

Effect of Whole Body Vibration on the BMD and Balancing Ability in Postmenopausal Women

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Selective sarcopenia and decrease in BMD are common in elderly. Their combined effect is the main cause of fragility fractures among elderly. Whole-body vibration has been shown to have positive effect on muscle strength and balancing activities in patients and athletes. It has also been shown to have positive effect on bone mineral acquisition in animal studies and in people with poor bone quality. We therefore hypothesised that elderly may be a special candidate for whole-body vibration as such treatment will improve muscular performance and bone quality. It will be useful for preventing falls and their associated osteoporotic fractures. The present study was designed as a prospective randomized controlled study to investigate the effects of whole body vibration therapy on BMD and balancing ability in the postmenopausal women.

Study designs:

In the first part of this study, we studied the effects of vibration on the body control, and stability with the elderly. 75 women with average age of 69.5 years old were recruited. The inclusion criteria were female with age 60 or above and able to stand independently without any aids. Elderly with conditions that affecting the bony metabolism and regular supervised exercise were excluded. Written consent was obtained from all subjects before enrolment of the study. The study protocol was approved by the Clinical Research Ethics Committee of the Chinese University of Hong Kong (Ref.: CRE-2004.187). With baseline measurement with Balance master, whole-body vibration with Galileo 900 was started within one week after the baseline measurements were completed. During treatments, the subjects stood on the Galileo oscillating platform on bare feet at the 2nd foot position at 20Hz for 3 mins/day and 3 days/week for 3 months. Assessments were repeated at the end of the treatment and results were compared with pre-treatment data.

In the second study, women within 5 years of postmenopausal were recruited in a randomised control studies with 2 different vibration mechanisms: Galileo and Juvent vibration platforms.

Randomization was performed by an independent research assistant with the use of sealed envelope. BMD was measured before treatment in spine and hips with DXA (Norland 46) and pQCT was used to measure the BMD in the distal tibia. Limits of stability, functional reach and quadriceps strength were measured. The whole-body vibration with Galileo 900 was started within one week after the baseline measurements were completed, while no treatment was given to the control group. During treatments, the subjects stood on the Galileo oscillating platform on bare feet at the 2nd foot position at 20Hz for 3 mins/day and 3 days/week.

While those treated with Juvent vibration platform, 30 minutes per day and 5 days per week on 50 Hz vibration were the protocol of treatment. All side effects during treatment were documented. Blood pressure was measured before and after each Juvent treatment.

All assessments on BMD and on the balancing ability were repeated for both groups at the end of study. BMI was calculated by the standard formula with data from the body weight and height. Data comparison between pre- and post-treatment were analyzed by Wilcoxon matched pairs signed rank test while data comparison between two groups by Mann-Whitney U test. Statistical significance was set at $p < 0.05$.

Results of the study:

1. Elderly group: three-month high-frequency vibration therapy with 3 mins/day and 3 days/week significantly enhance the balancing ability of elderly women in movement velocity[1.89 vs 2.75 deg/sec, $p=0.00$] maximum point excursion[43.02 vs 35.89% $p=0.00$] and directional control[1.89 vs 2.75 deg/sec, $p=0.00$]. Of these parameters, movement velocity and maximum point excursion were found to be the most sensitive ones to the vibration treatment. These findings provide good evidences to support the efficacy of whole-body vibration on enhancing muscular performance in elderly women who are at risk of fall.

2. Postmenopausal women:

a. Study with Galileo vibration platform for one year treatment in postmenopausal women showed significant improvement in body moment control[3.1 vs 3.9 deg/sec, $p=0.045$] and quadriceps muscle strength[21.4 vs 17.1 kg, $p= 0.028$] when compared with control group. BMD measurement showed continuous decline in control group while the treatment group showed decrease in the rate of BMC loss BMD of lumbar spine[-0.43 vs -3.00 %, $p= 0.081$], proximal femur [-0.87 vs -1.57 %, $p= 0.67$] and with changes in distal tibia[-0.08 vs -2.05%, $p=0.048$] showed statistical significant differences.

b. Study with Juvent vibration platform for one year treatment in postmenopausal women also showed significant improvement in body moment control[2.94 vs 3.90 deg/sec, $p=0.022$] and quadriceps strength[66.1 vs 29.7kg, $p=0.041$]. BMD measurements also showed continuous decline in the control group while the treatment group showed decrease in the rate of BMC loss with BMD in lumbar spine[0.38 vs -1.80%, $p= 0.039$] proximal femur [-1.14 vs -1.92 %, $p=0.58$] and distal tibia[-0.72 vs -2.05%, $p= 0.015$]. When the consideration of BMI is taken, the differences between control and treatment groups are even bigger and seen in distal tibia, proximal femur and spine.

No complication was reported in the treatment group throughout the study period.

Discussion and conclusion

The significant improvement in balance and body movements control among elderly and postmenopausal women indicates the positive effect of vibration on skeletal muscle activities. The effect is independent of the mechanism of vibration though low amplitude high frequency vibration appears to have more prominent effects.

The positive effects on bone mineral maintenance with vibration is also demonstrated with 2 different vibration mechanism though low amplitude high frequency treatment seems to have much wider and prominent effects on the skeletal system with respect to maintaining bone mass in post-menopausal women.

Future studies should be focused on more refine treatment protocols in order to balance treatment compliance and beneficial effects. Mechanistic study on the positive effects on body movement controls with positive muscle regeneration should be carried out. The mechanism of improved bone mineral content acquisition needs further exploration. New application of the technology on fragility fracture prevention and healing may be another research strategy.

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