Speaker Abstracts

Pre-Symposium

Effects of high altitude on patients with cardiovascular disease

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The physiologic effects of high altitude on patients with cardiovascular disease are qualitatively equal to those occurring in healthy individuals, but they may differ in magnitude or with regard to the clinical impact. In healthy individuals, altitudes above 2,500 m cause hypoxemia to a degree that it leads to a noticeable reduction in aerobic capacity and an increased activity of the sympathetic nervous system. Exercise exacerbates hypoxemia and sympathetic activity. Thanks to acclimatization, hypoxemia decreases within the first 2 weeks at a given altitude with a major increase of arterial PO\textsubscript{2} and SaO\textsubscript{2} occurring during the first few days already. Thus, for patients with impaired blood supply to any organ, the first days after a substantial gain in altitude are the most critical. In untrained people, the altitude-related decrease of maximum aerobic performance starts at an altitude of about 1,500 m and increases by approximately 1% per each 100 m above 1,500 m. Thus, the impact of an altitude-related decrease in performance for patients also depends on their aerobic capacity at sea level, i.e. how much reserve capacity they have above what is needed for daily activities. When advising patients with heart failure, it is important to know that the decrease of maximum aerobic performance is twofold greater with mild to moderate heart failure and fourfold greater with severe heart failure at any given altitude when compared to the loss of performance in healthy individuals. For a patient with coronary artery disease and stable angina pectoris reduction in performance at altitude means that angina will occur at a lower level of exercise. However, several studies demonstrate that the heart rate at this ischemic threshold will be similar at low and high altitude.

In general, we can say that any cardiac patient with a stable disease and sufficient work capacity for a normal life at low altitude can tolerate comparable daily activities at altitudes up to 2,500 m without a significantly increased risk for his health. Exposures above 2,500 up to 3,500 m may be allowed, when cardiovascular evaluation with exercise testing and echocardiography yield a stable disease, an ejection fraction $>40\%$, no significant arrhythmias and a symptom-free exercise capacity of $\geq 2$ W/kg. This recommendation does not apply to patients with primary or secondary pulmonary hypertension or with unilateral absence of a pulmonary artery, who should not go above 2,000 m because these patients are at risk for developing high altitude pulmonary edema and/or right heart failure. In general, patients with significant cardiovascular disease should be advised not to go above altitudes of 3,500 m.

Often, patients with cardiovascular disease have risk factors for this disease that may also be affected by high altitude. Increasing sympathetic stimulation over time raises blood pressure over 3 weeks at 4,300 m by 5–10 mm Hg in healthy individuals. With acute and with short term exposure to high altitude, blood pressure does not rise because hypoxia dilates systemic blood vessels and counteracts sympathetic vasoconstriction. It is not known whether changes of blood pressure at altitude are smaller or greater in patients with systemic hypertension compared to normotensive individuals. In a recent study in patients with metabolic syndrome at moderate altitudes of 1,700–2,500 m blood pressure decreased during a 3 week training program indicating that the blood pressure lowering effect of regular exercise outweighs the effect of hypoxia at moderate altitude. Weight loss might be slightly favoured in obese patients at high altitude since hypoxia is associated with an increased basal metabolic rate which is, at an altitude of 4,300 m, in the order of 20% compared to sea level. Altitudes, which obese people can reach in the Alps,
are usually much lower. Therefore, the increase of the metabolic rate is considerably less compared to an altitude of 4,300 m.

Pre-existing lung diseases and altitude compatibility

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Background: It is a fairy tale that only healthy people can go to high altitudes. Patients with chronic stable disease like arterial hypertension, diabetes and metabolic syndrome as well as respiratory disease can also enjoy such alpine sports as hiking, climbing, skiing and mountaineering. Depending on the altitude, exposure to hypoxic atmosphere may affect patients with lung disease. However, patients with obstructive (COPD, EIA, EIC) or restrictive impairment (ILD) of lung function are at variable risk of experiencing respiratory distress at higher altitudes.

Bronchial asthma: Up to 2,000 m, the reduction of pollen and fine particulate matter seems to be beneficial despite mild altitude hypoxia. At higher altitudes the effects of hypoxia, cold and decreased humidity become more evident. With an increase in catecholamines and corticosteroid secretion, asthma symptoms will decrease with bronchial hyperresponsiveness. There is no evidence that asthmatics are predisposed to acute mountain sickness.

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<th>Conditions with influence on respiratory function in asthmatics</th>
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<td>Negative influence</td>
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<td>* low humidity</td>
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<td>* inhaling cold air</td>
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<td>+ musculoskeletal exhaustion</td>
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<td>+ osmotic bronchial challenge</td>
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Chronic bronchitis and COPD: Low levels of COPD can take advantage of lower air density and reduction of air pollution with improvement of FVC and FEV\textsubscript{1} (5% of patients at 2,550 m). Otherwise, increasing hypoxemia can impair respiratory muscle function and compensate the advantage of reduced air density. Because of blunted HVR by hypercapnia in higher stages of COPD, patients risk further worsening of hypoxemia at altitude.

Pulmonary Hypertension: Patients with PPH or congenital absence of a pulmonary artery are at high risk of developing HAPE when ascending to high altitudes without supplemental oxygen. Pulmonary hypertension (PAP > 30 mm Hg) is a relative contraindication for high altitude exposure.

Pulmonary Emphysema: A rapid fall of barometric pressure (cable car, nonpressurized aircraft) can lead to rupture of bullae and subsequent pneumothorax (gas expansion symptoms).

Hypoventilation Syndrome and Obstructive Sleep Apnea Syndrome: Exposure to high altitude is contraindicated for patients who are unable to increase their ventilation upon hypoxic stimulation.

Pulmonary Thromboembolism: Patients with chronic pulmonary thromboembolism risk PAE recurrence with excess fluid loss, hemoconcentration or thrombophilia.

Interstitial Lung Disease: Depending on the impairment of gas exchange caused by reduced diffusion capacity, patients should be individually assessed; if there is any doubt, they should not exceed an altitude of 2,500 m.

Conclusion: Long-term exposure to moderate or high altitude may be associated with significant hypoxemia in patients with chronic lung disease. Hypoxic challenge tests (normobaric or hypobaric chamber) and spirometry can provide useful information about a patient’s condition at altitude.
Intermittent hypoxia: Pre-acclimatization to high altitude, training, therapy

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Intermittent hypoxia (IH) is defined as repeated episodes of hypoxia interspersed with normoxic periods. Hypoxic episodes are created by exposure to natural high altitude, sojourns in hypobaric chambers or by breathing hypoxic gas mixtures in normobaric conditions.

IH has been suggested to improve exercise performance, to acclimatize before going to high altitude or for prevention and treatment of various illnesses. IH is characterised by a progressive increase in ventilation, adaptations of the haematopoetic and cardio-circulatory systems, to enhance oxygen delivery to the tissues, and alterations on the tissue level to optimise the utilisation of oxygen, and to improve immune system functions.

Based on the reported IH-effects at least 5 IH protocols can be distinguished:

1. Short cycles of 30–90 s hypoxia for 7–8 hours per day over weeks to years
2. IH at rest with a cycle length of 2–10 min for 1–2 hours per day over 2–4 weeks
3. 1–2 hours hypoxia per day for 5 days
4. IH at rest for more than 90 min (to hours) per day over 2–6 weeks
5. IH with exercise for 30 min to 2 hours per day over 2–6 weeks

The various types of IH protocols seem to evoke different adaptation effects also depending on the health and training state.

Position stand of the DGSP on sports medical coaching of athletes

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Sports Medicine covers many different aspects, ranging from clinical specialities, such as Internal Medicine, Orthopaedics or Pediatrics to Physiology and Sports Sciences.

The requirements for Sports Medicine evolve mainly from exercise physiology (elite-, leisure- and health oriented physical activity), orthopaedics and traumatology as well as from preventive and rehabilitative issues.

In the new german curriculum, Sports Medicine is defined as a sub-speciality.

Historically, Sports Medicine in Germany has a federal structure with a governing body (Deutsche Gesellschaft für Sportmedizin und Prävention, DGSP). Due to these facts, universitary Departments of Sports Medicine (which vary greatly in size and performance) are either attached to Medical- or non-Medical Faculties, such as Sports Sciences.

In Medical Schools, Sports Medicine can be selected as an elective subject. However, the main part of Sports Medicine teaching is covered by Sports Science faculties.

In an international context, the strength of German Sports Medicine is its clinical orientation and close cooperation with the sport itself, especially high performance sports.
Compared to the English-speaking countries, issues related to health prevention and rehabilitation seem under-represented.

**Keywords:** Sports medicine, Germany, history, organisation, sports science

**Exercise Training as Therapy**

**Exercise training in heart failure**

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**Background:** While the reduction of left ventricular function is at the origin of the heart failure syndrome, the symptoms are the result of different peripheral adaptation mechanisms. Exercise training has the potential to reverse the changes in the periphery, whereas the impact on left ventricular function and remodelling remains uncertain.

**Methods:** We analysed the impact of cardiac rehabilitation (CR) on exercise capacity (peak VO$_2$), health related quality of life (HRQoL), brain natriuretic peptide (BNP), left ventricular function (LVEF) and diameter (LVEDD) in 198 patients (170 male/28 female, mean age 60.1 ± 11.4 yrs). They attended a hospital-based outpatient programme composed of aerobic endurance training, optimisation of medical therapy, detailed medical & educational information delivery and psychosocial support 3 times a week for a period of 3 months with an optional prolongation of 6 months. The data on LVEF, LVEDD and BNP of the subgroup of patients attaining the programme during 9 months (n = 68) was compared with a control group (n = 36).

**Results:** In the CR group, peak VO$_2$ increased from 17.1 ± 4.9 ml/min/kg to 19.5 ± 6.8 ml/min/kg (p < 0.001), LVEF increased from 28.1 ± 7.6% to 34.3 ± 10.0% (p < 0.001), LVEDD decreased from 64.4 ± 9.1 mm to 61.3 ± 8.4 mm (p < 0.001) and BNP decreased from 396 ± 422 pg/ml to 277 ± 270 pg/ml (p < 0.001). The total score of the Minnesota Living with Heart Failure Questionnaire decreased from 33.1 ± 23.0 to 20.1 ± 16.5 (p < 0.001). In the control group, LVEF increased significantly less than in the CR group (3.0% vs 11%, p < 0.001) and LVEDD increased slightly in the control group (+0.3 ± 5.8 mm), whereas it significantly decreased in the CR group (−4.2 ± 7.4 mm, p = 0.014). BNP increased by 109 ± 391 pg/ml in the control group and decreased by 163 ± 320 pg/ml in the CR group.

**Conclusion:** An exercise based comprehensive CR programme in patients with stable heart failure leads to an improvement of the prognostic relevant parameters BNP, peak VO$_2$, LVEF and LVEDD as well as HRQoL. The effect on the parameters of left ventricular remodelling are significantly different compared with a control group without exercise training. Exercise training should therefore be prescribed to all stable chronic heart failure patients as a component of a comprehensive therapeutic management.

**Physical exercise training increases number and improves the function of circulating endothelial progenitor cells in patients with end-stage heart failure**

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**Background:** The attenuated peripheral perfusion in patients with end-stage heart failure has been causally linked to general endothelial dysfunction. This impairment of endothelium-dependent vasodilatation (EDD) is believed
to partially result from an increased loss of mature endothelial cells by apoptosis and an attenuated liberation of endothelial progenitor cells (EPCs) from the bone marrow. Aim of the present trial was to elucidate, whether regular exercise training affects the number of circulating mature endothelial cells, stem cells as well as EPCs in patients with end-stage CHF and whether this was associated with a change in EDD.

Methods: Sixteen patients with CHF (LVEF 24 ± 2%, NYHA class III b) were randomly assigned to 3 months of exercise training (T) or sedentary lifestyle (C). Patients in the training group exercised on a bicycle ergometer at 60% of their peak oxygen uptake 30 minutes daily for 3 months. At begin (B) and after 3 months, the number of CD34+ stem cells, CD117+ stem cells and CD146+ mature endothelial cells was quantified by FACS in the blood. Apoptosis of these cells was recognized by an anti-annexin-5-staining. AcLDL/lectin+ cells, regarded as a read-out of all circulating EPCs, were recovered from blood-derived mononuclear cells by cell culture and counted using FACS. FMD of the radial artery in response to reactive hyperaemia was determined by high resolution ultrasound.

Results: Exercise training increased the number of CD34+ stem cells by 54 ± 18% and the amount of AcLDL/lectin+ EPCs by 100 ± 28% (p < 0.05 vs. B and C). FMD improved from 7.7 ± 1.8% at B to 17.4 ± 4.2% at 3 months in the training group (p < 0.05 vs. B and C). The increase in the CD34+ cell count was linked to the improvement in FMD in T (r = 0.74, p < 0.05). However, T neither affected the amount of CD117+ stem cells and CD146+ mature endothelial cells nor the number of apoptotic CD34+, CD117+, or CD146+ cells. All of the above-mentioned parameters remained virtually unchanged during the study period in the control group.

Conclusion: Exercise training promotes an increase in circulating EPCs and CD34+ stem cells in patients with end-stage heart failure. These cells might rejuvenate damaged endothelium thereby potentially contributing to a partial correction of endothelial dysfunction in CHF.

Fatigue and postural functions of patients with a multiple sclerosis

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Introduction: Main subject of the paper is a study of the fatigue and postural functions of patients with a brain-spinal cord multiple sclerosis. Symptom of the fatigue, origin of which among other things is also shared by disorder of an equilibrium, is considered as very essential [1]. Topics of the study are to find: 1) possibility to influence the fatigue, postural and movements functions and clinical state of patients, 2) relations between reduction of fatigue and improvement of postural functions, 3) if therapy on neurophysiological basis has a positive influence to the impairment, disability, handicap, fatigue, depression and quality of life of patients with a multiple sclerosis.

Methods: In the first part of the experiment we will be aimed at study of the fatigue and postural functions. In the second part of the experiment we will study possibilities to influence the fatigue and postural functions by a neurophysiological therapy. In this treatment we accept a theory of plasticity of the central nervous system. Before the beginning of the neurophysiological therapy a clinical examination as well as an examination of postural functions and equilibrium in stand will be performed. Postural functions will be evaluated by the examinations of stability and equilibrium stand (Bohannon Balance Scale). These evaluations will be completed by the FootScan examination and by a questionnaire review of the fatigue. Course of the clinical examination and the equilibrium in stand examination using the FootScan will be recorded on video. This process will make possible an objective determination of a deviation of gravity centre of the body related to an effort for the equilibrium in stand as well as an objective evaluation of the clinical examination. The evaluation of results obtained by the clinical and equilibrium in stand examinations will be performed using 3D analysis.

Results: Expecting results of the experiment consist in: 1) quality of movements, ability of coordination and postural function of patients with a multiple sclerosis are possible to influence by an individual therapy on neurophysiological basis, 2) positive influence of postural reactions and clinical state of patients substantially reduce
fatigue, 3) complex physiotherapy has positive consequences to the psychical state, ability to accomplish common
every-day activities as well as working and economic situation and social behaviour of patients and 4) development
of a complex programme in given care.

Discussion: Therapy on neurophysiological basis is focused on the therapy of sitting, standing and walking and
on the stimulation of postural functions. The target is a positive influencing of the equilibrium, coordination
of movements and reducing of abnormal postural reactions and fatigue [4]. The therapy on neurophysiological basis
helps to recall rapid reflex mechanisms, to extend normal feeling of the tonus, movement and relaxation of muscles.
The method is based on the Bobath concept, with using of technics of the sensomotoric stimulation and on the
Brügger conception [2,3]. Before any active therapy a differential diagnosis is realized and possible functional
disorders are suppressed by physiotherapeutic methods. Course and period of the therapy depend on the development
of neuromuscular fatigue or fatigue like manifestation of exacerbation a MS disease.

Conclusion: Described clinical experiment investigates a range of improvement of the fatigue, reduced movement
features and postural functions of patients with a multiple sclerosis using the complex therapy on neurophysiological
basis. Main endeavour of this experimental work is improvement of diligence to patients with a multiple sclerosis
and to put research results into rehabilitation practice.

References

Effects of a 3-year exercise program on exercise capacity in previously sedentary people

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Introduction: Exercise capacity has been shown to be a more powerful predictor of mortality than other established
risk factors for cardiovascular disease. Exercise capacity decreases with age especially in sedentary people. However,
the change to regular physical activity could reduce this decrease or even enhance exercise capacity. We studied the
effects of one supervised training session per week for 3 years on exercise capacity in previously sedentary adults.

Methods: Eleven sedentary subjects (6 males, 5 females, age: 54.5 ± 5.6 years, body mass: 26.1 ± 4.7 kg)
participated within 5 years for at least 3 years in a supervised exercise program. Training was offered once per week
for 90 min during 8 months per year focusing on cardiovascular fitness, musculo-skeletal strength, and flexibility.
Main outcome measures were maximal oxygen consumption and maximal power determined by an incremental
cycle ergometry.

Results: After the 3-year exercise program maximal oxygen consumption had increased from 30.3 ± 4.1 to 35.1 ±
5.9 ml/min/kg (+1.4 METs) (p = 0.02) and maximal power output had increased from 187 ± 3.1 to 205 ± 4.2 watt
(2.4 watt/kg to 2.6 watt/kg) (p = 0.06). Whereas maximal heart rates did not change resting hearts rates decreased
from 73 ± 9 to 66 ± 10 beats/min (p = 0.04).

Conclusion: An exercise program consisting of one weekly training session effected a marked increase of exercise
capacity in previously sedentary people. This is a very promising observation with important implications on quality
of life and longevity.
Short and long-term effects of an aquatic training on the health related quality of life and fitness in fibromyalgia

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Introduction: The purpose was twofold: firstly, to evaluate the immediate effects of a 12-weeks of aquatic training and subsequent detraining on Health-Related Quality of Life (HRQOL) and physical fitness in females with fibromyalgia; and secondly, to evaluate the permanence of these effects after 12 weeks without physical exercise.

Methods: Thirty-four female patients with FM [mean (SD) duration of FM symptoms 21(9) years] were randomly assigned into two groups: exercise group (EG), who exercised for 60 min in warm water, 3 times a week (n = 17); and control group (CG), who continued their habitual leisure time activities (n = 17). HRQOL was assessed using the SF-36 questionnaire and the Fibromyalgia Impact Questionnaire (FIQ). Physical fitness was assessed using the Canadian Aerobic Fitness Test, hand-grip dynamometry and the 10-meters walking speed, 10-step stair-climbing and blind one-leg stance tests. Outcomes were measured at baseline, at the end of the 12-weeks training and after the 12 weeks detraining period.

Results: The 12-week training revealed significant improvements in the EG in the total FIQ score and in physical function, body pain, vitality, social function, role emotional problems and mental health dimensions of the SF-36. Also major gains occurred in balance, although other fitness tests revealed unaffected. After the subsequent detraining period only the improvements in body pain, role emotional problems, and mental health dimensions were maintained. In the control group, HRQOL and physical fitness status remained unchanged during the duration of the study.

Discussion: The main findings in the present trial were: Firstly that 3 months of water based exercise decreased the impact of the disease in daily life by enhancing HRQOL with a major relief in pain and emotional problems, and by improving patients’ balance; and secondly that the improvements in fitness did not last for 12 weeks after the end of the training, while some of the gains in HRQOL, and specially the pain relief, were maintained. On the other hand, the maintenance over 3 month of the pain relief achieved after the treatment is to our knowledge a novel finding, as our study showed a meantime between follow-ups with no physical exercise (patients had completely sedentary habits), and the previous studies did not (and patients remained physically active) [2], or it was not controlled [3]. These findings are complementary and consistent with the neuromuscular changes observed in a previous study [1].

Conclusion: The present water exercise protocol improved female patients HRQOL and balance. Nevertheless, although most of the previous gains were lost during the detraining, the improvements pain and emotional problems were preserved. Regular exercise is required to preserve most of fitness and HRQOL gains.

References

Genetics

Genetics in sports and medicine

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Introduction: Genetics is the science of genes, heredity, and the variation of organisms. Since all diseases and physiological adaptations have a genetic component like resulting from the body’s response to (environmental) stresses and strains (e.g. viruses, toxins and sports), meanwhile, genetics is playing not only an increasingly important role in the diagnosis, monitoring and treatment of diseases but also in the diagnosis of sports performance. With the start of the human genome project in 1990, the project goals were to determine the complete sequence of the 3 billion DNA subunits (bases), identify all human genes and make them accessible for further biological study. Even the ultimate goal of the project was to use this information to develop new ways to treat, cure or even prevent the thousands of diseases afflicting the humankind, nobody can deny that this knowledge may be misused in several ways. In this connection, the genetic knowledge opened new ways of performance enhancing manipulations even doping in various forms has always been a major problem in competitive sports. Therefore, genetics in sports and medicine has to be analyzed under different aspects: 1) genetic diagnosis of sports performance, 2) genetic and molecular adaptations to sports (or exercise), especially under the focus of health preventive and rehabilitative strategies and 3) genetic ways to enhance performance under illegal aspects.

Fig. 1. Micro-array analysis: Gene expression pattern of the colon mucosa after analysis and calculation of three gene arrays
1 expressed genes
2 not expressed genes
3 expressed and regulated genes.

1) Recently, the use of DNA micro-arrays emerged as a core technology in many research facilities, as indicated by over 4,800 articles published in those fields described above. It has been appealed for applying innovative screening methods such as micro-arrays in exercise sciences in order to get new insights into the diagnosis of performance. Nevertheless, only a few working groups describe micro array experiments in connection with physical exercise performance. However, Claude Bouchard’s team is working on the human gene map for performance and health-related fitness phenotypes since 2000: in the meanwhile, more than 140 gene entries and quantitative trait loci are located on the gene map of physical performance. There are a lot of candidate genes whose regulation may play an important role in enhancing speed, such as alpha actinin-3 or developing muscle growth like myostatin or improving endurance like angiotensin converting enzyme or HIF-1. Additionally, a series of gene polymorphisms such as ACE or PPARalpha, are discussed to be associated the higher physical performance.

2) The preventive and rehabilitative effect of physical activity is well established on a lot of diseases (like cardiovascular diseases, obesity, diabetes . . .). Even though the epidemiological evidence for breast and colon cancer is convincing, little is known about the molecular and biological mechanisms involved in this risk reduction. The
discussed mechanisms include: increased gut motility; enhanced immune functions; decreased insulin and insulin-like growth factor levels; decreased obesity; enhanced free radical scavenger systems and modulated prostaglandin levels. In this connection we detected in first gene expression studies 54 regulated genes (see Fig. 1) in the colon mucosa after long term voluntary physical exercise. Our data indicate an influence of exercise on prostaglandin synthesis in the colon mucosa as well as influences on the angiogenesis, shown by reduced transcript levels of vascular endothelial growth factor (VEGF) and angiopoietin-2 (ANG-2) and modulations of immune parameters.

3) In ancient times, athletes tried to improve their physical performance and used doping methods such as eating the testis of bulls. Today, gene therapy, gene manipulations and the progress in recombinant DNA technology offer tremendous possibilities to achieve peak performance. Well known candidate doping recombinant proteins used in doping are, for example, rEPO or rhGH. Gene doping is the next higher step of (genetic) manipulation; a method to produce recombinant proteins within human cells or to block protein biosynthesis by silencing RNA. Besides EPO and hGH, myostatin, IGF, HIF or PPARδ are discussed target genes to manipulate. The effectiveness of those target genes was demonstrated by several animal trials. Today, there are a lot of existing (known) negative health side effects of the gene therapy, but nevertheless it could be expected that successful human trials may be only a few years away.

Increased expression of E3 ubiquitin ligase Murf-1 and MaFBx in cardiomyocytes after induction of heart failure: Impact of inflammatory cytokines and exercise training

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Background: Muscle wasting is a common feature of many hypercatabolic states such as sepsis, cancer and chronic heart failure. Overexpression of MaFBx or Murf-1, two E3 ubiquitin ligases specifically expressed in skeletal muscle myocytes and cardiomyocytes resulted in the induction of atrophy. So far nothing is known about MaFBx and Murf-1 expression in the myocardium after induction of heart failure, and its regulation by inflammatory cytokines and exercise training.

Methods: Three weeks after LAD ligation (n = 20) or sham operation (n = 20) male Wistar Kyoto rats were divided either into a training (T, n = 10) or an inactive control group (C, n = 10). Animals of the training group exercised over a period of 3 weeks twice a day on a treadmill (30 m/min, 30 min each session), whereas the control animals were kept under standard conditions. The expression of MaFBx and Murf-1 was analyzed by qRT-PCR in the left ventricle and expressed as ratio over the expression of 18S rRNA. To investigate the potency of inflammatory cytokines to regulate MaFBx and Murf-1 expression of the local TNF-α concentration was determined by ELISA. Furthermore, H9C2 myocytes were incubated with TNF-α (6 ng/ml) for 24 h in the presence/absence of SB 203580 or PD 98059 and the expression of Murf-1/Mafb was quantified.

Results: A positive correlation was observed between the concentration of TNF-α and the expression of MaFBx (r = 0.70, p < 0.001) and Murf-1 (r = 0.62, p < 0.01). Incubation of H9C2 myocytes with TNF-α revealed a 5.1-fold increase of MaFBx and a 3.7-fold increase of Murf-1 expression as compared to control cells. The TNF-α induced Murf-1 expression could be inhibited by PD 98059, whereas SB 203580 suppressed the TNF-α induction of MaFBx.
Conclusion: The results of these experiments demonstrate, that MafBx and Murf-1 expression is upregulated in the myocardium after induction of heart failure. Regular exercise training has the potential to reduce the expression of these atrophy-related E3 ubiquitin ligases possibly via its anti-inflammatory action.

Effects of exercise and ischemia on mobilization and functional activation of blood-derived progenitor cells in patients with ischemic syndromes

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Background: Exercise training has been shown to improve regional perfusion in ischemic syndromes. This might be partially related to a regeneration of diseased endothelium by circulating endothelial progenitor cells (CPCs) or CPC-derived vasculogenesis. The aim of the present study was to determine whether ischemic stimuli during regular exercise training are required to promote CPC mobilization in patients with various cardiovascular diseases.

Methods: (A) Patients with peripheral arterial occlusive disease (PAOD Fontaine II b) were randomized to 4 weeks of daily ischemic walking training or sedentary lifestyle. (B) Patients with stable coronary artery disease (CAD) were subjected either to 4 weeks of subischemic bicycle ergometer training (T) or control (C). At begin and after 4 weeks the number of KDR/CD34^{POS} CPCs was determined by FACS. Serum levels of VEGF were measured by ELISA. Matrigel assay was used to quantify CPC integration into vascular structures. The homing factor CXCR4 was determined by RT-PCR.

Results: (A) In PAOD (n = 18, 57 ± 2 years), ischemic walking training increased VEGF levels by 310% (p <0.05 vs. control). This was associated with a rise in KDR/CD34^{POS} CPCs by 440% (p <0.05 vs. C), an increased CXCR4 expression and enhanced incorporation of CPCs into endothelial networks as compared to C. (B) In contrast, subischemic training in patients with CAD only increased CXCR4 expression and the ability of CPCs to incorporate into vascular structures as compared to C.

Conclusion: In training programs tissue ischemia seems to be a prerequisite for CPC mobilization. However, ischemic and sub-ischemic ET affects CXCR4 expression of CPCs, which might lead to an improved CPC incorporation into endothelial networks.

The impact of prolonged strenuous endurance exercise on Interleukin 18 and Interleukin 18 binding protein in recreational cyclists

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Introduction: Interleukin 18 (IL-18) is an important pro-inflammatory cytokine in the early phase of human immune response to microbial infections. The influence of strenuous exercise on the intrinsic balance of IL-18 and its endogenous antagonist IL-18 binding protein (IL-18BP) is unknown, but could be of major relevance for the athlete’s immune function empirically and epidemiologically proven to be altered after exhaustive exertion.

Methods: To study the effect of strenuous marathon cycling on the interaction of IL-18 and IL-18BP we investigated 37 male, healthy and well-trained amateur cyclists participating in the Ötztaler Radmarathon 1999 in Tyrol (distance:
230 km; cumulative altitude difference: 5,500 m). IL-18 was measured by a commercially available ELISA-Kit and IL-18BP by a novel IL-18BP ELISA method. Free, unbound IL-18 was calculated according to a standard equation.

**Results:** The mean plasma level of IL-18 was 142.27 ± 21.85 pg/ml pre-race, remained nearly unchanged (124.35 ± 13.16 pg/ml; \( p = 1.0 \)) immediately after competition (mean race time 9 h 38' min), but declined significantly 24 h afterward (62.92 ± 6.80 pg/ml; \( p = 0.002 \)). The plasma levels of IL-18BP increased considerably immediately after and kept on rising for the following 24 h (pre-race: 1.51 ± 0.20 ng/ml; immediately post-race: 3.84 ± 0.26 ng/ml, \( p < 0.001 \); 24 h post-race: 4.33 ± 0.42 ng/ml, \( p < 0.001 \)). Therefore, the calculated free IL-18 was 122.06 ± 16.79 pg/ml pre-race, declined to 82.86 ± 8.59 (\( p = 0.05 \)) immediately post-race and to 39.17 ± 3.76 pg/ml 24 h post-race (\( p < 0.001 \)). The respective percentages of this post-exercise reduction in free IL-18 plasma levels were 32% and 68%. The mean values of IL-18, IL-18BP, free IL-18 and of 3 selected parameters are summarised in the Table. The courses of IL-18, IL-18BP and free IL-18 during the marathon are presented in the Figure.

<table>
<thead>
<tr>
<th>before</th>
<th>immediately after</th>
<th>24 h after</th>
</tr>
</thead>
<tbody>
<tr>
<td>IL-18 (pg/mL)</td>
<td>142.3 ± 21.9</td>
<td>124.5 ± 13.2 (ns)</td>
</tr>
<tr>
<td>IL-18BP (ng/mL)</td>
<td>1.51 ± 0.20</td>
<td>3.84 ± 0.26 (( p &lt; 0.001 ))</td>
</tr>
<tr>
<td>free IL-18 (pg/ml)</td>
<td>122.1 ± 16.8</td>
<td>82.9 ± 8.6 (( p &lt; 0.05 ))</td>
</tr>
<tr>
<td>CK (U/L)</td>
<td>79 ± 58</td>
<td>160 ± 12 (( p &lt; 0.01 ))</td>
</tr>
<tr>
<td>CRP (mg/dl)</td>
<td>all &lt; 0.70</td>
<td>0.73 ± 0.14 (ns)</td>
</tr>
<tr>
<td>Leukocytes (G/L)</td>
<td>6.74 ± 1.51</td>
<td>17.35 ± 4.3 (( p &lt; 0.001 ))</td>
</tr>
</tbody>
</table>

Values presented as mean ± standard deviation; ns = non significant; CK = creatine kinase; CRP = C-reactive protein

**Discussion:** The present study reveals an exercise-induced significant decline in free IL-18 accompanied by an immediate up-regulation of IL-18BP and decreased IL-18 in marathon cyclists. This down-regulation of free IL-18 may (i) limit the magnitude and duration of a too excessive inflammatory response to the exercise-induced tissue damage and (ii) on the other hand contribute to the elevated susceptibility to infection in athletes undergoing exhaustive exercise.

**Strength and Conditioning in High-Level Athletes**

**Physical conditioning in high-level basketball**

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There are two possible explanations for an importance of physical conditioning (PC) in a modern basketball. First explanation undoubtedly is that higher physical qualities of athletes improve basketball game. Second, better individual physical conditioning level of players extend their high level of short-term and long-term performance. Sometimes, examples of sport success are not well connected with newest scientific proofs. Although, practical approach with scientific background has a great benefit. Multidirectional game analysis has a great influence on a PC structure in basketball. In fact, basketball game is a really complex sport with numerous factors which influence a final score. Next step is performance analysis of basketball players. It results by player’s performance profile. Both game analysis and players performance profile need to be calculated in PC program design [3].

Motor and energetic abilities, body composition, health status and both specific and nonspecific motor skills are main target of PC programs. Those qualities could be improved by versatile, basic, specific and situational PC programs and procedures [1]. As level of basketball players is higher, more specific and situational PC contents are included. All types of PC are intraconnected and put together in the complex net of periodization. Periodization is the key term of controlling of the high sport shape level. Competition calendar determine periodization parameters. That is the reason why PC goals are not always and only individual and isolated. It means that wide range of group and team PC exercises and methods should be calculated. European high-level basketball has great demands to athletes. Long season and extended national teams competitions allow just a few weeks of rest in one year cycle.

As we can see, there is not enough time for developmental programs. PC coaches have a hard task to maintain and sometimes rebuild current state of athletes. Furthermore, three well known states of athletes need to be identified (overtraining, detraining and untraining), and should be avoided. By avoiding those states, possibility of less injuries and better training effectiveness is real. Finally, what has to be trained in PC? Both neuromuscular and energetic strategies of PC training are directed to improve characteristics which are necessary for manifestation of competition qualities. Those programs should include exercises, methods and loads which are functionally close to basketball game demands. In simply way, five general purposes of PC in basketball could be recognized: development of basic physical abilities and capacities, improving of specific and situational preparedness, fatigue put off, increasing speed of recovery and injury prevention [2].

References


Strength and conditioning in motor sports athletes

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Introduction: Regarding physiological profiles and training regimens for professional motor sports drivers there is a lack of evidence-based scientific data and training recommendations [1,2]. Mainly in GT sports while attending short-term (up to 3 hours) and long-term races up to 24 h (e.g. 24 h of Le Mans; 12 h of Sebring) the physical fitness of the drivers is one of the limiting factors during competition. Furthermore, participation in different racing series world wide (e.g. ALMS series in the US, FIA GT series) and additional race car or tire test sessions require weekly,
mainly intercontinental travelling. Adding all these different activities and requirements in modern motor sports, an all-year fitness program has to be established.

Methods and Results: 8 professional motor sport athletes (Porsche AG factory drivers) were followed over a period of three years. Basically, an initial performance capacity test concerning endurance performance capacity (cycle and running ergometry), strength capacity in single and multi-joint exercise situations (e.g. lower limbs, steering wheel), postural control, simple and multiple reaction tests as well as different medical examinations were done. In addition to these traditional athletes testing procedures sport-type specific requirements were evaluated during different training sessions in the car.

According to the data analysed, different training regimens (aerobic endurance training, strength and sensory motor training and body stabilisation work) have been developed and performed with the drivers. In accordance with the time schedule of the drivers a year round training regimen including basic periods, training camp and competition accompanying work-outs were defined.

As a result an improvement in all categories of physical fitness could be seen. The overall level after the observation period was comparable to other physical active populations. With respect to postural control and reaction tasks the motor sport athletes are excellent which can be interpreted as sport-type specific requirements. Besides the improvement of physical fitness medical diagnosis (e.g. common colds) and overuse injuries were reduced. Furthermore drivers report less physical stress due to intercontinental travelling as well as an enhanced ability to recover during and after race competition was observed.

Discussion and Conclusion: Professional motor sport drivers are exposed to a high degree of physical and mental stress [3,4]. Consequently, an optimum physical fitness adapted to sport-type specific requirements is necessary. Furthermore, year-round travelling requires a high amount of basic endurance capacity to optimize regeneration.

References

Strength and conditioning in high-level athletes in alpine skiing

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Introduction: An optimized training environment ensures consistent success in alpine ski racing at all age levels. Optimal training quality can be reached only when exact knowledge of biomechanical characteristics of modern racing techniques employed by elite racers is elicited through complex field research [4–6]. Alpine ski racing demands a multitude of technical skills and excellent physical abilities, but there is relatively little published sport scientific data of fitness profiles of athletes. Two contradictory studies describe what are considered essential physical qualities for ski racing success. Neumayr et al. [3] used physiological and strength data from Austrian world cup athletes in the time period from 1997 to 2000 and concluded that aerobic capacity and strength were paramount. Bosco [1] maintained after testing Italian ski racers that anaerobic endurance was most important in determining performance potential, and advised against high volume aerobic training. Due to the constant evolution of ski equipment as well as changing environmental factors (e.g. artificial snow) and the complexity of skiing techniques, there is no one single physiological variable that can determine success in alpine ski racing.

Importance of long term training concepts: Training quality is optimized through systematic planning and goal oriented training programs, especially in a seasonal sport like alpine ski racing. Testing must aid in this process, examining the sport specific parameters so that the test results can determine current individual status and evaluate
individual progress. Even young ski racers must develop appropriate physical fitness and skills (e.g. mastering power cleans and squats) in order to cope with the demands that are placed upon the musculoskeletal system. Injury prevention is a critical factor in every training program. In Austria, schools which focus on ski sport (International Schools for Ski Athletes in Stams or Schladming) are an essential part of this concept. It should be also noted that the 10–16 years age group can be very sensitive to training volume and intensity due to physical development changes which are occurring. Therefore it is imperative that training exercises and programs as well as test batteries are designed with the physical development and sensitivity of the athletes in mind. As the athlete matures, intensity and volume of conditioning training are increased.

**Periodisation, individualisation and ski-specific aspects of strength and conditioning training:** Obviously skiing is the most important part of training but due to financial and organizational reasons off season training is dominated by dryland training. All athletes must have a solid fitness base to withstand the rigors of a ski season, so aerobic fitness is critical and a certain level must be achieved. Coordination training often combined with strength training is a very important aspect of dryland conditioning. In recent years balance, rhythm, kinesthetic sense and other coordination abilities vital to ski racing are emphasized even more. Müller and Schwameder [2] showed that with the new carving skis, unintentional changes of the edging angel in a turn cause big changes in the turn radius. Actual testing has shown that Austrian top ski racers have excellent leg and core strength, but the individuals may vary greatly in power and quickness. Most athletes in the Austrian world cup teams have private conditioning coaches and together with the training group conditioning coach programs are developed to improve the weaknesses and maximize the strengths of each individual. In the 10–16 years age group most programs are general in that the athletes have similar programs unless individual problems or deficiencies are detected by coaches, physiotherapists or sport scientists. They do not yet specialize in racing disciplines, so it is important that the athletes develop an excellent general fitness base. Strength, power, strength endurance, coordination, and aerobic/anaerobic fitness (in no particular order) are part of age-appropriate general training programs. As a racing career progresses, most athletes specialize and do not ski all 4 alpine disciplines. Training will then become more specific as the athlete moves into the speed or technical disciplines. Downhillers tend focus less on power and quickness than slalom skiers, for example.

**Conclusion:** Ski racing has become more ‘athletic’ in the last decade due to shorter skis with more sidecut and binding plates. Quicker turns at higher speeds require skiers to be more agile and simply better athletes. There cannot be a ‘cookie cutter’ approach to producing top ski racers, as there is no prototype for success. Skiers have not only individual racing styles, but are unique physically as well.

**References**


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**Strength and conditioning in high-level athletes in soccer**

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**Introduction:** While success in soccer depends on a myriad of factors (technical/biomechanical, tactical, mental and physiological factors [4], sprint and power capacity seem to be the most important physical performance components determining succesful actions in modern professional soccer. In addition, the duration of the game
and the accompanying high running distances (8–12 km) require sufficient endurance capacity in order to allow for adequate reproducibility of sprint and power events. Finally, since soccer is a discipline with a rather high risk of injury (especially ankle and knee joint as well as muscle injuries), complete strength and conditioning programmes for soccer players should integrate active prevention training strategies to reduce injury occurrence.

**Training of speed and power:** The soccer player has to fulfil different physical requirements within the game. With regard to sprint and power activities these include acceleration sprints (5–15 m), maximum velocity tasks (20–30 m sprints, sometimes also longer distances), agility tasks (multidirectional sprinting including deceleration tasks) as well as jumping and forceful balance activities in the single combat. Basically, sprint and jump performance is greatly influenced by the levels of maximum strength, especially in the squat exercise. In addition, jumping performance (i.e. vertical jumping height in a counter movement jump) is significantly related to sprinting performance. Consequently, training for improving maximum strength of the leg extensor chain and training strategies to improve jumping ability are basic necessities in targeted strength and conditioning in soccer. With regard to the movement patterns of soccer-specific sprint- and power-events, it seems that the conditioning specialist in soccer has to put emphasis on training of the different components of sprint performance (acceleration, maximal velocity, agility intensively) intensively and indepentely. This is indicated by research demonstrating that there is limited transfer between the different expressions of sprint (i.e. improvements in linear sprint performance cannot be transferred to agility sprints and vice versa [5]. In the field of strength and conditioning, reproducibility of sprint and related power activities has to be realized by means of improving endurance capacity (i.e. maximal oxygen uptake). Actual research indicates that high-intensity interval programmes seem to induce the necessary improvements in maximal oxygen uptake very specifically [2]. Consequently, since the endurance requirements in soccer are related to multidirectional sprint endurance, interval programmes consisting of soccer-specific variable movements tasks seem to induce the necessary adaptations more appropriately than long low-intensity linear endurance runs. In other words, it may be advantageous for the soccer player if endurance capacity is trained mainly with the target movement patterns of competition.

**Training strategies for injury prevention:** Biomechanical research indicates that improvements in local and global neuromuscular function (landing mechanics, eccentric muscle function, optimization of length-tension-relationship) are important prerequisites for efficient active injury prevention [3]. In addition, a high repertoire of soccer-related movement patterns may assist in decreasing injury risk. This can be concluded from research showing that in soccer-specific running and cutting tasks unanticipated conditions induce poor activity of stabilizer synergies [1]. Rather, generalized co-activation patterns of prime movers were observed which seem to represent an insufficient strategy in resisting abnormal joint loading (i.e. high valgus moments in the knee joint).

**Integration of strength and conditioning in soccer-specific periodisation:** The strength and conditioning specialist in soccer has to deal with a broad spectrum of factors and components limiting physical performance. As a consequence, integration of all these necessary aspects is very time consuming. In addition, since most of the performance-related activities have a high-intensity component, proper planning of preparatory periods as well as weekly training schedule is of paramount importance to allow for optimal performance development thereby avoiding symptoms of overreaching and overtraining. Consequently, the proper integration of relevant strength and conditioning exercises in the training schedule of a sports discipline with about ten months of season and a high frequency of competition (for international level teams frequently two games per week) represents a big challenge for the strength and conditioning staff.

**References**

Rehabilitation – Gait Analysis

Gait analysis in special populations

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Introduction: In recent years new kinetic and/or kinematic systems for gait analysis, including enhanced computing power, have been launched on the market. Their capability to handle and analyse large data sets renders possible to perform extensive measurements of many parameters and in different populations and situations [2]. Although such systems could stimulate the work and the creativity of researchers, they have still limitations. Whatever the sophistication of the measurement systems, the accuracy and the scientific relevance of the measurements must be always (re)evaluated. In addition measurements have nowadays to comply with ethical committee requirements and thus with limited possibilities to recruit sufficient number of subjects showing exactly the same specificity, i.e. homogeneous biological characteristics including (or not) the same pathologies. Nevertheless single subject analysis (SSA, which consists of making a large number of repeated measurements on one subject instead of one measurement on large number of subjects) could be applied in such case [6]. The aim of this presentation is to report both the new possibilities and limitations offered by recent systems and new analysis methods in gait analysis of special populations.

Methods: Biomechanical data mainly obtained with a treadmill dynamometer [2] for several years on many consecutive steps in many experiments (e.g. [1,4]) on different groups of subjects, including specific population [5] were revisited. Both the intra-individual (i.e. the intra-stride) and the inter-individual coefficient of variability (CV = mean/SD.100) have been established and compared for selected mechanical parameters and in different situations.

Results: To summarize, the intra-individual CV could vary from about 1% to 10% meanwhile inter-individual CV values were about twice the intra individual CV values. Intra- and inter-individual CV were mainly dependant of the studied parameter, and with less extension of the population and the situation.

Discussion and conclusion: Intra individual CV values confirm that whatever the studied parameter, mechanical measurements should be performed on many consecutive steps [3] in order to be representative of the “average” step and compatible with accuracy of dynamic measurements [2]. SSA assumes that intra-individual variability is representative of inter individual variability. This assumption is supported by the proportionality found between inter and intra CV values in different mechanical parameter. This could dramatically reduce the experimental protocols needed to evaluate the influence of treatments and/or devices in special population. However further analysis of inter- and intra-variability characteristics have still to be performed in order to generalise SSA possibilities to different populations and conditions.

References
Nordic walking – A field study of biomechanical loading of the lower extremities

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Introduction: Nowadays, according to the German Nordic Walking association 2 million people are doing Nordic Walking in Germany. Previous studies about the benefits of this sport for prevention and health promotion have shown positive physiological effects like higher oxygen consumption, heart rate and caloric expenditure [1,4]. However, the biomechanical loading of the lower extremities is still a widespread discussed issue. For example, some sports associations or journals of physical exercise still state that walking with Nordic Walking poles provide 30–50% load reduction to the lower extremities (see e.g. [3]). Though, this reduction seems to be clearly overestimated. Therefore, the aim of this study was to analyse the loading of the lower extremities during Nordic Walking compared to walking.

Methods: For that purpose 14 experienced, middle aged Nordic Walkers and 6 Nordic Walking instructors have been asked to walk a 1575 m field track in randomised sequence, once with and once without poles. All subjects wore a little backpack with mobile data acquisition equipment. Biomechanical variables like the vertical ground reaction force (by insoles), vertical forces in the walking poles and position (by force transducers and inclinometers), and range of motion of the ankle and knee joint (by goniometers) have been recorded over 100 step cycles.

Results: The mean vertical ground reaction forces are not different between Nordic Walking and Walking. Due to dynamic forces, peak loads of approximately 140–170% of the body weight have been measured. Nordic Walking differs from Walking mainly by the lower forces (around 4%) measured by toe off due to the use of the poles. On the other hand, at heel contact the forces are turning out a bit higher caused by forward acceleration. Similar results have been found on different walking trails.

The vertical forces measured in the poles are in average 5 kg and could exceed to 12 kg maximum. It has to be pointed out, however, that the landing of the pole has been measured in an angle of 30–50°, so that an effective release through the poles becomes less in vertical direction.

Discussion: The present results show that the common opinion of a load reduction of the lower extremities by 30–50% during Nordic Walking has to be rejected. Therefore, Nordic Walking as a sport to reduce joint loading of the lower extremities should not longer be recommended. Though, physiological benefits and motivational aspects to decrease inactivity should be more emphasised.

Conclusion: In future, research should focus on clinical examples of patients with anterior knee pain who indicate less pain after Nordic Walking. One additional factor of pain relief might be in these cases a different neuromuscular control mechanism compared to Walking.

References

Gait analysis in dysplasia of the cruciate ligaments

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Introduction: Congenital aplasia of only the anterior or both cruciate ligaments is a very common associated pathology of the knee joint in congenital longitudinal deformities. The cruciate ligaments and associated abnormalities of the bony configuration were evaluated on magnetic resonance imaging and tunnel view radiograph.

Methods: Gait analysis was employed to determine kinematic, kinetic, and muscle electromyographic data in 25 patients and the results were compared to an age-matched control group. The cruciate ligaments and associated abnormalities of the bony configuration were evaluated on magnetic resonance imaging and tunnel view radiographs.

Table 1
Results of gait analysis and EMG

<table>
<thead>
<tr>
<th>Gait analysis</th>
<th>Total (n = 27)</th>
<th>Type I (n = 16)</th>
<th>Type II (n = 6)</th>
<th>Type III (n = 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal flexion moment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface EMG</td>
<td>n = 17</td>
<td>n = 10</td>
<td>n = 3</td>
<td>n = 4</td>
</tr>
<tr>
<td>Mid stance activity of M.rectus femoris</td>
<td>59%</td>
<td>50%</td>
<td>66%</td>
<td>75%</td>
</tr>
<tr>
<td>M.gastrocnemius and M.vastus lat. activity</td>
<td>normal</td>
<td>normal</td>
<td>normal</td>
<td>normal</td>
</tr>
</tbody>
</table>

Results: The main findings in gait analysis were significantly increased extension moment of the hip, increased flexion of the knee in mid stance phase and reduced ankle power in comparison to the control group. 44% of the patient group showed a quadriceps avoidance pattern and abnormalities in the EMG pattern were found in 59%. The knee joint with aplastic cruciate ligaments shows typical radiological changes, thus, one will be able to distinguish between aplasia of the ACL only or both cruciate ligaments by observing plain tunnel view radiographs. From this classification we were able find a different amount of the quadriceps avoidance pattern.

Discussion: We differentiated 3 main types of absence of the cruciate ligaments with typical associated changes in the femoral intercondylar notch and the tibial eminence. The quotient of the quadriceps avoidance pattern in the group with no ACL and PCL was higher then in the two other groups. As reported in other studies about patients with an ACL-deficient (injury) a quadriceps avoidance pattern can be seen but not in all patients. Also in our patients we have seen patients with an abnormal EMG activity but normal joint kinematics and kinetics.

Conclusion: Our obtained data of the gait analysis revealed specific gait patterns as adaptation to underlying aplasia of the cruciate ligaments. Not all patients showed a quadriceps avoidance pattern, some of same were able to walk in a normal way without any cruciate ligaments. Some patients with congenital aplasia of only the anterior or both cruciate ligaments we able to walk quit normal without any abnormal kinematics, kinetics or EMG activities. Further research is needed to analyze the EMG activity of smaller muscles surrounding the knee joint.
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Introduction: Increased knee valgus alignment and alteration in Hamstrings/Quadriceps (H:Q) muscle activity are to be related to higher anterior cruciate ligaments (ACL) injury risk in women during squat tasks (e.g. [1,2]). ACL injuries may be induced by high loadings, however, no gender studies on knee valgus movement and H:Q muscle imbalances during maximal eccentric contractions (ECC) have yet been presented.

Methods: Twenty-six healthy, recreational athletes (13 men, 13 women; aged: 20–35 years) with no history of knee injuries and knee pain were asked to perform 6 eccentric right-leg press contractions (velocity: 0.2 m/s) on the isokinetic CON-TREX dynamometer. The knee flexion during the movement was determined by knee angles that ranged from 130° to 85° (LUKOTRONIC 3-D Motion AS 2000). Surface electromyographic (EMG) signals were recorded (NORAXON), filtered, and rectified from Hamstrings (BF+ST) and Quadriceps (VL+VM). Three contractions with the highest force values were used for subsequent analyses. The time of knee flexion motion (~100%) was divided into five sections (20%) and all values within each section were averaged. The knee valgus alignment during ECC was related to the automatically driven movement without any muscle contraction (i.e., relaxation). The EMG data were normalised individually to the largest value within ECC and presented as H:Q. Two-way ANOVA for repeated measurements with Bonferroni correction for force, valgus movement and muscle activity, and Pearson’s correlation coefficient for the relationship between knee valgus motion in relaxation and...
during ECC were calculated \((P < 0.05)\). Values given below are mean ± SD or mean ± SE (Fig. 1), respectively. All analyses were performed using MATLAB and SPSS.

**Results:** Expectedly, significant differences in forces between sexes were found \((P < 0.001)\), with greatest values occurred at 20–40% of the time of knee flexion in both men and women. There were no significant differences in knee valgus movement in gender; however, male subjects displayed a gradual knee valgus motion towards the end of ECC \((P <0.001)\) (Fig. 1). In the beginning, women with slight knee valgus alignment in relaxation showed significantly increased knee valgus movement during ECC (Table 1). The H:Q muscle activity ratio was similar in gender \((P > 0.05)\) and the ratio was not altered significantly by the time of knee flexion.

<table>
<thead>
<tr>
<th>Time of knee flexion (%)</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–20</td>
<td>−0.24</td>
<td>−0.77**</td>
</tr>
<tr>
<td>20–40</td>
<td>0.12</td>
<td>−0.69*</td>
</tr>
<tr>
<td>40–60</td>
<td>0.43</td>
<td>−0.56</td>
</tr>
<tr>
<td>60–80</td>
<td>0.58</td>
<td>−0.47</td>
</tr>
</tbody>
</table>

**Discussion:** The unchanged knee valgus movement in gender is not consistent with the previous studies. Moreover, the trend towards greater dynamic knee valgus movement in subjects with greater valgus alignment in relaxation [3] could not be presented in our female group. There was also lack of evidence for alterations in H:Q ratio between sexes. These controversial results might be based on the experimental conditions in which hip muscles which are suggested as a risk factor for ACL injuries [5] were partly excluded. In addition, improved vision control in sitting position can not be neglected [4].

**Conclusion:** These results did not confirm the assumption that women are more vulnerable to ACL injuries during high loadings. Further studies on knee valgus movement and neuromuscular activity during ECC in both sitting and standing experimental position will be required in order to verify these controversial results.

**References**


**Longitudinal observation of walking stereotype and its changes in patients suffering from stroke or brain injury**

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**Introduction:** The purpose of the research described in this work is to answer how the alignment of muscle groups changes in lower limb before and after application of botulinum A toxin using 3-dimensional motion analysis study. The movement of our patients is specific in walking stereotype. It can be simplify in terms of flexion – extension of knee and ankle joints.

**Methods:** We have been working on this study for 3 years and so far we have examined 23 patients at least twice. The aim of our work was to observe and determine the changes in flexion – extension movement of the knee joint,
circumduction of pelvic and the forward trajectory of the ankle joint during the treatment helped by botulinum A toxin injection into medial head of gastrocnemius muscle and soleus muscle. All the patients suffer from stroke or other brain injury and this suffering turns out as spastic hypertonia which does not allow the proper movement and walk. This observation was done by 3-dimensional motion analysis study. Every patient walked three times for the intra-individual stability measurement provision. Motion analysis study was taken before, 14 days and sometimes 85 days after application of botulinum A toxin. The patients walked on the 5 m long carpet and their movement was recorded by 4 miniDV video cameras. On the lower limbs, upper limbs and trunk there were the marks on the skin, which represented the significant points on the skeleton: fifth metatars, extraneous ankle (lateral melleolus), head of fibula, hip (greater trochanter). For the 3D coordinates of the points on the body the DLT algorithm was used supported by Tema Bio software, which allows automatic recognition of the marks.

**Results:** The measurements show that the alignment of lower limb in therm of hyperextension, plantar flexion changes in physiological extension in knee joint and decreasing of plantar flexion. Circumduction disappears and also the elevation of hip disappears.

**Conclusion:** In conclusion, one can state that the injection of botulinum A toxin decreases the muscle stiffness in specific muscle groups and it automatically changes the alignment of lower limb in better way. The analysis of walking can be simplified by several points on the lower limbs, which are characteristic for specific stereotype of movement for selected group of patients. Among to these movements belongs flexion – extension of knee and ankle joint and forward trajectory of foot. These three specific movements we consider as the most characteristic for patient’s walking stereotype.

**References**


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**Exercise Testing in Health and Disease**

**Performance diagnostics in athletes and patients**

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Diagnosing physical capacity, particularly endurance capacity, has become an important field of investigation in sports medicine. Originally it was developed to measure an athlete’s performance capacity and to give advice on an appropriate training program. It is now also used to diagnose and advise patients with cardio-respiratory illnesses. In athletes, we want to determine their maximum individual performance capacities, while in patients the aim is to set limits on physical activity or training. In athletes and untrained subjects, there is no difference between maximum
performance capacity and the maximum possible activity level. In patients with cardio-respiratory illnesses, however, these values may differ widely. Patients with ischemic conditions or various heart insufficiencies are able to perform very well, but they may enter the danger zone at a very low level of physical activity.

All essential diagnostic procedures include an incrementally increasing exercise test as well as physiological and clinical parameters. The simplest parameters are the patients subjective symptoms (Borg Scale) or clinical signs, for example the appearance of exercise dyspnoea, hypertonic blood pressure or significant arrhythmias. Further criteria are heart rate behaviour, blood lactate concentration or behaviour of spiroergometric parameters. More complex diagnostic tests may be necessary in the case of myopathy, for example, it is important to determine pyruvate and ammonia concentrations in the blood. But, to achieve a rational relationship between cost and effectiveness, more extensive diagnostic procedures should be reserved for the verification of a particular disease in question.

References


Laboratory testing and physiological characteristics of top czech soccers

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Introduction: Soccer is one of the most popular sports in the world, and its popularity is continuing to increase. There is still much uncertainty and debate surrounding its physiological requirements. The coaching emphasis on skill development, deficiencies in fitness training and conservative training methods lead to difficulties in the scientific study of soccer. Generally, there is a reduction in the level of movement activity in the second half of the game. There is some empirical evidence that increased aerobic fitness may help to improve the second half performance.

The laboratory testing and thus the evaluation of changes in cardiorespiratory and metabolic variables during submaximal exercise, may help to explain the process of adaptation (actual training state) to the training stimulus, and these variables could be used for training checking. This is because the maximal functional variables in homogeneous groups of trained subjects cannot adequately evaluate changes in the training state. The changes in the maximal values of functional variables during the season are almost indistinguishable from errors of measurement. The most frequently used variables for the characterisation of adaptation to physical activity are related to the ventilatory threshold (VT). Another variable which may be used for indirect evaluation of changes in adaptation to exercise is the energy cost of exercise. The energy cost of running may be assessed with a help of energy cost coefficient C, which indicates how much energy is required to transfer the body mass of 1 kg over 1 m.

Methods: Nowadays could be used together with long time used classical parameters of body composition – body fat content and free fat mass - also other variables which may characterise the BC like are body cell mass (BCM) and extracellular mass (ECM). At the cellular level, FFM consists of BCM, extracellular fluids (ECF) and extracellular solids (ECS), and FFM could be calculated as follows FFM = BCM + ECF + ECS, ECM = ECF + ECS, and FFM = BCM + ECM. The fact that differences in body size and body composition influence the predisposition and interpretation of parameters such as absolute and relative maximal oxygen consumption and/or physical performance
is well known. Less well studied are the effects of differences of body composition on performance predispositions like maximal oxygen uptake, CTW and MPO in top soccerers.

The physiological profiles of 97 top Czech soccer players (mean age = 24.6 ± 3.4 years, mass = 78.9 ± 6.3 kg, body height = 182.4 ± 5.4 cm, body fat = 10.8 ± 2.1% and ECM/BCM = 0.78 ± 0.06) were measured by the incremental exercise protocol on the treadmill with 5% inclination. All players systematically trained at least 11 years with a minimum of five training units per week.

Results: Mean VO$_{2\text{max}}$ kg$^{-1}$ was 61.9 ± 5.5 ml.kg$^{-1}$.min$^{-1}$. Mean value of maximal running speed was 16.8 ± 1.0 km.h$^{-1}$. Values of RER$_{\text{max}}$ = 1.16 ± 0.08 and L$A_{\text{max}}$ was 12.1 ± 1.3 mmol.L$^{-1}$. The selected variables at the VT level corresponded to VO$_2$ kg$^{-1}$ = 49.4 ± 2.2 ml.kg$^{-1}$.min$^{-1}$, %VO$_{2\text{max}}$ kg$^{-1}$ at VT level were 80.5 ± 3.5%, speed = 13.5 ± 1.1 km.h$^{-1}$, %$V_{\text{max}}$ at VT level were 80.4 ± 2.9%. The energy cost of running was 3.86 ± 0.22 J.kg$^{-1}$.m$^{-1}$.

Discussion: Three general areas of fitness is necessary to assess if we have interest to characterise the predisposition for sport performance: anthropometry (mainly body dimensions and body composition); muscular strength, endurance and power (often determined by help of motor performance in field or laboratory conditions); and aerobic and anaerobic fitness (mainly characterised with help of maximal oxygen uptake and lactate or variables which may describe the anaerobic production of an energy). The actual motor performance and thus the actual state of physical fitness of subjects is partly a consequence of their genetic predisposition and partly a consequence of the moving training they undertake. In practice it is difficult to separate these two components. As in other sports events where the skills play the decisive role, the physiological data are not the sole predictor of racing success. On the other hand we must remark than these standards are necessary but not only sufficient conditions for success in the race, but the decisive predispositions for long lasting successful training process. These data play important role in selection of talents for particular sports event.

Conclusion: We may conclude that the physiological characteristics of top players should be as follows: VO$_{2\text{max}}$ higher than 60 ml.kg$^{-1}$.min$^{-1}$ in defenders, and higher than 62 ml.kg$^{-1}$.min$^{-1}$, in midfielders and forwards. Maximal speed (at 5% inclination) should be higher than 17 km.h$^{-1}$ in all players, the speed at VT higher than 13.8 km.h$^{-1}$, %VO$_{2\text{max}}$ at VT level higher than 81.0%, and the energy cost lower than 3.85 J.kg$^{-1}$.m$^{-1}$.

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Influence of different work load protocols on standard criteria of physical performance and on characteristics of lactate kinetics

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Introduction: Exercise tests are performed to determine physical performance capacity and to set guidelines for an optimal training intensity. Tests commonly used rely on lactate concentration in arterial blood as a metabolite linked to anaerobic energy metabolism and use specific work load protocols to establish a functional relation between lactate concentration and work load (so called “work load-lactate-curve”). However, several different stepwise increasing work load protocols are applied which differ both in work load increment and step duration. It was the goal of our study to investigate the influence of different work load protocols both on standard measures of physical performance (lactate thresholds, maximal lactate concentration, maximal work load) and on the estimated parameters of a two-compartment-model of lactate kinetics.

Methods: Nine male well endurance trained volunteers were subjected to three work load protocols on a bicycle ergometer: protocol A (starting work load 60 W, step increment 20 W, step duration 1 min), protocol B (starting work load 50 W, step increment 50 W, step duration 3 min), and protocol C (starting work load 40 W, step increment 40 W, step duration 4 min). The measured physiological variables were lactate concentration in arterialized capillary blood and heart rate, determined at the end of every single work load step and successively for 30 min during the recovery phase. The standard criteria of physical performance for each protocol were obtained according to established procedures. For the model oriented evaluation a two compartment model in combination with nonlinear
representations for lactate production and elimination with 5 free parameters was established (1 parameter: diffusion, 2 parameters: production, 2 parameters: elimination). Based on experimental lactate-data from the ergometer tests the 5 parameters were estimated for each protocol using the Levenberg-Marquardt-procedure on a standard-PC. Using the estimated parameters the work load-lactate-relation was simulated for each protocol and the simulation results were compared to the experimental data, using a cumulated squared sum of deviations criterion to quantify the quality of the fit.

Results: The standard criteria of physical performance differed statistically significant between the protocols, with protocol A showing the most prominent differences (ref. Fig. 1: anaerobic thresholds – 4 mmol/l lactate concentration). The set of parameters estimated via the model oriented approach also showed differences between the protocols but to a much lesser extend than the standard criteria. Nevertheless, prognostic simulations based on the parameter set obtained from protocol A onto experimental data from protocol B resp. C showed marked deviations between simulation and experiments, prognostic simulations from protocol B to C and vice versa came close to the experimental data.

Discussion: Our results demonstrate that the standard criteria of physical performance depend strongly on the work load protocol used, in contrast to the model oriented approach, which seems largely to be independent from the work load protocol (effects only to be seen on the diffusion and on the primary elimination parameter). Protocol A, however, seems to be a rather problematic protocol for the estimation of the parameters of lactate kinetics because the step duration of 1min is in the range of the half life time of the diffusion process and therefore interferences occur.

Conclusion: The results of standard criteria of physical performance depend to a high extend on the work protocol used. A model oriented approach is less sensitive to the work load protocol, however, a work load protocol with a step duration greater than 1min should be used. A crossover-interpretation from one work load protocol to another is highly erroneous for the standard criteria and simple guidelines for correction can hardly be defined.

Effect of competitive marathon cycling on plasma n-terminal probrain natriuretic peptide and cardiac troponin t in healthy cyclists

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Introduction: N-terminal pro-brain natriuretic peptide (NT-proBNP) and cardiac troponin T (cTnT) are today’s preferred humoral marker for heart failure and myocardial injury. Prolonged strenuous exercise may cause cardiac fatigue characterized by transient impaired cardiac function. For a further depiction of exercise-induced cardiac dysfunction we measured NT-proBNP and cTnT in recreational marathon cyclists (n = 29) during the Otztal Radmarathon 2004.

Methods and Results: NT-proBNP and cTnT were assessed by standard methods the day before, immediately after, 24 hours and one week after the competition. The workload of the race (total distance: 230 km; altitude difference: 5500 m) is comparable to that of the hardest mountain stages of the Tour de France. In all subjects levels of NT-proBNP rose significantly immediately after race from 27.9 ± 21.1 to 278.4 ± 151.5 ng/L (p <0.001), fell again on the following day and returned to baseline values one week later (Fig. 1). The mean percentage increase in NT-proBNP was calculated to be 1128 ± 803%. There was no correlation between NT-proBNP and baseline features or the markers investigated including cTnT. cTnT, negative in all subjects before, rose transiently in 8 athletes (27.5%) with levels ranging between 0.043–0.224 μg/L. A day after competition cTnT had normalized again in all athletes (Fig. 2). Athletes with and without exercise-induced cTnT elevation did not differ in their baseline features, such as age, race time, training-km in 2004, etc.

Conclusion: Owing to the general physiological effects of BNP and the release kinetics observed we consider the deflection of NT-proBNP to be the adequate volume-regulatory response of a haemodynamically stressed myocardium to cardio-renal distress. The observed kinetics of cTnT substantiates a release from the free cytoplasmatic pool due to the half-life of cytosolic cTnT (6h). As the underlying mechanism we suppose an exercise-induced overload of free radicals by the oxidative long-term stress which causes a hasty cardiomyocyte-membrane leakage with some egress of cytosolic cTnT into circulation. In healthy cyclists transient increases in NT-proBNP and cTnT are more likely to reflect reversible cardiac fatigue than irreversible cardiac injury or dysfunction in respect of the typical release kinetics of the indicators.
A comparison of different tests to assess lower extremity left/right strength imbalances

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Introduction: Assessing bilateral (BL) imbalances in strength is very important. However, imbalances may vary depending on the means of strength testing. Unilateral (UL) isokinetic and isometric testing have been used to test BL differences, but there are few studies comparing BL strength differences in a BL leg movement. Gerber et al. [4] showed differences in right and left leg force production during BL squats, but a comparison of UL and BL tests to our knowledge has not been undertaken. The aim of this study was to compare BL strength differences in isometric leg press, isokinetic (eccentric and concentric) leg press and squat jumps (SJ) (loaded and unloaded).

Methods: In preseason fitness testing 13 female members of the junior, European Cup and World Cup alpine ski teams of the Austrian Ski Federation were tested on the Contrex leg press with isokinetic concentric (CT Con) and eccentric (CT Ecc) UL leg extensions, isometric UL leg press and BL SJ. 2 separate isometric leg press tests were performed, at knee angles 85° and 100°. The subjects performed unloaded SJ (SJ Unl) and loaded SJ (SJ L) (100% of bodyweight as additional load) with ground reaction forces measured by two separate force platforms. A L/R strength ratio was calculated from the maximal force results for each test. A factor analysis was used to analyse the data.

Results: It was expected that each subject would have similar L/R ratios for each test, but this was not the case. See Table 1. The factor analysis extracted 3 factors, and the 3 types of tests each loaded on a different factor. See Table 2.

Discussion: The factor analysis suggests that BL imbalances in isometric, isokinetic and squat jump tests are not strongly related. Baker et al. [2] and Kanehisa and Miyashita [5] reported that isometric and dynamic strength are not related. Abernethy and Jurimae [1] showed that the timing and magnitude of changes in isometric and isokinetic strength with training vary from person to person. Blazevich et al. [3] demonstrated that isometric leg strength tests correlate to 1RM squat, but the correlations are not high enough to be highly valid. We found that the L/R strength ratios vary by test for some athletes, leading to this statistical analysis. It can only be speculated why differences occur between the tests. Variations in the structural, neural and mechanical mechanisms of the different types of muscle contractions and movements strongly influence commonalities and discrepancies between the tests.

Conclusion: BL imbalances should be tested, but can vary, depending upon the strength test used. BL tests should be used if possible, as they are more comparable to real athletic movements. The history of the individual
Table 1
L/R Ratios for 6 Strength Tests

<table>
<thead>
<tr>
<th>Subject</th>
<th>ISO 85°</th>
<th>ISO 100°</th>
<th>SJ Unl</th>
<th>SJ L</th>
<th>CT Con</th>
<th>CT Ecc</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>0.97</td>
<td>0.99</td>
<td>1.01</td>
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<td>0.89</td>
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<td>2</td>
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<td>1.00</td>
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<td>0.96</td>
<td>0.87</td>
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<tr>
<td>3</td>
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<td>5</td>
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</tr>
<tr>
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</tr>
<tr>
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<td>0.94</td>
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<td>0.96</td>
</tr>
<tr>
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<td>0.97</td>
<td>0.93</td>
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</tr>
<tr>
<td>12</td>
<td>0.89</td>
<td>0.99</td>
<td>1.03</td>
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<td>1.01</td>
</tr>
<tr>
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<td>1.10</td>
<td>1.08</td>
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Table 2
Rotated Component Matrix

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<th>3</th>
</tr>
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<td></td>
</tr>
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<td>ISO 100°</td>
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<td></td>
<td></td>
</tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>SJ L</td>
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<td></td>
<td></td>
</tr>
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<td>CT Con</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>CT Ecc</td>
<td>0.952</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The human power spectrum: maximum physical power is a function of activity duration

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Introduction: In all sports where the body or other heavy masses are to be accelerated, the physical power is a major performance factor. Maximum power production is a function of activity duration. Various biochemical mechanisms (immediate, glycolytic, oxidative energy sources) keep the cellular concentration of the chemical intermediate ATP which powers muscle contraction almost constant over a wide range of turn-over rates (ATP homeostasis).

Methods: For data evaluation the recently developed Power Spectrum Software package (bewotech.com) was used.
(1) For the jumping power analysis a Kistler force plate was used and power was determined according to
\[ P = \vec{F} \cdot \vec{s} / t = \vec{F} \cdot \vec{v}, \] with \( v = 1 / m \int F(t) \, dt \). Additionally, power during a time span below 0.1 s (the phase of maximum power during the acceleration movement of a jump with both legs) was measured. For the other time domains of relevance in sports the following test procedures were used for maximum power output determinations.

(2) The Sprint Power Test [1,2]: This test was designed to measure maximum short-time muscle power (time domain of a few seconds) on a mechanical weight ergometer (Monark, rotosport.com). The velocity of the flywheel was measured with an electronic device (Power Analyzer, bewotech.com; accuracy ± 0.001 s) which also allowed determination of the rotational energy of the fly-wheel: \( E_{\text{rot}} = I \omega^2 / 2 \), with \( I \) being the moment of inertia. For the Sprint Power Test the athlete performs a short sprint at 4% load to obtain maximum, followed by a pause of 5 minutes, followed by the next load step, etc. (4, 8, 10, 12, 14%) until maximum power decreased for the first time (the maximum of the sprint power function is called the sprint power SP).

(3) For the interval 10 to 100 seconds, the Wingate test with 7.5% load was applied and the 30-second mean power was used to represent this time domain.

(4) Endurance power was tested by means of a step test protocol (one-minute each), from 40 W to the obtainable maximum, using power increments resulting in 15 steps over all [3]. Here, the 75%-value of maximum power was used to estimate endurance power EP, which is in good agreement with the extensive empirical data of Hofmann P et al. [4].

**Results:** The example of a power spectrum of a decathlete is shown in Fig. 1. The athlete’s body mass \( m \) was 82.3 kg, BMI was 25.3 kg/m², the MI [5] was 25.2 kg/m² (indicating average leg length). The relative power in W/kg is indicated in the Figure. The endurance power EP of 3.3 W/kg was determined by means of a bicycle ergometer step test according to Hofmann [3,4], a Wingate Test (7.5% load) resulted in a mean power over 30 s of 8.0 W/kg (transition power TP), the Sprint Power SP [1] resulted in a maximum power of 17 W/kg, mean jumping power (JP) during the upward acceleration phase (225 ms from \( t_3 \) to \( t_5 \); Fig. 2) was 19.7 W/kg, and the maximum power (25 ms duration) during the jump was 40.5 W/kg (peak jumping power PJP). The upward movement of the centre of mass started at \( t_3 \), and \( t_5 \) was the take-off time. Compared to the EP (270 W), the TP (660 W) was 2.4 times higher, SP (1400 W) 5.2 times, JP (1620 W) 6.0 times, and the PJP (3340 W) was 12.4 times higher.

**Discussion and Conclusions:** The Power Spectrum Test results in a survey of the maximum mechanical power out-put of a test person in the time domains: (1) 0.01 to 0.1 s and (1a) 0.1 to 1 s, (2) 1 to 10 s, (3) 10 to 100 s, (4) 1.000 to 10.000 s. Various power-profiles of different athletes can easily be compared this way. However, for performance diagnosis for a given sport, the role of mechanical power has to be seen in the context of all other factors determining performance.
Obesity and Co-Morbidities

Epidemiology of obesity and hormonal markers

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\textit{Background:} The prevalences of obesity [defined as body mass index (BMI) \( \geq 30 \text{ kg/m}^2 \)] and also that of overweight (BMI >25–30) have increased during the last two decades in adults and in children. Also in European countries the number of overweight children is increasing by at least 400,000 every year, of which 85,000 can be considered as obese [1–3]. The unwarranted increase in body fat mass is the consequence of an altered energy balance, that is, an energy intake (EI) too high for the energy expenditure (EE) of an individual. Several studies have shown that an excess of body fat (especially when stored in the abdominal cavity) is associated with multiple metabolic complications [4] although the clinical perception that considers obesity as a disease is not in perfect harmony with the literature documenting the important physiological role of adipose tissue [5].

\textit{The Role of Adipose Tissue and secreted Peptides:} Adipose Tissue (AT) secretes a variety of peptides and non-peptides (‘Adipokines’). Most of them, such as, e.g. leptin, IL-6, TNF-\( \alpha \), PAI-1, resistin, LPL, adiponectin, ASP etc. are involved in many physiological mechanisms to regulate EI and EE. Research has revealed many functions of adipokines extending far beyond metabolism, such as immunity, cancer and bone formation [6]. In the state of obesity, however, some of these adipokines are elevated whereas others are downregulated. This has led to a series of studies investigating the possibility that AT-derived adipokines are involved in the development of obesity. Only a few studies found that obesity is the consequence of a genetic dysregulation and an altered level of the adipokines. Most studies have shown that an interaction of a genetic heritability and susceptibility to environmental factors is the
likely cause for the excess increase in body fat mass. Notwithstanding, the possibility that adipokines are involved in the maintenance of an altered EI and EE by adapting the neuronal circuitry and the limbic-hypothalamus-pituitary-adrenal axis can not be ruled out [7]. Noteworthy, some of adipokines are shown to affect several aspects in the pathogenesis of obesity-related diseases such as the metabolic syndrome [5].

**Current Strategies in the Treatment of Obesity:** Because body weight is greatly influenced by diet and exercise, a successful approach in the treatment includes low-caloric diet and regular exercise. Low-caloric diet is often associated with a loss in lean body mass and with a poor compliance leading to a regain in body weight and fat mass. Hence, physical activity through life-style modifications and regular exercise as part of the treatment are helpful in the maintenance of a reduced body weight. However, combining moderate energy restriction and physical training does not prevent the decline in EE even after adjustment for lean body mass in obese adolescents [8]. It is still matter of investigations whether resistance training or endurance training [9] is superior in weight management and also how much activity should be performed to stop an unhealthy body weight gain.

**Perspectives:** Given the difficulties to reduce an excessive body fat mass once it has already established prevention must be a key strategy for controlling the current epidemic of obesity. Therefore, children should be considered the priority population for intervention strategies. Some of these potential strategies for intervention in children can be implemented by targeting preschool institutions, schools or after-school care services as natural setting for influencing the diet and physical activity [10]. However, given the popularity of short-term weight loss camps but their poor outcome in the long-term, more successful interventions have to be developed. Such interventions have to include alterations to the obesogenic environment because these alterations are predicted to play a key role in reducing the prevalence of obesity [11].

**References**


**A 12 week endurance training program conducted in obese children**

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**Introduction:** This study investigates the effects of a twelve week endurance training program to physical fitness, body weight, lean body mass, plasma insulin, and plasma glucose, LDL, HDL and TG.

**Methods:** Twenty one morbidly obese children (13 boys and 8 girls ranging between 9 and 14 years) participated in this investigation. From these subjects 11 finished the study. Two retired because of injuries sustained in leisure time, 7 dropped out or did not reach the required 80 percent of training sessions. Eleven subjects finished the study.
Age was 10.9 ± 1.04 years, height 152 ± 11 cm, weight 75.0 ± 2.16, BMI 31.6 ± 5.13, lean body mass \((n = 10)\) 40.5 ± kg and body fat \((n = 10)\) was 46.9 ± 6.0 percents. The Subjects performed three 1-min-incremental tests at cycle ergometer (at the beginning, after 6 weeks and after 12 weeks). The test after 6 weeks was used to adjust the training to the actual physical fitness of subjects. Power output, VO\(_2\), HR and lactate (LA) were evaluated at exhaustion and at an “anaerobic threshold” (LTP2). Body composition was measured by Dual Energy X-Ray Absorbtimetry (DEXA). The training was conducted on cycle ergometer twice a week. It started with 21 minutes \((3 \times 7 \text{ minutes with 5 minutes rest between the exercise bouts})\) per training session (42 min per week) and ended with 42 minutes \((3 \times 18 \text{ min})\) per training session (108 min per week). The training intensity was set at 90% of power output determined at the “anaerobic threshold” (= LTP2).

**Results:** The evaluation of our study variables (Pre-Training = PRE vs. Post-Training = POST) showed following results:

<table>
<thead>
<tr>
<th></th>
<th>Pre – Training (PRE)</th>
<th>Post – Training (POST)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Height (m)</td>
<td>1.52</td>
<td>0.11</td>
</tr>
<tr>
<td>Body weight (kg)</td>
<td>75.0</td>
<td>2.16</td>
</tr>
<tr>
<td>BMI</td>
<td>31.6</td>
<td>5.1</td>
</tr>
<tr>
<td>Lean Body Mass (kg)</td>
<td>40.5</td>
<td>8.7</td>
</tr>
<tr>
<td>Body Fat (%)</td>
<td>46.9</td>
<td>6.0</td>
</tr>
<tr>
<td>Maximum Power output (Watt)</td>
<td>107.9</td>
<td>21.8</td>
</tr>
<tr>
<td>Power output LTP2 (Watt)</td>
<td>72.6</td>
<td>19.9</td>
</tr>
<tr>
<td>Maximum Power output (Watt.kg(^{-1}))</td>
<td>1.53</td>
<td>0.48</td>
</tr>
<tr>
<td>Power output LTP2 (Watt.kg(^{-1}))</td>
<td>1.09</td>
<td>0.37</td>
</tr>
<tr>
<td>Maximum Power output (Watt.BMI(^{-1}))</td>
<td>3.49</td>
<td>0.92</td>
</tr>
<tr>
<td>Power output LTP2 (Watt.BMI(^{-1}))</td>
<td>2.36</td>
<td>0.79</td>
</tr>
<tr>
<td>VO(_2)max (ml.min(^{-1}))</td>
<td>1774</td>
<td>316</td>
</tr>
<tr>
<td>VO(_2)LTP2 (ml.min(^{-1}))</td>
<td>1347</td>
<td>356</td>
</tr>
<tr>
<td>VO(_2)max (ml.kg(^{-1}.\text{min}^{-1}))</td>
<td>24.5</td>
<td>3.9</td>
</tr>
<tr>
<td>VO(_2)LTP2 (ml.kg(^{-1}.\text{min}^{-1}))</td>
<td>18.4</td>
<td>3.9</td>
</tr>
<tr>
<td>HRmax (bpm)</td>
<td>190.6</td>
<td>13.4</td>
</tr>
<tr>
<td>HR LTP2 (bpm)</td>
<td>166</td>
<td>12.8</td>
</tr>
<tr>
<td>Maximum Lactate (LAmax) (mmol.l(^{-1}))</td>
<td>6.4</td>
<td>1.9</td>
</tr>
<tr>
<td>LA LTP2 (mmol.l(^{-1}))</td>
<td>3.0</td>
<td>0.8</td>
</tr>
<tr>
<td>Insuline (µU/ml)</td>
<td>27.3</td>
<td>8.1</td>
</tr>
<tr>
<td>Glucose (mg/dl)</td>
<td>73.9</td>
<td>16.4</td>
</tr>
<tr>
<td>Cholesterol (mg/dl)</td>
<td>177.1</td>
<td>30.4</td>
</tr>
<tr>
<td>HDL-Cholesterol (HDL) (mg/dl)</td>
<td>41.4</td>
<td>6.9</td>
</tr>
<tr>
<td>LDL-Cholesterol (LDL) (mg/dl)</td>
<td>116.3</td>
<td>22.0</td>
</tr>
<tr>
<td>LDL/HDL- Ratio (LDL/HDL) (mg/dl)</td>
<td>2.9</td>
<td>0.9</td>
</tr>
<tr>
<td>Triglycerides (TG) (mg/dl)</td>
<td>95.8</td>
<td>27.2</td>
</tr>
</tbody>
</table>

**Conclusion:** The 12 week endurance training program performed in our study increased the physical fitness morbidly obese children significantly. Comparing the PRE vs. POST the average maximum power out increased 24.8% and the average power output determined at the “anaerobic threshold” (LTP2) 35.6%. Relating power output to the actual BMI (Watt.BMI\(^{-1}\)) the average POST values were even 28.0% higher at maximum load and 35% higher at the LTP 2. Concerning body weight there was a trend in the reduction of body weight (1.02 kg in average), but this decrease was not significant. But however, subjects significantly increase their average height (2 cm). These changes were also accompanied by significant changes in body composition (a significant decrease in body fat and BMI). Our training program also significantly influenced blood parameters. We found a significant decrease in LDL/HDL-Cholesterol value (which was caused by a significant increase in HDL and a slight but not significant decrease in LDL).
Evaluation of two methods for the estimation of physical activity of obese patients

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Introduction: Regular physical activity is accepted to be an important preventive factor against the development of several cardiovascular and metabolic diseases. However, the measurement and determination of physical activity is a complex and difficult task especially in obese patients.

The aim of the study was to evaluate two questionnaires (IPAQ, “International Physical Activity Questionnaire” and FFB, “Freiburger Fragebogen zur körperlichen Aktivität”) in consideration of their use in obese patients. Both questionnaires register the patients’ physical activity of the last 7 days.

Methods: Two groups of persons were interviewed with both questionnaires from March 04 until September 05. First group consisted of 100 obese patients (59 female, 41 male) with an average age of 49.5 years (21–76) and an average BMI of 36.5 kg/m\(^2\) (30–72). The second group consisted of 100 persons with normal weight (64 female, 36 male), an average age of 40.0 years (19–80) and an average BMI of 23.1 kg/m\(^2\) (18–27).

Results:

<table>
<thead>
<tr>
<th>Adipose group</th>
<th>active</th>
<th>minimal active</th>
<th>inactive</th>
<th>“outlier”</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPAQ</td>
<td>12%</td>
<td>32%</td>
<td>40%</td>
<td>16%</td>
</tr>
<tr>
<td>Freiburger FB</td>
<td>38%</td>
<td>25%</td>
<td>37%</td>
<td>—</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Control group</th>
<th>active</th>
<th>minimal active</th>
<th>inactive</th>
<th>“outlier”</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPAQ</td>
<td>28%</td>
<td>44%</td>
<td>19%</td>
<td>9%</td>
</tr>
<tr>
<td>Freiburger FB</td>
<td>61%</td>
<td>22%</td>
<td>17%</td>
<td>—</td>
</tr>
</tbody>
</table>

A moderate correlation between both questionnaires was determined \(r = 0.35^{**}\). When the entire group was split, the highest correlations between FFB and IPAQ were found in the adipose male-group \(r = 0.47^{**}\) and in the female group with normal weight \(r = 0.46^{**}\). In the remaining subgroups no significant correlations were found.

Discussion: In both questionnaires the obese patients showed a significant lower physical activity than the control group, as expected. The advantage of the FFB was, that leisure time activities with low intensities (like climbing stairs, working in the garden, going by bicycle) were also documented, which resulted in a higher score. Compared to IPAQ for both groups, the IPAQ focuses on more intensive physical activity, and also detects “outliers” (thus excludes persons, which exaggerate their data concerning the “activity-hours”), which could be advantageous for the use with obese people.

Conclusion: In both groups (adiposity, as well as control) it seems to be reasonable to combine FFB and IPAQ in order to receive valid information. An improved tool could be developed out of both which should be the issue of further studies.

Body composition as a determinant factor of the aerobic fitness and physical performance

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Introduction: An accurate assessment of body composition is necessary to properly identify a client’s health risk associated with an excessively low or high relative body fat (%BF). This assessment can then be used to estimate a subject’s ideal body mass and formulate an exercise and diet regimen. Periodic body composition measurements
can be used to assess the effectiveness of exercise and diet interventions or monitor changes in body composition associated with growth and maturation or disease state. Body composition has been linked to numerous health conditions, such as cardiovascular disease, diabetes, certain types of cancers, osteoporosis, and osteoarthritis. Thus, there is a clinical need to measure not only %BF, but fat distribution, muscle mass, total body water (TBW), body-water compartments (extracellular – ECW, and intracellular water – ICW), body-water volumes changes, and bone mass as well. Whatever the reason for assessing body composition, health and physical educators, fitness specialists, nutritionists, and other clinicians in health-related fields should have a general understanding of the most commonly used techniques for assessing body composition. The results exercise testing was in children significantly influent by actual state of subjects development. Body composition (BC) may be used as a criterion of the actual biological state of children development.

Methods: Dependence between frequently used indicators of aerobic fitness (VO\textsubscript{2max}.kg\textsuperscript{−1}), and physical performance variables (calculated total work – CTW, and maximal power output – MPO), and BC (%BF, FFM, BCM and ECM/BCM) were studied in a group of 1235 Czech children (756 boys and 479 girls) in age from 6 to 14 years. The physical performance variables were assessed by incremental treadmill test with constant slope of 5%. The age dependent initial speed was increased by 1 km.h\textsuperscript{−1} till subjective exhaustion. Body composition was determined by whole body bioimpedance measurements using a modified prediction equation for children.

Results: The mean values of %BF were 19.7 ± 5.3% of total body mass in boys, and 21.7 ± 5.0% in girls. In both sexes a positive significant gender dependencies were found (r = −0.698, p <0.0005 in boys, and r = −0.681, p <0.005 in girls). We found the significant negative relationships between %BF and VO\textsubscript{2max}.kg\textsuperscript{−1} (r = −0.511, p <0.0001 in boys; r = −0.584, p <0.0001 in girls), MPO (r = −0.471, p <0.0005; r = −0.435, p <0.0005), and CTW (r = −0.531, p <0.0001; r = −0.495, p <0.0001). The significant positive relationships were found between FFM and CTW (r = 0.311, p <0.0005; r = 0.421, p <0.0005), MPO (r = 0.401, p <0.0005; r = 0.456, p <0.0005), and VO\textsubscript{2max}.kg\textsuperscript{−1} (r = 0.371, p <0.0005; r = 0.332, p <0.0005). Also we found significant relationships between BCM and CTW (r = 0.583, p <0.0001; r = 0.598, p <0.0005), MPO (r = 0.535, p <0.0001; r = 0.578, p <0.0005), and VO\textsubscript{2max}.kg\textsuperscript{−1} (r = 0.612, p <0.0001; r = 0.751, p <0.0005). The ECM/BCM relationship was significantly negatively correlated with CTW (r = −0.671, p <0.0001; r = −0.634, p <0.0001), MPO (r = −0.683, p <0.0001; r = −0.687, p <0.0001), and VO\textsubscript{2max}.kg\textsuperscript{−1} (r = −0.787; p <0.0001; r = −0.766, p <0.0001).

Discussion: The fat-free mass, and thus BCM rises throughout childhood similarly in boys and girls until the age of puberty. The acceleration in FFM at this time in males reflects their augmented muscle mass at the adolescent growth spurt. The absence of an increase in FFM at puberty in females means that girls reach adult levels approximately 5 years before males, whose FFM matures at age 19–20 years. Average fat mass in females is greater than in males from mid-childhood on. This difference becomes more obvious in the pubertal years as girls accumulate greater adipose tissue. Percent body fat slowly declines during early childhood in both sexes after an early jump in infancy. As puberty approaches, females demonstrate a progressive rise that continues throughout adolescence. Males, on the other hand, show a slight increase in relative fatness in the late prepubertal age; percent body fat then slowly declines, reflecting the development of FFM at puberty. Consequently, females have greater percent body fat than males throughout childhood after age 3–4 years. In the late teen years, the average female has about 50% higher the relative fatness of her counterpart. The primary determinant of success by physical activity like sport is the ability to sustain a high rate of energy expenditure for prolonged periods of time. Exercise training-induced physiological adaptations in virtually all systems of the body allow the subject to accomplish this. Aerobic capacity described with help of VO\textsubscript{2max}, economy of motion and fractional utilisation of maximal capacity reflect the integrated responses of these physiological adaptations.

Conclusion: In conclusion, the BC is an important determinant of physical performance in laboratory (treadmill exercise tests) and in field (running and/or walking tests). The observed variables of BC significantly determine the variables that characterise both aerobic fitness and physical performance. The results further demonstrate that when oxygen consumption is not feasible, the physical performance characteristics together with parameters of BC seem to be a good predictor of aerobic fitness; this may be very helpful in large population studies.

Acknowledgment: The study was supported by grant of Czech Ministry of Education MSM 115100001.
Vibration Training in Health and Disease

Potentials of stochastic resonance in neurorehabilitation

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Introduction: In our usual understanding fluctuating input signals – like noisy interferences – impair the performance of dynamic systems, i.e. signal-to-noise-ratio (SNR) of the output is reduced. Whereas this view is valid in linear systems functioning of nonlinear systems can be – quite counterintuitively – improved by influences of random noise. This phenomenon is termed Stochastic Resonance (SR). In the last three decades SR was described in various scientific disciplines like Physics, Biology, Geodynamics, Chemistry etc. [1]. As the underlying mechanisms are relatively simple and robust SR is regarded as a manifest in nonlinear systems. In the most general form SR is based on a form of threshold or barrier and two or more inputs. One input is a coherent signal; another input of the same modality is random noise. The output function results from the quality of the inputs and the internal system behaviour. Transferred to neuronal systems SR can improve signal detection and optimize SNR of the output which has been experimentally demonstrated in various animal and human experiments.

SR Functions in Rehabilitation: In various neural diseases sensory processing is disturbed (e.g. Parkinson’s disease or Neuropathy) which reduce the ability of generating functional movements; i.e. improving sensory function might be a precondition for effective motor control. Thus several experiments proved the effects of SR and sinus stimulation on sensory functioning. Nearly all experiments describe significantly higher sensitivities under SR condition. Liu et al. [6] found 34% better signal detection in diabetic neuropathy patients and 16% better in stroke patients. Wells and co-workers [7] show comparable results in young and old subjects. As the human neural system is characterised by an ‘all or nothing’ function, signal detection is based on the precondition of supra-threshold nerve cell activations. With respect to this function the findings shown above might explainable by the stochastic properties of human nerve cells. Accordingly, the interference of stochastic input signals with stochastic sensory functions lead to a resonance like behaviour. Figure 1 shows the results of a firing simulation using a single nerve cell model. While a sinus stimulation leads to nerve cell activity below the threshold (○), SR generate supra-threshold activity (▲) which is connected with action potential spikes. Anyway, there is no 1:1 relation between afferent signal processing and
muscular activation. Consequently we proved the effects of SR treatment (SRT) on motor control in Parkinson’s disease and other neural disorders. Overall PD patients show significantly improved motor behaviour [2,3], e.g. Turbanski et al. [5] found spontaneous postural control improvements after 5 minutes SRT. Schuhfried et al. [4] describe comparable results in Multiple Sclerosis patients. With respect to other experiments these improvements in complex motor control might not result exclusively from a higher sensory sensitivity. Since various neural diseases are characterised by bistable behaviours we suggest that SR provide the ability for switching between potential states (e.g. from ‘Off’ to ‘On’ in PD). Bringing all results together one has to conclude that SR mechanisms provide potential to optimize rehabilitation of neural disorder.

References


Whole-body vibratory exercise reduces the risk of bone fracture

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Introduction: While vibratory exercise has been highly effective in the increase of bone mineral mass on animals, the use of this technique in humans has shown non-conclusive results. The purpose of this study was to evaluate the effects of Whole-Body Vibration Training (WBV) on the bone mineral density (BMD) and on balance in post-menopausal women.

Methods: Twenty-eight healthy but non-trained post-menopausal women were divided randomly in two groups (experimental G\textsubscript{1} and control G\textsubscript{2}) of 14 subjects. Training consisted in 3 weekly sessions during a time span of 8 months. Each session consisted of (a) 10 min of warming up on a cycle-ergometer, (b) 5 minutes of stretching and (c) 6 series of 1 min WBV within 1 min interval between series. WBV was performed at 25 Hz of frequency and 3 cm of vertical amplitude in erect position with a knee flexion of 60\textdegree. Hip and lumbar BMD (g·cm\textsuperscript{-2}) was measured using DXA technique. Balance was measured by blind famingo test. Data was examined by analyses of variance for repeated measurements being adjusted by body weight for BMD data.

Results: The femoral neck BMD increased by 2.3% in G\textsubscript{1} while this of the G\textsubscript{2} decreased by 2.0% during the same time span. Inter-groups variation was significant (\(p=0.016\)). At level of the trochanter, G\textsubscript{1} increased BMD with 1.05% and G\textsubscript{2} decreased with 1.2% showing non-significant inter-group variation (\(p=0.07\)). At level of the Ward’s triangle BMD, G\textsubscript{1} record a non-significant increase of 7.8% while G\textsubscript{2} did not change. At lumbar level, the decrease in both G\textsubscript{1} and G\textsubscript{2}, was non-significant (0.9% vs 1.0% respectively). WBV group increases significantly (\(p=0.033\)) balance comparing with W (−28.7% of falls vs +4.4% respectively).

Discussion: This non-significance at lumbar level could be partially attributed to: (a) the partial knee flexion during the vibratory exercise reducing the transmissibility of the mechanical stimulation of the platform and (b) the WBV produced by the device we used produced a 3 times greater acceleration on X-axis than Y-axis.

Conclusion: The eight-month exercise programme of whole-body vibration with a frequency of 25 Hz reduced the risk of fracture by increasing the BMD at level of femoral neck and increasing the balance in post-menopausal women.
Acute cardiovascular and metabolic strain during whole body vibration training (ZEPTOR®) with patients following stroke

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Introduction: Whole body vibration has been recently proposed as an exercise intervention because of its potential for increasing force generating capacity in the lower limbs. Its popularity is due to the combined effects on the neuromuscular and neuroendocrine systems. But the question is how strenuous is a series of whole body vibration training on a Zeptor training device for the cardio vascular and the metabolic system. Because the acceleration the patient is exposed to during the Zeptor-training, constitutes loads of his multiple body weight and the amount of force impacts is vast.

Methods: In a cross-sectional study involving 13 stroke patients (60.9 ± 11.2 years, 1.72 ± 0.73 cm, 71.7 ± 9.6 kg; 10 men, 3 women) in the acute phase, Zeptor-training with individual sub-maximum frequency was carried out. It was applied standing on both legs (a slight flexion of knee and hip) in a series of 5 one-minute applications, with a one-minute pause. Blood pressure and lactate were measured in rest and after every application. The heart frequency was recorded continually, using a Polar heart rate belt. A “beat by beat” data recording of blood pressure and heart frequency was not possible because measurement artefacts caused by vibration. The descriptive statistics and the nonparametric analysis of variance of the dependant measurements (rest, 5 series) of parameters were calculated using SPSS (Friedman-Test; post-hoc: Wilcoxon-Test).

Results: The systolic blood pressure did slightly rise from 130.6 mmHg (rest) to 137.8 mmHg after the first series (p = 0.028). During the 5 series the blood pressure varied not significantly between 135.9 und 142.1 mmHg (p >0.05). The diastolic blood pressure at rest was 86.5 mmHg and increased after the first series to 93.9 mmHg (p = 0.028). The blood pressure measurements after the first until the fifth series varied between 90.4 and 93.9 mmHg also at random (p >0.05). The lactate tests showed after all the series and in comparison to rest (1.8 mmol/l) no increase (p = 0.657), also the heart rate variations between 88.1 and 90.9 beats/minute were not significant (p = 0.205).

Discussion: During the 5 series of Zeptor-training the results showed only a marginal increase in the systolic and diastolic blood pressure. Lactate and heart frequency did not exceed the measurements at rest. The strain caused by Zeptor-training doing high knee bends, is comparable to cardio vascular and metabolic strain between values during rest and the aerobic threshold. Comparing to strength training all the measured parameters of strain were significantly lower during a Zeptor-training.

Conclusion: Only a little sensorimotor skill like upright standing is needed for Zeptor-training. The Zeptor-training also offers a good neuromuscular effect, a minimum training effort and overall as shown above only a slight strain. For this reason the Zeptor seems to be very suitable for the general use in physiotherapy, and especially for patients with a cardio vascular risk factor like stroke patients.

References

Isokinetic testing at a short range of motion: Research findings and clinical applications

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The measurement of muscular strength depends on the way it is being measured: statically or dynamically, concentrically or eccentrically. Within each measurement mode different factors such as the angular velocity, the isometric preloading bias, the test position, the number of criterion contractions etc., take place. Therefore ‘standard’ protocols prescribing these parameters have never been firmly adopted, a situation which contributes substantially to the significant diversity of findings reported with respect to muscle strength.

Among the above intervening parameters the effect of the specific testing range of motion (RoM) has recently attracted growing attention; using shorter RoMs offers a number of advantages. Specifically testing at a standard (‘full’) RoM may be unsafe and/or painful. For instance testing along 90° RoM of knee motion may be problematic in the inner (0–30°) knee range in patients suffering from hamstring strains [1,2], whereas testing at a corresponding 60–90° range is contraindicated in those suffering from patellofemoral pain [7,9]. Also, in patients during the earlier stages following anterior cruciate ligament reconstruction maximal testing near full extension [6] may put the reconstructed ligament at risk. Thus testing within a range that is unlikely to compromise the relevant joint or muscles yet is capable of faithfully depicting muscle strength is a highly desirable objective. Other advantages of short RoM testing refer to facilitating the problems associated with polycentric joints (mechanical alignment), obviating the need to perform gravity correction procedures while encouraging the use of simpler systems.

That short RoM testing is indeed a viable option has been shown in a number of studies focusing on trunk [3,5], shoulder [4] and knee [8,?] muscles. The findings revealed excellent compatibility with those derived from so-called ‘standard’ RoMs. Research that is currently underway as a part of on going collaboration between the Universities of Tel Aviv and Liège sheds further light on this subject. The methodological issues emerging from these studies as well as their implications in testing of normal subjects and patients constitute the main topic of this presentation.

References

Injuries – Management and Prevention

Management and prevention of arm and hand injuries

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Introduction: Sport-activity is very closely related to acute and overuse injuries to the arm and hand. Not only bony structures, but also tendons, ligaments, nerves and vessels as the skin are at danger depending on the energy level. Pain in the radio-carpal joint needs special attention and examination, otherwise long lasting consequences can even lead to an end of the career.

Methods: As head of a weekly sport-clinic and from the experience of the intensive work with sportsmen for now more than 15 years as team physician of the Austrian Ski Team and others the most common injuries and their treatment options will be outlined and presented. Additionally special attention will be dedicated to rare injuries, typically for different sports, as nerve compression syndromes in cycling, carpal bone injury in golf, pulley rupture in climbing and others. As specially designed gloves and protection gear can help to avoid trauma to the carpal bone and the soft tissues of the hand they can provoke in some bad circumstances trauma to the forearm.

Results: In correlation to the literature, hand injuries are not well documented and therefore special percentages are very difficult to tell. Without a clear knowledge of the sport and a good clinical examination even the working diagnosis can be difficult. Besides standardized x-ray examination very often additional checks by ultrasound, MRI or CT or also motion analyses of the carpal bones under image intensifier will help in finding the right diagnosis. One of the most important corners of the hand is the radial side of the carpal bones with the possibility of a hidden scaphoid fracture, a non-dissoziative scapho-lunate ligament tear or the worst case – a dissoziative scapho-lunate ligament tear (Fig. 1). In some instances even a diagnostic wrist arthroscopy is necessary to get a clear view of the pathology. Skiers thumb, Mallet deformity, Bennet’s fracture as others will be discussed in diagnosis and treatment.

Discussion: The simple diagnosis “distortion of the radio-carpal joint” needs in most cases a second view; nevertheless it is necessary to keep pain in mind as serious as possible, because an overlooked scaphoid fracture could lead very soon to the end of a sports-career. Special hand therapists are often necessary to get the best results after soft tissue or also bony trauma to the hand. Surgery without excellent rehabilitation will never lead to good results and will therefore prolong the interruption of sports-activity.
Conclusion: In some dedicated problems therapy options are as unclear as protection possibilities. Therefore we need continuous work, discussion and investigation concerning trauma mechanisms and healing potential to protect our dedicated population of sportsmen from chronic pain or early degenerative changes, which will in the future hopefully lead to excellent protection possibilities.

References


Sensorimotor, conditional and functional deficits after surgical hip dislocation

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**Introduction:** At the University hospital in Berne 200–300 surgical hip dislocations are annually performed. After surgery the patients stay partly immobilised for 8 weeks, meaning they walk with a maximum load of 5 kg on the operated leg. Negative effects of immobilisation are well known in the literature, such as muscle weakness, hypotrophy of muscles, passive structures and cartilage, reduced aerobic capacity and others. The aim of this study is to characterise the deficits concerning sensorimotor, conditional and functional aspects 3 and 12 months after surgery.

**Methods:** This cross-sectional study involves a total of 90 subjects (age 20–40 years), divided in three groups: one group with patients three months after surgery (G3), the second with patients twelve months after surgery (G12) and the control group (G0) consisting of healthy individuals matched for age and gender, without any pain or disability in the lower limbs or back. The following measurements have been performed with all subjects: time-distance-parameters in level walking (Locometer), ground reaction forces during level walking and stair climbing (Kistler force plates), maximum voluntary isometric contraction (MVIC) and rate of force development for hip abduction (force sensor and surface EMG of M. gluteus medius and M. tensor fascia latae) and knee extension (force sensor and EMG of M. vastus medialis), standing-balance on one leg (Kistler force plate, deviation of COP), tension-force-curve for hip flexion with extended knee (straight leg raise machine, surface EMG of M. semimembranosus), aerobic threshold (cycle ergometer), questionnaires for daily-life-functions (SMFA-D, COPM) and pain, observational gait analysis by a physical therapist. Descriptive statistics and group differences (nonparametric: Kruskal Wallis) were computed using SPSS (V12.0).

**Results:** Preliminary results show for aerobic performance 1.35 ± 0.54 W/kg in G0, 0.88 ± 0.44 W/kg in G3 and 0.91 ± 0.36 W/kg in G12. The difference between G0 and G3 respectively G0 and G12 is −35% and −32% (p = 0.002). MVIC in hip abduction related to body weight is 2.3 ± 0.6 N/kg (G0), 1.5 ± 0.5 N/kg (G3) and 1.3 ± 0.5 N/kg, meaning differences of −36% and −41% between G0 and G3 respectively G12 (p = 0.014). The rate of force development of hip abduction in relation to body weight is 27.4 ± 11.2 Nm/s/kg (G0), 20.1 ± 14.0 Nm/s/kg (G3) and 14.2 ± 4.2 Nm/s/kg (G12) with differences of −27% and −49% between G0 and G3 respectively G12 (p = 0.002). At the congress a selection of final results will be presented.

**Discussion:** These preliminary results show substantial differences between the patients after surgical hip dislocation and the healthy subjects for strength, power and endurance. The expected deficits three months after surgery are obviously real and still persist one year after surgery. In the further evaluation of the data we will focus on
relationships between different parameters and the question how the existing deficits are related to daily-life disability or pain of the patients.

**Conclusion:** Based on the preliminary results we suggest that physical therapy would be useful for patients after surgical dislocation of the hip to gain a better strength and endurance for function and daily-life performance. With the final results of this study a deficit-oriented therapy plan for these patients could be provided. The therapy and exercise concept will be investigated in a further study.

**References**


**Repeated bout effect on eccentric exercise-induced muscle damage: Study of the cross-over effect**

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**Introduction:** Many studies have demonstrated that a single bout of unfamiliar eccentric exercise induced delayed onset muscle soreness (DOMS) due to muscle damage [1].

It is established that a repeated bout of identical eccentric exercise results in reducing symptoms. This adaptation has been mentioned as the repeated bout effect (RBE). RBE is clearly established when the bouts of eccentric exercises involved the same limb [2].

Central and local mechanisms have been suggested to explain RBE [3]. To confirm the existence of central (or systemic) adaptation to explain RBE, we have hypothesised that a cross-over effect should exist.

**Methods:** Eleven moderately active male volunteers underwent an isokinetic eccentric provocation session consisting of 2 trials of 4 maximal contractions (at 60°/sec.) of the hamstrings.

Two weeks later, the contralateral leg was submitted to the same protocol.

Before and after (24, 48, 72 hours) each session we measured:

- Serum level of the creatine kinase (CK).
- Subjective intensity of pain using a visual analog scale (VAS).

Those two parameters are commonly used as indirect indices of exercise-induced muscle damage. Statistical analysis was performed using Wilcoxon test for paired samples and ANOVA.

**Results:** The statistical analysis demonstrated that both eccentric sessions have similar intensity regarding peak torque and total work.

After the two sessions, we observed a significant increase of serum CK level (at 48 h post-training). These signs clearly identified the presence of DOMS.

The comparison of DOMS intensity after each session showed significant effect of a second eccentric session on decreasing the average maximal serum CK (24200 UI/l versus 12800 UI/l) and pain ($p < 0.05$).

**Conclusion:** The recent advances in the understanding of the repeated bout effect suggest different theories. Potential adaptations have been categorized as neural, mechanical and cellular.

In contrast with Conolly [4], we observed existence of cross-over effects when analyzing RBE. This finding demonstrates that the adaptations related to the RBE are not only due to local phenomenon, but that a central or systemic adaptation exists.

Further research is needed to understand the crossover effect of RBE.
The efficiency of sensorimotor training in treatment of tendinopathies in athletes

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Introduction: Tendinopathies (TP) are the most prevalent overuse injuries of the lower extremity in sportsmen. Different treatment strategies have been proposed and are still unsystematically combined to date. In previous studies it could have been shown that strength capacities are reduced in Achilles tendinosis patients (AT) compared to healthy individuals [3,4]. It is thus assumed that improvement of maximal strength or neuromuscular coordination will improve symptoms in TP. Recently, several well conducted studies showed the efficacy of eccentric training in chronic AT and patellar tendinosis (PT) patients [1,2,6,7]. Additionally, it is assumed that proprioception is altered in TP. Therefore, sensorimotor training seems to be a further therapeutic option. We hypothesized that a new developed training regimen including stability training, stretching and plyometrics is superior to classic physical therapy and orthopaedic insoles in athletes with chronic TP. The aim of the study was to evaluate the effect of the new sensorimotor training on subjective pain and strength capacities.

Methods: 65 injured and 30 healthy [H] sportsmen of various disciplines were included in the study. Every subject underwent an orthopedic evaluation prior to randomization followed by a 2 weeks documentation of training habits and habituation to the pain questionnaires. 39 of the patients were diagnosed of AT, 15 of PT, 8 of iliotibial band syndrome (ITBS), 2 of semimembranosus and 1 of pes anserinus tendinopathy. Randomization was done according to GCP guidelines in 3 treatment groups (physical therapy [P, \( n = 17\)], sensorimotor training [S, \( n = 17\)], sport shoe insoles [I, \( n = 14\)] and an untreated control group [C, \( n = 17\)]. During the therapy phase of 8 weeks, subjects completed a training and therapy documentation as well as the 2 validated pain questionnaires “Pain Experience Scale” (SES) and “Pain Disability Index” (PDI). Measurements of isokinetic peak torque \( (60^\circ/s) \) of ankle and
knee flexion and extension were taken concentrically and eccentrically before and after the intervention (Con-trex® multijoint system, CMV AG, Switzerland) (ANOVA, α = 0.05). 10 patients were dropped out due to non-compliance or incomplete follow-up.

Results: PDI was reduced of more than 30% in all 3 therapy groups, not in CO (p < 0.05). Responder rates were 20% in CO, 57% in I and 60% in S and P. Peak torque improved statistically significantly in S (p < 0.05) whereas it remained unchanged in H and CO and diminished in P (p>0.05). The improvement was most pronounced in the injured leg at the pathology specific localisation (ankle for AT, knee for PT and ITBS).

Discussion and Conclusion: It has been found that a new developed sensorimotor training is as effective as physical therapy and sport shoe insoles in the treatment of chronic tendinopathies in athletes. In addition to the 2 other therapies, the sensorimotor training regimen was able to improve maximal strength capacities. As it has been shown that muscular weakness is a risk factor in the development of TP it is concluded that the sensorimotor training may prevent the rehabilitated sportsmen from future relapses. Further studies should address this long-term effect as well as the primary preventing effect of sensorimotor training in healthy sportsman prospectively.

References