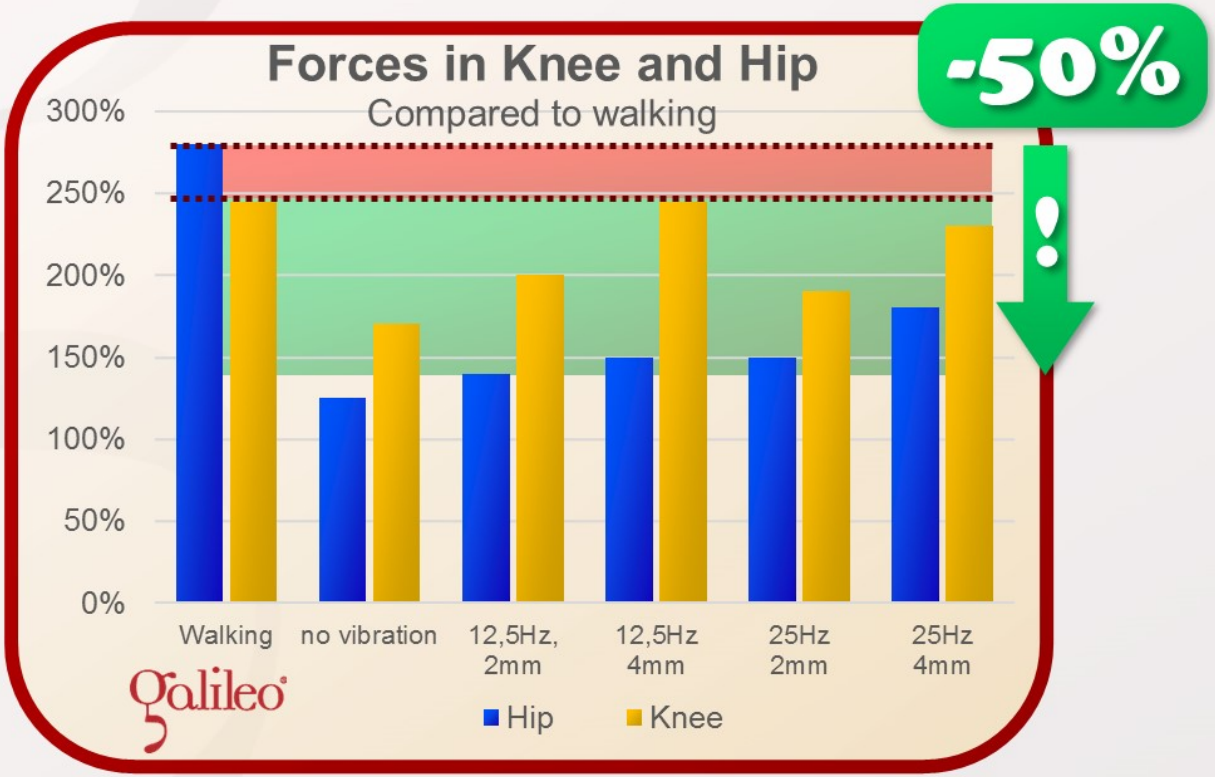
Galileo Training

Does Galileo Training cause high joint forces ?

The answer is: NO

This Study compares forces within the knee during Galileo Training and training with vertical vibration. Measurements were done in-vivo with individuals who had artificial knee and hip implants with built-in force sensors. It proves that even at high frequencies and amplitudes Galileo Training causes smaller internal joint forces then walking. Another reason why Galileo Training is such a safe training method.



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LOADING OF THE KNEE AND HIP JOINT DURING WHOLE BODY VIBRATION

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Introduction

Whole body vibration (WBV) training uses high-frequency stimuli which are generated by a vibrating platform. The goal of the stimulation of the musculoskeletal system is mainly to increase muscle function, such as strength and power, or to increase bone mineral density. However, the efficacy of WBV has been discussed controversially [Merriman, 2009]. So far, information about the actual loading of the musculoskeletal system is lacking. The goal of this study was to measure joint contact forces during WBV *in vivo*.

Methods

Instrumented knee and hip implants were developed to measure the joint contact forces and moments *in vivo* [Heinlein, 2007; Damm, 2010]. 6 subjects (age: 63-77 years, weight (BW): 68-110 kg) with instrumented knee implants and 4 subjects (age: 51-64 years, weight: 81-90 kg) with instrumented hip implants participated in this study. For the WBV training the Galileo 2000, a system with a side-alternating vibration, was used. The subjects were standing with shoes on the platform with their knees slightly bent. Vibrations with frequencies of 12.5 and 25 Hz and amplitudes of 2 and 4 mm were applied for 15 seconds.

Results

During WBV the maximum resultant joint force (F_{res}) was on average not higher than during walking (Fig. 1). Compared to the standing position without vibration F_{res} increased by 24-57% (knee joint) and 10-38% (hip joint) during WBV. In general, peak forces and force increases in the knee joint were higher than in the hip joint during WBV. An increase of the vibration amplitude from 2 to 4 mm led to an increase of F_{res} by 16-22% (knee) and 6-20% (hip). A correlation between the vibration frequency and the magnitude of F_{res} was not observed.

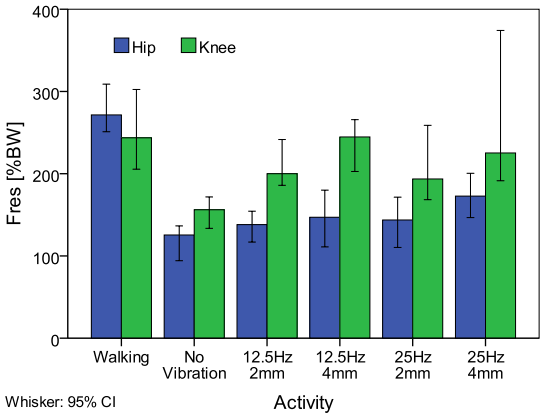

Figure 1: Resultant joint forces during walking, standing position without vibration and during vibration

Discussion

This data shows that during WBV the resultant joint contact force is not higher than during walking. The magnitude of the resultant force itself can therefore not be detrimental for hip or knee joints. However, this study cannot make a statement about the efficacy of WBV or its risk factor for patients with osteoarthritis or joint implants. Further knowledge about the effect of forces acting at high frequencies on bone, cartilage or implant fixation is necessary to evaluate this topic thoroughly. Furthermore, only the resultant joint force was presented. Other force or moment components might exceed the ones during walking or other daily activities.

Due to the higher damping distance smaller dynamic forces can be expected in the hip joint than in the knee joint. Our results tend to support this assumption. Further measurements with greater subject cohorts are necessary to provide evidence for this trend.

References

Damm *et al*, Med Eng Phys, 32:95-100, 2010.
Heinlein *et al*, J Biomech, 40:S4-10, 2007.
Merriman *et al*, J Geriatr Phys Ther, 32:134-45, 2009.

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