**Supplement 1**

**Survey of literature on whole body vibration training**

At least 560 scientific studies on whole body vibration (WBV) training have been published [1]. Only a small part of them could be checked and information on details, such as investigated frequencies, strokes and subjects, had to be omitted in the following survey, in which **Meta** **studies** (**MS**) are marked. The focus was set on WBV-induced changes in the *lower* extremities.

**Muscles and movements**

*Positive* *effects*: Improved knee extension, muscle strength, jump height and sit-to-stand performance were reported by MS [2-4]. Another study found similar positive influences [5]. In postmenopausal women, the muscle strength increased by 15% [6]. Training proved to be as effective as conventional training [7, 8], but possibly only at high accelerations [9]. In a bed rest study, WBV training proved to be positive for structure and function of the lower limb muscles [10].

*No or minor effects*: Low evidence for training effects was stated by four MS [11-14]. Other studies also observed no improvements [15-17]. In a bed rest study, the decrease in leg muscle volume was not prevented [18].

*Controversial effects:* Varying influences were reported in two MS [19, 20] and in other investigations [21, 22].

**EMG activities**

*Positive effects*: EMG activities were increased with WBV by factors of approximately 2.8 for the quadriceps femoris and between 2.8 and 27.6 for eight different muscles involved in pelvic stability [23]. However, much lower increases of only 8% were also published [24]. At the foot acceleration afoot ≈ 50 m/s2, the average EMG signals from six muscles in the lower leg rose by 100% [25]. Another study reported less linear relations between afoot and EMG signals, but only for afoot < 0.74 g in one subject and afoot < 2.88 g in another [26].

*No or minor effects*: Only small or no effects were found in [24, 27].

**Bone remodelling**

*Positive* *effects:* In patients with rheumatoid arthritis, bone mineral density improved [28]. Remodelling of new bone increased at higher bone strains, caused by (assumed) higher JCF, but that was only shown at much lower frequencies than those used during WBV training [29-32]. The rate of bone remodelling depended of the frequency of loads [33], and even small but fast vibrations (afoot = 0.3 g, f = 30 Hz) increased the bone mineral density [34]. Comparable effects on the mineral density in the proximal femur were seen as those seen with resistance exercises [35]. In postmenopausal women, the bone mineral density increased by 0.95% when accelerations up to 5g were applied [6]. In young women the bone mass in the femur rose by about 2% when vibrations of very low magnitude were applied, i.e. when the acceleration forces were much lower than the forces during daily living [36]. Similar results were obtained by [37].

*No or minor effects:* In a MS, mineral density in osteoporotic femoral necks was not changed by WBV [4]. No changes of BMD in the femoral neck and greater trochanter were observed in [38]. Bone resorption and formation markers were not affected in a bed rest study [39]. Trabecular bone in proximal mice tibia stayed unaffected [40]. No influence on mineral density in the hip region and on bone remodelling biomarkers was reported [41]. Only slight benefits were observed for osteoporosis in the trochanter region (MS) [42]. Only small effects on bone architecture were found in older adults (MS) [12]. Mineral density in the hip area improved only slightly in postmenopausal women, children and adolescents, but not in young adults (MS) [43].

*Controversial, small or lacking effects:* Increases of cortical but not trabecular bone were observed, but only during the first nine weeks [44]. Controversial influences on trabecular and compact bone in healthy and osteotomized mouse femora were published, depending on the frequency; but even ‘disruption of fracture healing’ was expected [45]. Application of vibrations in mice with inhibited muscle activities didn’t prevent bone loss [46].

**Implants**

*Positive effects:* In patients with knee and hip implants, WBV and resistance training caused comparably strong improvements of muscle strength, muscle activation and mobility. Adverse side effects were not observed, but longer follow-up studies were suggested [47]. Positive effects were also seen in patients with knee arthroplasty [48]. Enhanced osteogenesis and osseointegration were described at non-cemented interfaces of titanium implants in rats, especially for low accelerations and high frequencies [49-54]. Osteogenesis was enhanced in vitro in rabbits [49].

*Negative effects*: In an analytical study, the number of bone cement cracks at the interface to bone increased with the number of loading cycles [55]. Another analytical investigation showed that even medium-high cyclic loads increased the number of cement cracks and the stresses at the interface to bone [56]. It must be kept in mind that daily WBV (5 minutes, 50 Hz) would load knee and hip implants 4.6 times more often than normal walking [57]. An overview of various studies reported that micro cracks in cement are initiated by voids, caused by the cement mixing technique, and also by roentgen opaque barium sulphate particles [58].

**Osteoarthritis**

*Positive effects:* Pain, stiffness and function (MS) improved in patients with knee osteoarthritis [59, 60]. Beneficial influences were also published by others [28, 61-63]. The performance in a step test improved [64].

*No effects:* Pain, functional performance and muscle strength did not improve [65, 66]. Pain and performance in walking tests remained unaffected [64]. Knee osteoarthritis did not improve in mice [40].

**Recommendations for subjects with implants or osteoarthritis**

Many public health advice sites warn against using WBV training in subjects with joint implants or osteoarthritis [67, 68]. The producers of the training devices state the same warning on their web sites and in their training manuals. Galileo mentions the insufficient knowledge about the long term effects of WBV on implant fixation and cartilage in osteoarthritic joints [69, 70].

**Summary of literature**

The reports on all possible applications of WBV training are controversial. This controversy may be due to the differences between investigated subjects and applied vibration parameters (frequency, stroke, platform type). It may also be that other parameters and mechanisms were not identified yet. In none of the studies were proportional increases of EMG signals and muscle forces or joint contact forces JCF explicitly stated.

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