECG gated 1,5 T cine cardiac magnetic resonance images showed a right ventricle that was distinctly enlarged and had a severely reduced ejection fraction of less than 20%, due to diffuse hypokinesia. Localized aneurysms were found in the lateral free wall and the right ventricular outflow tract. In addition right ventricular intramyocardial fat infiltration, the hallmark of the disease, was demonstrated in the free wall of the right ventricle. Of particular interest is the involvement of the left ventricle that also showed a markedly reduced ejection fraction of 38% due to akinesia of the lateral wall. Delayed Gadolinium enhanced images revealed myocardial scar in this region. **Conclusion:** This patient with ventricular arrhythmias fulfills several major diagnostic criteria of ARVC/D and in addition has considerable involvement also of the left ventricle.

P 2

Seasonal Variation of VO₂max and the VO₂:Workrate Relationship in Elite Alpine SkiersMicah Gross¹, Fabio A. Breil^{1,2}, Andrea D. Lehmann¹, Hans Hoppeler¹, and Michael Vogt¹¹Institute for Anatomy, University of Bern, Switzerland²Institute for Human Movement Sciences and Sport, Federal Institute of Technology, Zurich, Switzerland

PURPOSE Alpine ski performance relates closely to both anaerobic and aerobic capacities. During their competitive season, skiers greatly reduce endurance and weight training, and on-snow training becomes predominant. To typify this shift, we compared exhaustive ramp cycling and squat (SJ) and countermovement (CMJ) jumping performance in elite males before and after their competitive season.

RESULTS In post- compared to pre-season 1) maximal oxygen uptake (VO₂max) normalized to bodyweight was higher (55.2 ± 5.2 vs. 52.7 ± 3.6 ml·kg⁻¹·min⁻¹, p<0.01), but corresponding workrate (W) was unchanged, 2) at ventilatory thresholds (VT), absolute and relative workrates were similar but heart rates were lower, 3) VO₂:W slope was greater (9.59 ± 0.6 vs. 9.19 ± 0.4 mlO₂·min⁻¹·W⁻¹, p=0.02), with similar flattening (p<0.01) above VT₁ at both timepoints, and 4) jump height was greater in SJ (47.4 ± 4.4 vs. 44.7 ± 4.3 cm, p<0.01) and CMJ (52.7 ± 4.6 vs. 50.4 ± 5.0 cm, p<0.01).

DISCUSSION We believe that aerobic capacity and leg power were constrained in pre-season, and that improvements primarily reflected an in-season recovery from a fatigued state which was caused by incongruous pre-season training. Residual adaptations to high-altitude exposure in pre-season could have also affected results. Nonetheless, modern alpine skiing seemingly provides an ample cardiovascular training stimulus for skiers to maintain their aerobic capacities during the racing season.

CONCLUSIONS We conclude that aerobic fitness and leg-explosiveness can be maintained in-season, but may be compromised by heavy or excessive pre-season training. Additionally, ramp test VO₂:W slope analysis could be useful for monitoring both positive and negative responses to training.

P 3

Keep it simple! - The Conconi test as predictor of 10km running performance

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Introduction: The Conconi test (CT) is a standardised and easy to perform incremental exercise test often used in Switzerland to assess physical performance and derive training prescriptions. During the early phase of the CT a linear relation between speed and heart rate exists until the so-called deflection point (DP) is reached as the curve alters to a curvilinear behaviour.¹ The present study aimed to investigate, if results of the CT - namely speed and heart rate at DP - are suitable to predict 10km running performance.

Methods: 10 healthy, non-smoking subjects (age: 37±10 years; height: 177±5cm; weight: 73±6kg; VO_{2max}: 49.4±5.4ml/min/kg) performed a CT on a treadmill as well as a competitive 10km run on a 400m track within one week. For data analysis Spearman correlations as well as Bland and Altman plots comparing heart rate and speed at DP with the corresponding average values of the 10km run were made.²

Results: A high correlation ($r=0.973$; $p<0.001$) between heart rate at DP and average heart rate during the 10km run was found. Speed at DP vs. 10km running speed also revealed a highly significant correlation ($r=0.838$; $p<0.002$). Validity analysis suggested by Bland and Altman showed that all data points were within the limits of agreement, which confirms a high agreement between the two methods. The corresponding bias for heart rate was 3±2 bpm and 0.5±0.7 km/h for speed.

Conclusion: It seems to be possible to predict target heart rate and running speed for a competitive 10km run based on results of a simple CT. For practical recommendations concerning a 10km run, the chosen target heart rate should be about 3 bpm below heart rate at DP. The recommended racing speed was found to be 0.5km/h below speed at DP. Interestingly, heart rate data showed a higher correlation than speed data, which favours heart rate rather than speed as pacing strategy, especially on undulating race courses.

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2) Bland JM and Altman DG. Lancet 1 (1986) 307-310.

P 4

Laufen Dänen schnell flach und Schweizer schnell bergauf? - Laufleistung bergauf vs. flach von international und national erfolgreichen Orientierungsläufer und -läuferinnen von Dänemark und der SchweizBeat Zimmermann¹, Sven Moosberger², Lars Lindström³, Achim Conzelmann², German E. Clénin^{1,3}¹ Sportmedizinisches Zentrum Bern-Ittigen² Institut für Sportwissenschaften, Universität Bern³ Swiss Orienteering, Olten⁴ Dansk Orienterings-Forbundet, Brøndby, Denmark

Einleitung/Fragestellungen: Der Orientierungslauf ist eine Sportart, bei der neben technisch/kognitiven Fähigkeiten vor allem die Laufleistung im Gelände einen entscheidenden Einfluss auf die Wettkampfleistung hat. Das Laufen im Gelände weist dabei ein ähnliches physiologisches Anforderungsprofil wie ein Berglauf auf. 1. Unterscheiden sich Junioren Spitzenorientierungsläufer mit internationalem Format von übrigen Kadernmitgliedern in der Bergauf- und Flachlaufleistung? 2. Laufen Dänen schnell flach und Schweizer schnell bergauf? - Wie beeinflusst die Trainingsumgebung und Trainingsgestaltung die Bergauf- und Flachlaufleistung?

Methode: 21 Orientierungsläufer und 22 -läuferinnen (m 18.9J ±1.2; f 18.6J ±1.3) der Junioren-Nationalkader von Dänemark (7 m u. 9 f) und der Schweiz (14 m u. 13 f) absolvierten einen Berglauf (BL; 1km, 195m Steigung) und einen Flachlauf (FL; 2km) im Feld mit maximaler Ausbelastung. Herz- und Schritzfrequenz wurden kontinuierlich, Laktat und Borg am Belastungsende gemessen. Mit einem Fragebogen wurden Angaben zur individuellen Trainingsumgebung und -gestaltung erhoben.

Resultate/Diskussion: Die Junioren absolvierten den BL in 9min 35 ±47sec, die Junioren in 7min 13 ±22sec. Für den FL benötigten die Junioren 8min 17 ±30sec, die Junioren 6min 32 ±10sec. Weltklasseorientierungsläufer (WK) waren im BL für m um 19sec ($p=0.049$) für f um 72sec ($P<0.000$) und im FL für m um 6sec (n.s.) und für f um 38sec ($p=0.004$) schneller als die übrigen Kadernmitglieder (NK). Ebenfalls zeigen WK für m und f eine relative Bergaufstärke im Vergleich zu NK ($p=0.36$). Sowohl bei m als auch bei f fand sich aber kein signifikanter Unterschied zwischen den Dänischen und Schweizer Athletinnen und Athleten im BL und FL. Hingegen finden sich wie erwartet signifikante Unterschiede in der für Dänen flachen und der für Schweizer gebirgigen Trainingsumgebung. Bezüglich Trainingsumfang, gelaufener Höhenmeter, Lauftrainings bergauf, Lauftrainings im Gelände und auch laufspezifischer Krafttrainings lassen sich in dieser Querschnittstudie keine sicheren Beobachtungen erkennen, welche Hinweise auf eine erfolgreiche Trainingsgestaltung liefern.

Konklusion: Unabhängig von der Trainingsumgebung und der Nationalität zeichnen sich international erfolgreiche Orientierungsläufer beider Geschlechter durch sehr gute Laufleistungsfähigkeiten sowohl flach als auch bergauf aus. Dabei diskriminiert die Bergaufleistung signifikant zwischen den international erfolgreichen und den übrigen Kadernmitgliedern und erklärt die Laufleistung im Orientierungslauf besser als das Flachlaufen.

P 5

Physiologische Charakterisierung von wettkampfmässigem steilem Bergauf- versus Flachlaufen bei männlichen und weiblichen 16-21 jährigen SpitzenorientierungsläufernGerman E. Clénin^{1,3}, Sven Moosberger², Lars Lindström⁴, Achim Conzelmann², Beat Zimmermann¹¹ Sportmedizinisches Zentrum Bern-Ittigen² Institut für Sportwissenschaften, Universität Bern³ Swiss Orienteering, Olten⁴ Dansk Orienterings-Forbundet, Brøndby, Denmark

Einleitung/Fragestellungen: Der Laufsport ist eine der weltweit am meisten praktizierten Sportarten und eine der ursprünglichsten Bewegungsformen. Entsprechend ist die Fülle an Studien zum Laufen im Flachen sehr gross, hingegen ist die Literatur zum Berglaufen spärlich. Dabei fehlen insbesondere Messungen zur Schritzfrequenz und Schrittlänge.

1. Welche leistungsphysiologischen Unterschiede lassen sich zwischen wettkampfmässigem Bergauf- und Flachlaufen erkennen?

2. Wie unterscheiden sich die durchschnittliche Schritzfrequenz und Schrittlänge sowie deren Verlauf in einem Laufwettkampf bergauf versus flach?

Methode: 43 Orientierungsläufer (21m 18.9y ±1.2; 22f 18.6y ±1.3) der Junioren-Nationalkader von Dänemark und der Schweiz absolvierten einen Berglauf (BL; 19.5% Steigung, 1000m) und einen Flachlauf (FL; 2000m) im Feld mit maximaler Ausbelastung. Herz-(HF) und Schritzfrequenz (SF) wurden kontinuierlich, Laktat (LA) und Borg (B) bei Belastungsende gemessen.

Resultate/Diskussion: Für den BL (MW Laufzeit $m=7\text{min}13\text{sec}$ / $f=9\text{min}35\text{sec}$) fand sich im Vergleich zu dem FL (MW $m=6\text{min}32\text{sec}$ / $f=8\text{min}17\text{sec}$) eine HF von $189\pm9/\text{min}$ vs $189\pm9/\text{min}$, LA von $8.8\pm2.4\text{mmol/l}$ vs $9.3\pm1.8\text{mmol/l}$, B von 19.2 ± 0.84 vs 17.7 ± 1.08 sowie eine SF von $79\pm5/\text{min}$ vs $88\pm3/\text{min}$. Das subjektive Belastungsempfinden ist im BL signifikant höher als im FL ($p<0.000$). SF und Schrittlänge (SL) sind im BL signifikant kleiner als im Flachlauf ($p<0.000$). Sowohl bei m wie bei f kann im FL über die ganze Wettkampfzeit die SF konstant gehalten werden. Im BL gelingt dies nur den besten Bergläufern, also den international erfolgreichen Läuferinnen und Läufern, die anderen Kadernmitglieder zeigen einen Abfall der SF und SL am Belastungsende.

Konklusion: Ein BL ist subjektiv anstrengender und wird mit einer kleineren SF und SL absolviert als ein FL. Der Verlauf der SF im BL scheint ein Mass für die Ermüdung zu sein, international erfolgreiche Athletinnen und Athleten können die SF auch im BL bis zum Ziel aufrechterhalten.

P 6

Der besondere Fall – Eishockeyprofi mit progressiven Rückenschmerzen, intermittierenden Schwächeepisoden und erhöhten InfektparameternP. Fluri¹, R.M. Biedert¹, Ph. Tscholl¹¹ sportclinic Villa Linde, Biel

Fallbeschreibung: Anamnese: 27 jähriger Eishockeyprofi mit progressiven Rücken- und Leistenschmerzen seit 4 Tagen. Zusätzlich intermittierend Schwächeepisoden seit 1 Woche. **Klinik:** Reduzierter Allgemeinzustand. Subfebrile Temperatur. Kreislauf stabil. Kardiopulmonal unauffällig. Abdomen mit diffuser Druckdolenz. Rektal-digital normaler Sphinktertonus, druckdolente Prostata.

Neurologisch Quadriceps rechts geschwächt, grobe Kraft in den Füssen bds o.B. Sensibilität perianal, Hoden und Beine normal. Linke Ferse mit infizierter Blase. **Labor:** Hämoglobin 11,8 g/l, Leukozyten 9.8 mit Linksverschiebung, CRP 237 mg/L, Transaminasen erhöht. Positive Blutkulturen auf Staphylococcus aureus. Bei Verdacht auf Spondylodisitis erfolgt die weitere Diagnostik und Therapie stationär.

Bildgebung: Normales Thoraxröntgen. Abdomensonografisch Splenomegalie, harnableitende Organe und Prostata unauffällig. MRI LWS mit Spondylitis LWK 5 ohne ossäre Abszessbildung. Abszessformationen im M. obturatorius externus und M. pectineus rechts. Knochenmarködem um die Symphyse, passend zu einer Symphysitis.

Im Thorax-CT pneumonische Infiltrate beider Unterlappen. Echokardiografisch kein Nachweis von Klappenvegetationen. **Therapie:** Die Behandlung erfolgte mit Flucloxacillin 4x2 g i.v., darunter rasche Besserung der pulmonalen und lumbalen Beschwerden. **Verlauf:** Nach 4 Wochen Umstellung der Antibiose auf Ciprofloxacin und Rifampicin per os für 6 Wochen. Verlaufs-MRI nach 3 Monaten ohne MR-morphologische Hinweise auf Spondylitis und muskuläre Abszessformationen.

Wiederaufnahme des Trainings erfolgte 3 ½ Monate nach Diagnosestellung, der erste Einsatz in einem NLA-Meisterschaftsspiel nach 4 ½ Monaten.

Diskussion: Wahrscheinliche Eintrittspforte war die superinfizierte Blase der linken Ferse. Die Läsion wurde inzidiert und mittels Naht wieder adaptiert. Splenomegalie und Transaminasenerhöhung sind am ehesten im Rahmen der Sepsis zu interpretieren. Insgesamt nahm die Ausheilung 3 Monate in Anspruch. Während dieser Zeit wurden Belastungen, die über die alltäglichen Verrichtungen hinausgingen vermieden.

Prophylaktisch wurde das Schuhwerk angepasst sowie die Haut über der Ferse fortan mittels „second skin“ geschützt.

P 7
Alterations of plantar pressure distribution in posttraumatic end-stage ankle osteoarthritis

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BACKGROUND: In the past few years, several studies have tried to identify clinical limitations of patients suffering from end-stage ankle osteoarthritis. However, very few have attempted to assess foot and ankle function in a more objective biomechanical way, and in particular, using dynamic pedobarography. The aim of this study was to explore plantar pressure distribution characteristics in a large cohort of patients with end-stage ankle osteoarthritis.

METHODS: 120 patients (female, 54; male, 66; 120 cases) suffering from posttraumatic end-stage ankle osteoarthritis were included. The clinical examination consisted of an assessment of the American Orthopaedic Foot and Ankle Society hindfoot score, a pain score, the range of motion for ankle dorsiflexion and plantar flexion, and the body mass index. Radiological parameters included the radiological tibiotalar alignment and the radiological ankle osteoarthritis grading. Plantar pressure distribution parameters were assessed using dynamic pedobarography.

FINDINGS: Intra-individual comparison between the affected and the opposite feet revealed significant differences for several parameters: maximum force and contact area were decreased in the whole osteoarthritic foot. Peak pressure in the hindfoot and toes area was decreased as well. No correlations could be found between pedobarographic data and clinical parameters, such as hindfoot score, pain score, and range of motion. However, results indicated a positive correlation between dorsiflexion and the pedobarographic parameters.

INTERPRETATION: In conclusion, posttraumatic end-stage ankle osteoarthritis leads to significant alterations in plantar pressure distribution. These might be interpreted as an attempt of the patient to reduce the weight-bearing load on the painful ankle. Other explanations include bony deformity and ankle malalignment, as a consequence of either the initial trauma or of the degenerative process itself, pain related disuse atrophy of surrounding muscles, or scarred soft tissue.

P 8
Respiratory muscle training enhances maximal minute ventilation and forced vital capacity in adolescent athletes

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Introduction. Respiratory difficulties in athletes are common, especially in adolescents, even in the absence of exercise-induced bronchoconstriction. Immaturity of the respiratory muscles coupling at high respiratory rates could be a potential mechanism. Whether respiratory muscle training (RMT) can positively influence it is yet unknown.

Goal. We investigate the effects of RMT on ventilation and performance parameters in adolescent athletes and hypothesize that RMT will enhance respiratory capacity.

Methods. 12 healthy subjects (8 male, 4 female, 17±0.5 years) from a sports/study high school class, competitively involved in various sports (minimum of 10 hours per week) underwent respiratory function testing, maximal minute ventilation (MMV) measurements and a maximal treadmill incremental test with VO₂max and ventilatory thresholds (VT1 and VT2) determination. They then underwent one month of RMT (4 times/week) using a eucapnic hyperventilation device, with an incremental training program. The same tests were repeated after RMT.

Results. Subjects completed 14.8 sessions of RMT, with an increase in total ventilation per session of 211±29% during training. Borg scale evaluation of the RMT session was unchanged or reduced in all subjects, despite an increase in total respiratory work. No changes (p>0.05) were observed pre/post RMT in VO₂max (53.4±7.5 vs 51.6±7.7 ml/kg/min), VT2 (14.4±1.4 vs 14.0±1.1 km/h) or Speed max at end of test (16.1±1.7 vs 15.8±1.7 km/h). MVV increased by 9.2% (176.7±36.9 vs 192.9±32.6 l/min, p<0.001) and FVC by 3.3% (6.70±0.75 vs 4.85±0.76 litres, p<0.05). Subjective evaluation of respiratory sensations during exercise and daily living were also improved.

Conclusions. RMT improves MMV and FVC in adolescent athletes, along with important subjective respiratory benefits, although no changes are seen in treadmill maximal performance tests and VO₂max measurements. RMT can be easily performed in adolescent without side effects, with a potential for improvement in training capacity and overall well-being.

P 9
Changement de l'incidence et de l'étiologie des blessures apparues consécutivement à la course à pied dans les dernier 25 ans

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Introduction : Les concepteurs de chaussures destinées à la course à pied ont, au cours des 25 dernières années développé sans relâche de nouvelles chaussures dans le but d'améliorer la capacité d'amortissement des chocs. Est-ce que la génération actuelle des chaussures peut influencer l'incidence des blessures chez le coureur populaire ?

Méthode : Sur les quelque 1200 participants du Tour du Canton de Neuchâtel - course populaire en 6 étapes - 372 ont rempli un questionnaire sur leurs habitudes d'entraînement et leurs blessures liées à la course à pied. Les résultats ont été comparés avec la littérature des années quatre-vingt-dix.⁽¹⁾

Résultats : Lors de leur carrière de coureur 176 participants (47 %) ont subi une ou plusieurs blessures consécutives à la course à pied, soit 275 blessures au total. 210 fois il s'agissait d'une blessure typique: entorse de la cheville (38%), tendinite du tendon d'Achille (23%), tendinite, périostite ou étirement musculaire du pied et de la jambe (9 %), et douleurs du genou (30%). 65 blessures sont moins spécifiques : douleurs de la hanche (26 cas), du dos (24 cas), fracture de fatigue (5 cas) et suites d'une chute avec fracture de la cheville, du poignet et déchirure du ménisque (10 cas). 62 coureurs ont pu poursuivre leur entraînement soit sans réduction soit avec une certaine diminution, 213 ont dû s'interrompre totalement.

Au cours des 144 étapes il y a eu 2 décès suite à un arrêt cardiaque.

Discussion : En comparant avec une étude de 1984⁽¹⁾, nous constatons que le nombre total de blessures liées à la course à pied chez des populaires n'a pas changé. Par contre l'incidence de certaines blessures a beaucoup changé. L'entorse de la cheville est devenue presque deux fois plus fréquente et la périostite du pied, du tibia et la tendinite du tendon d'Achille ont légèrement diminué (de 36% à 32 %). Les douleurs du genou restent la pathologie la plus fréquente. Quant aux douleurs de la hanche et du dos elles sont devenues presque 3 fois plus fréquentes.

L'étiologie de ces blessures est multifactorielle. On peut suspecter qu'on a d'avantage d'entorses de cheville, de douleurs du genou, de la hanche et du dos parce que certains coureurs ont porté des chaussures inadaptées pour eux : trop amortissantes ou avec des protections antipronation trop prononcées.

Bibliographie

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P 10
Muskuläre Dysbalancen als Risikofaktor für Hüft-Leistenschmerzen bei Sportlern

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Einleitung: Muskuläre Dysbalancen im Becken-Beinbereich sind abgesehen von aktiven und passiven Stabilisationsdefiziten einer der Risikofaktoren für das Auftreten von Hüft-Leistenschmerzen beim Sportler. Die aus diesen Faktoren resultierende ventrale Beckenkippung und LWS-Hyperlordosierung, führt zu vermehrtem Stress und Instabilitätsproblemen der LWS, des Beckenrings, der Hüftgelenke und auch zum Psoas- und Piriformis-Syndrom.

Methode/Ergebnisse: Wir untersuchten 300 jugendliche (Durchschnittsalter 15,9 J.) Leistungssportler beider Geschlechter (m:56%, w:44%) aus unterschiedlichen Sportarten prospektiv hinsichtlich des Vorliegens von muskulären Dysbalancen in Form von klinisch relevanten Verkürzungen der posturalen, tonischen LWS- und Becken-Beinmuskulatur mit dementsprechenden Fehlhaltungen. Insgesamt zeigten sich bei 55% der Athleten muskuläre Dysbalancen im Becken-Bein-Bereich. Differenziert fanden wir relevante Verkürzungen des M. iliopsoas in 37,3%, des M. quadrizeps femoris in 42,6%, der Hamstrings-Gruppe in 31,3% und des M. erektor spinae in 10,6% der Fälle. In den zahlenmässig am besten vertretenen Sportarten (Eishockey n=30, Fussball n=32, Kunstturnen n=84, Radfahren n=17, Schwimmen n=49) untersuchten wir im Quervergleich, ob signifikante Unterschiede bestehen. Hier zeigte sich, dass bei Fussballspielern die Hamstringsgruppe, Iliopsoas und Quadrizeps gleichmässig in ca. 80% der Fälle, bei Eishockeyspielern vorwiegend Quadrizeps (87%) und Iliopsoas (57%) relevant verkürzt waren. Bei den Schwimmern war der Iliopsoas bei 27 %, der Quadrizeps bei 18% und die Hamstrings bei 20% der Athleten deutlich verkürzt. Bei den Radfahrern zeigten sich in 35% Verkürzungen der Iliopsoas-, in 47% die Quadrizeps- und in 35% die Hamstrings- Muskulatur kontrakt. Erwartungsgemäss fanden sich bei den Kunstturnern die wenigsten Verkürzungen (Iliopsoas 13%, Quadrizeps 25%, Hamstrings 9%).

Diskussion: Unsere Untersuchung zeigt, dass unter den sportmotorischen Grundeigenschaften (Schnelligkeit, Kraft, Ausdauer, Koordination, Beweglichkeit) das Training der Beweglichkeit offensichtlich bei jungen Sportlern in eine untergeordnete Rolle geraten ist. Insbesondere im Becken-Bein-Bereich können dadurch induzierte muskuläre Dysbalancen das Auftreten von Hüft-Leistenschmerzen beim Sportler verursachen, sodass von präventiv tätigen Sportmedizinern hier Aufklärungsarbeit bei Trainern und Athleten gefordert ist.

P 11**Zweiseitiger, beidseitiger Abriss der Spina iliaca anterior inferior bei einem 13jährigen Fußballnachwuchsspieler**

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Einleitung:

Die Ossifikation der Apophyse der Spina iliaca anterior inferior beginnt zwischen dem 13. und 15. Lebensjahr und ist zwischen dem 16. und 18. Lebensjahr abgeschlossen. Erstmals beschrieb 1951 De Cuveland die sehr seltenen Apophysenausrisse an der Spina iliaca anterior inferior. Beidseitige Abrisse sind in der Literatur bisher nicht beschrieben.

Case Report:

Wir berichten über einen Nachwuchs-Fußballspieler, der sich im Alter von 12 bzw. 13 Jahren jeweils bei einem Sprint einen Apophysenausriss der Spina iliaca anterior inferior, zuerst links, dann ein Jahr später rechts, zuzog.

Unser Report beschreibt die Anamnese sowie die klinischen, bildgebenden und biomechanischen Befunde sowie das konservative therapeutische Vorgehen unter besonderer Berücksichtigung der Verbesserung der Beweglichkeit.

Diskussion:

Vor allem in der Pubertät sind die Apophysen (Spina iliaca anterior superior und inferior) mit phasenweise verminderter Festigkeit vermehrt verletzungsanfällig. Wir sehen im von uns beschriebenen Fall einen Zusammenhang mit der beim Patienten bestehenden muskulären Dysbalance bei beidseits massiv verkürzten M. quadriceps femoris, der aufgrund seiner reduzierten Länge bei explosiven Bewegungen der Hüftgelenke an den Muskelursprüngen (Caput rectum, Caput reflexum) überhöhte Zugkräfte bewirkt hat. Von entscheidender Bedeutung für den Therapieverlauf und die wohl nach der ersten Verletzung vernachlässigte Prophylaxe einer erneuten Läsion ist unserer Ansicht nach die Verbesserung der Beweglichkeit nach gesicherter Abheilung der Verletzung.

P 12**Vergleich der Wirkung oraler und parenteraler Eisensubstitution bei Sportlern auf Hb, Hkt und Serum-Ferritin**

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Wir verglichen retrospektiv bei insgesamt 68 Sportlern (Durchschnittsalter 19.5 Jahre, 33 m, 35 w) aus 13 verschiedenen Sportarten die Wirkung von indizierter oraler Eisensubstitution mit parenteraler Eisengabe hinsichtlich Hämoglobin, Hämatokrit und Ferritin. Die Nachuntersuchungen erfolgten nach einem durchschnittlichen Zeitraum von 10.6 Wochen. Die Gruppe mit oraler Eisensubstitution umfasste 24 Sportler, diejenige mit intravenöser Eisengabe setzte sich aus 44 Sportlern zusammen. Es zeigte sich in keiner der beiden Gruppen eine signifikante Veränderung der Hämoglobin- und Hämatokrit-Werte.

In der Gruppe der parenteralen Eisengabe steigerte sich der Serum-Ferritin-Wert von durchschnittlich 27,0 ng/l auf 153,0 ng/l (Anstieg 126 ng/l), während sich in der Gruppe der oral substituierten Sportler der Wert von durchschnittlich 28,6 ng/l auf 49,9 ng/l (Anstieg 21,3ng/l) steigerte.

Zusammenfassung : Die parenterale Verabreichung von Eisen hat im Vergleich zur oralen Gabe einen deutlich höheren Anstieg des Serumferritins zur Folge, was aufgrund der bei Sportlern gestörten enteralen Eisenresorption zu vermuten war. Eine Veränderung der Hb- und Hkt-Werte konnte nach durchschnittlich 10,6 Wochen erwartungsgemäss nicht gefunden werden.