

The MBT shoe and its biomechanical/ therapeutic effects

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MBT Model: Sole 2004

ABSTRACT

THE HUMAN PERFORMANCE LABORATORY (HPL): The Human Performance Laboratory (HPL) is one of the world leaders in basic and applied research related to human neuro-musculo-skeletal health and well being from birth to old age. The HPL is a multidisciplinary research group consisting of nine full-time and seven adjunct faculty members (professors) with research backgrounds in anatomy, muscle mechanics, physiology, motor control, biochemistry and biomechanics. The total working force of the HPL includes approximately 100 full-time equivalent researchers, visiting professors, post-doctoral fellows, graduate students, as well as secretarial and technical assistance. The HPL has an international flavour with a constant presence of students, fellows and professors visiting, studying and participating in collaborative research from all over the world.

Last year, the research activities of the HPL have been assessed by an independent external reviewer as "*.... the best in the world in Clinical Biomechanical Research.*"

The HPL is specialized to study the mechanical and neuro-physiological effects of medical devices for prevention and rehabilitation of movement related problems.

CONCEPT: Stability during locomotion is important for all age groups. Two strategies are available to improve stability during locomotion, constructing shoes that provide

support and/or strengthening lower extremity muscles. However, when using shoes that provide stability, the muscles contributing to static and dynamic stability get weaker because they are not used. For this reason, many people train these under-activated muscles, using unstable situations (e.g. a wobble board). Conceptually, it does not seem logical to separate the functions of static and dynamic stability and mechanical muscle training. One may suggest that training of lower extremity muscles should be combined with the actual locomotion activities.

A mechano-therapeutic training device has recently been developed by Masai Barefoot Technologies (MBT). The MBT device has a rounded sole in the anterior-posterior direction, thus providing an unstable base. These shoes act as a training device for lower extremity muscles and frequent use of this device is associated with several positive medical and health benefits.

The theoretical concept behind this unstable construction is to strengthen the muscles close to the movement axes because strong forces close to the joint axes reduce the resultant joint loading substantially (Fig. 1). Reduced joint loading, however, has a beneficial effect on lower extremity joint pain.

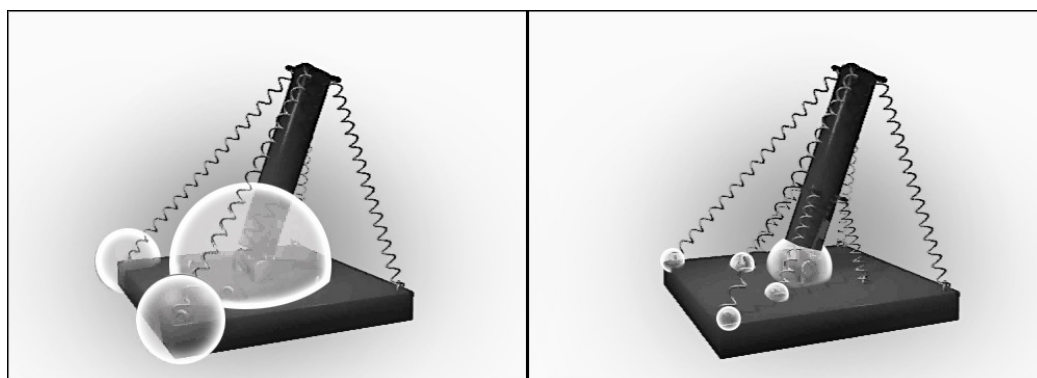


Fig. 1 Illustration of the calculated effect of the inclusion of strong forces close to the joint axis (right picture) on the joint and insertion loading for a mast with large and small springs, oscillating around its equilibrium position. The spheres at the insertion of the springs and at the joint of the mast indicate the magnitude of the forces at these locations.

METHOD: In a comprehensive study with 8 test subjects that used the MBT device in the average 9.5 hours per day for two weeks, the HPL studied the mechanical effects of the MBT device. Specifically, kinematics, kinetics, muscle activity, soft tissue vibrations and oxygen consumption during standing and/or walking were assessed for healthy subjects using an unstable MBT device and a conventional control shoe.

RESULTS: The results of this study revealed the following facts:

- During standing quietly, the MBT device increased the movement of the center of pressure, producing an increased demand of muscle activity in the lower extremities to balance the body. Thus, during standing, the MBT device acts as a mechanical muscle training device.
- During walking, the MBT device produces an increased rotational ankle joint impulse for foot plantar-flexion and foot inversion for the first half of ground contact. Thus, the MBT device acts as a mechanical training device for the muscles crossing the ankle joint.
- During walking, the MBT device reduces the rotational ankle joint impulses for the knee joint (average reduction 27 %). Thus, the MBT device reduces mechanically the forces at the knee and hip joint. This result is typically associated with a reduction of joint pain.
- During walking, the MBT device required 2.5 % more oxygen consumption for the same walking task, thus requiring more mechanical energy, which translates into a mechanical training effect.
- Based on the results of this study it is concluded that the MBT device strengthens the small muscles with small levers with respect to the rotational axes. This would reduce the joint loading (Fig. 1), which explains the results of less pain and discomfort when using this training device.

CONCLUSIONS

- The MBT device when applied as described in the user's instructions is a device for mechano-therapy.
- The mechano-therapy with the MBT device influences the patient during standing and walking. During standing, the MBT device increases the muscle activity,

therefore increasing the muscle forces and producing a training effect. During walking, the MBT device reduces the joint loading, therefore reducing the joint pain.

- The MBT device is, therefore, an effective device for mechano-therapy.