Safety considerations in vibration training

Kleinöder Heinz, Ziegler Jörn, Bosse Christian, Mester Joachim

Institute of Training and Movement Science, German Sport University Cologne

Introduction

Although the intensities of vibration training (i.e. frequency, amplitude and training duration) are not yet well-known, vibrations are used in many sports at different levels of performance in order to improve strength and flexibility. Therefore, as a basis for the proper use of vibration training, it is important to get safety guidelines for training comparable to ISO 2631. An important question in this context is whether there are vibratory thresholds as proposed by SPITZENPFEIL (2000). Analogue to lactate thresholds they can be explained and interpreted as an exponential increase of the EMG response and the shock transmission with increasing vibration load. Another general problem with vibrations is that they cannot be clearly restricted to the target muscles, but are transmitted to other areas of the body. Of special interest here is the vibration load on the brain, since it is generally accepted that this part of the body should be protected in order to avoid various sincere consequences (cf. GRIFFIN 1994).

Methods

The investigation took place on the Galileo 2000 vibratory machine. 30 persons (healthy sport students between 21 and 29 years of age) got the task to dampen vibrations with 2.5 mm amplitude at increasing frequencies (5-10-15-20-25 Hz) to their maximum. While standing on the vibratory platform they were loaded with a barbell weighing about 30% of the individual body weight. The duration of the single steps were 30 s each with 60 s pause between sets. Muscular acitvities were measured by EMG for the m. vastus medialis, the m. biceps femoris, the m. tibialis anterior and the m. gastrocnemius. The average of 10 s was taken and related to the MVC of each muscle group. In addition to this, accelerometers were placed at the vibration platform and the head in order to calculate the transmission factors from the platform to the head.

Results

The mean of the muscle activity of all test persons showed an increase from 5 to 25 Hz for all investigated muscle groups. The increase of muscle activity in most cases can be represented by an e-function.(see fig.1). Nevertheless, individual differences occured in form of high muscle activation already at low frequencies indicating high coordinative demands. The reason for this can probably be found in the varying quality of coordination between the test persons. In contrast to the increase of muscle activity the values of the transmission factors TF = RMS head / RMS platform show an exponential decrease from lower to higher frequencies. This can be interpreted as a better dampening of the body as an reaction to higher frequencies. Interestingly there are no individual exceptions from this pattern although the height of the individual transmission differs remarkably from test person to test person (see fig. 2).

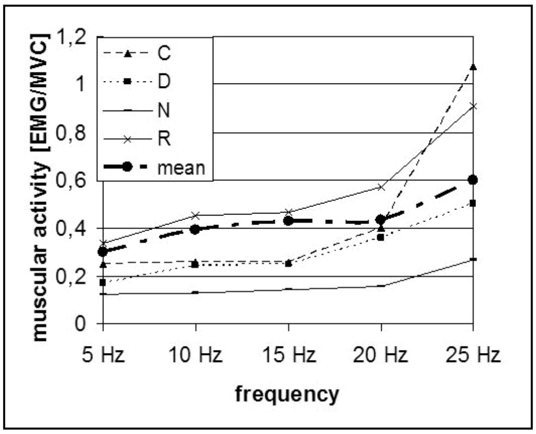

Fig.1: EMG acitvity for the m. biceps femoris

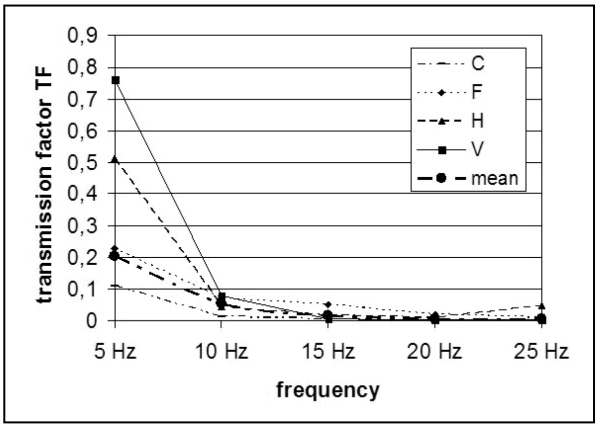

Fig. 2: Transmission factors [RMS head/platform]

Discussion/Conclusion

The results show that lower frequencies mean high transmission factors to the head which should generally be avoided since they can cause sensory mismatch and nausea. Their decrease at higher frequencies can be interpreted as the effort of the body to dampen the vibrations in order to protect the brain. Vibratory thresholds cannot definetely be confirmed as there are many individual deviations from a clear pattern. These individual differences also include at least partly very high coordinative demands during vibration training which need a good preparation esp. in spare time and fitness sport.

References

Spitzenpfeil P (2000). Vibrationsbelastungen im alpinen Skirennlauf: Analyse – Simulation – Training, Dissertation

Griffin R (1994). Handbook of Human Vibration, Second Printing, London