using "bed-rest-studies" as test designs. More recently, tuning of muscles under vibration has become an important topic in research. These topics can more or less be associated with biological areas of interest, such as muscles, bones and cartilage. So far, the effects of vibration load and especially of whole body vibration have not yet played a major role in exercise-research that is related to the cardio-vascular system. But today there are indications that, for example, the deformation of vessels under vibration with corresponding alterations in fluid-dynamics could lead to angiogenesis. Traditionally, this has been explained mainly as a result of higher cardiac output (e.g. in the course of endurance training). Taking together the variety of known effects of vibration load on the human body leads to the hypothesis that vibration load can be understood as a biological multi-effect systemic stimulus.

5953 Mo, 16:30-16:45 (P12)

The potential of vibration training to affect the response of muscle, bone and cartilage during short term bed rest

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Mechanical stimulation is essential for the homeostasis of the musculo-skeletal system. In microgravity muscle and bone respond with atrophy to the lack of mechanical loading. On earth these effects can be simulated with immobilization at 6°-head-down-tilt bed rest (6°-HDT). In this context cartilage has not been investigated yet, although cartilage health is important, especially with respect to the increasing numbers of patients with osteoarthritis. For space flight and for clinical applications countermeasures have to be developed, to prevent losses in bone and muscle and potentially in cartilage.
In the 'Vibration Bed Rest Study' (VBR-Study) we hypothesized that whole body vibration training will change the response of the body to bed rest with focus on bone, skeletal muscle and knee cartilage. Vibration training seems a promising method because of beneficial effects on muscle and bone that have been found previously in training studies.
We investigated the combined effect of bed rest and vibration training (twice per day; 5 1 Minute; 20 Hz) on muscle strength, systemic biomarkers of bone metabolism and cartilage morphology. 8 male healthy subjects performed two phases of 14-days of 6°-HDT bed rest in a randomised cross-over design. Biomarkers of bone metabolism did change due to bed rest. This effect did not change with the vibration intervention. Isometric force of knee flexors and extensors decreased due to bed rest. Cartilage morphology and biology changed due to bed rest and partially also due to the training intervention.
In summary the chosen training regime could only confirm the hypothesis for cartilage morphology. Vibration training failed to counteract bed rest effects on bone and isometric force.
This leads to the conclusion that the understanding of the integrative chain of biological response to mechanical stimuli has to be improved.

5931 Mo, 16:45-17:00 (P13)

Mechanical impacts to the human body by different vibration training devices

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Even though there are a lot of studies about the effects of vibration training on power, strength and flexibility the physiological mechanisms behind and the responsible mechanical inputs are still rather uncertain. The presented study tries to investigate the mechanical impacts to the human body using two of the most common device constructions and different training protocols.
Method: Eight male subjects (age: 32.4±8.2 y., weight: 79.7±7.3 kg) performed different sets of training (15 s) on the two different devices ("Galileo 2000" and "PowerPlate"). The sets varied in frequency (25 Hz, 30 Hz, 35 Hz, 40 Hz and 50 Hz), additional load (0%, 60% and 80% of body weight) and posture (knee angle: 110° and 150°) which were allocated and combined randomly. At every time angle movement was measured by a goniometer, accelerations were recorded at foot, knee, hip and head by 2-d-accelerometers and body position was determined by pressure soles and video recording.
Results: Generating about the same input at the platform (3–6 G), the transmission of accelerations through the body is different using the two devices. Especially the acceleration of the head is much higher on the "PowerPlate" (0.2–0.6 G) than on the "Galileo 2000" (0.1–0.2 G). On both devices different postures led to greater differences in transmission to head than different additional loads. Accelerations at knee and hip show that on the "Galileo 2000" highest accelerations were measured at hip in contrast to knee on the "PowerPlate".
Discussion: As for health reasons high accelerations to the head should be avoided the results show that the "Galileo 2000" seems to be more suitable for training in the field of fitness and rehabilitation. On the other hand it may be suggested, that the training effect on leg muscles is higher on the "PowerPlate" where more damping activity is done by the knee.

5174 Mo, 17:00-17:15 (P13)

Short-term effects of vibration stimuli during intensive cycling performance on angiogenesis

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For the induction of angiogenesis there are various major stimuli e.g. metabolites, mechanical forces and hypoxia. These factors are known to induce the expression of matrix metalloproteinases (MMPs), the formation of Endostatin, the stabilization of HIF-1α, and the increased expression of VEGF.
Mechanical forces and hypoxia normally are present in the blood vessels by deformation of muscle tissue, an increased cardiac minute output and lowered oxygen supply during exercise and therefore they are key regulators in the development of new capillaries. The study aimed at the biological response in this area following highly intensified stimuli (vibration and artificial hypoxia).
Twelve cyclists (age 27±4 years) participated in this study. Each subject completed four training sessions (90 minutes cycling for each) at weekly intervals in a randomised order. The four trainings sessions were: normoxia without vibration, normoxia with vibration, normobaric hypoxia without vibration, normobaric hypoxia with vibration. Blood samples were taken: pre training, 0 h, 0.5 h, 1 h and 4 h after training. Hypoxia was induced by a hypoxic-chamber with an average altitude of 2500 m. The artificial mechanical forces (cycling with or without vibration) were induced by a cycling ergometer (a specially designed bicycle fixed on a vibration platform with a peak-to-peak amplitude of 4 mm, and a frequency 30 Hz, where the vibration could be switched on or off.). The parameters VEGF, Endostatin and MMPs have been measured by ELISA kits (R&D systems GmbH, Wiesbaden, Germany).
The sessions with vibration resulted in significant VEGF-effects compared to the non-vibration sessions. These results show that the treatment with vibration is an important stimulus for an increase in the expression of VEGF. These findings may lead to new concepts of training concepts for the induction of angiogenesis and thus energy supply for the muscles.

7074 Mo, 17:15-17:30 (P13)

The effect on coefficient of restitution and vibratory conduction of tennis racket arranged in one-piece molded and pu-foam handles

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Tennis racket material composition and structure might affect the racket feature when impact. This study aimed at analyzing the characters of tennis racket which were varied with one-piece molded and pu-foam handles. This study was also to investigate how the vibratory conduction on racket handles and coefficient of restitution of the ball from each racket were affected by the vibration of the racket. There were ten different kinds of tennis racket, composed by mixing carbon fiber and glass fiber in the ratio of 1 to 0, 3 to 1, 1 to 1, 1 to 3 and 0 to 1. The structure of the racket handles were arranged in one-piece molded handle and pu-foam handle. The rackets had the same weight, string tension and balance. In this study, one experiment was to monitor the vibration in the grip of every tennis rackets. Three accelerometers (500 G) and BioPAC system were attached to each racket to acquire the vibratory signals, and the sample rate was 2000 Hz. The other experiment was to distinguish the coefficient of restitution between the ball and everyone of ten different rackets. The impact of the tennis ball was set in the velocity of 28 m/s or so. SIMI Analysis System with one high-speed video camera (1000 Hz) was used to record the kinematics data and to calculate the coefficient of restitution between the ball and racket. The results of this study indicated that the racket arranged in pu-foam handles had high value of vibratory damping ratio. On the other hand, however, the racket arranged in one-piece molded had high value of coefficient of restitution.