SKIN SENSATION THRESHOLDS OF THE HUMAN FOOT IN OBESE AND ANORECTIC PATIENTS

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INTRODUCTION

The foot as a sensory organ has received much attention in recent years. Studies by Perry et al. [1] demonstrated the importance of the mechanoreceptors under the foot for balance control during gait. A reduction of plantar sensation will cause less stability to maintain balance during standing and walking. A study, investigating threshold sensitivities at 30 different anatomical locations, has shown that touch and vibrotactile sensitivity varies considerably across the plantar and dorsal surfaces of the foot [2]. Three studies are presented here that compared touch and vibration skin threshold perception values of overweight and underweight subjects against two normal weight groups.

METHODS

To study the influence of overweight on the perception of touch and vibration 37 overweight subjects with a mean Body Mass Index (BMI) value above 35 were compared to 41 men and women with a mean BMI below 25. In a second study 17 underweight women with a BMI of 18.4 were compared to 22 women with a BMI of 22.9. In a third study 14 women with anorexia nervosa and a BMI of 15.5 were compared to the 17 underweight women of our second study. The subject groups in each of the 3 studies were matched with regard to age and body height. The chosen anatomical locations (right foot) for the measurement of the sensitivities were the heel (P1), the medial arch (P2), the 3rd distal phalanx (P9), and the dorsum of the hallux (D8). Additionally, sensitivities were also determined at the middle distal phalanx (Finger) at the inside of the right hand (FB,M1). Touch and vibrotactile threshold sensitivities were determined by using "Semmes Weinstein" monofilaments and a "Horwell" Neurothesiometer. The order of measuring the anatomical sites was randomized between subjects. An infrared lamp was used to maintain constant foot temperature. Touch threshold detection was realized with the "Semmes Weinstein Monofilaments". A ramp generator was used for a slow and linear amplitude increase of the 50 Hz vibration stimulus from the "Horwell Neurothesiometer". As soon as the subjects detected a vibration sensation at the measuring site they pushed a button to record the current amplitude value.

RESULTS AND DISCUSSION

In all three studies statistical significant between group differences were found for the touch as well as the vibration threshold perception scores. However, the vibration results had larger between group effects and will be presented here. The vibration threshold recognition for the overweight subjects showed clear differences with worse perception scores (figure 1) in all foot regions as well as the hand. A similar trend is also observed for the comparison of the underweight against the normal weight subjects (figure2). In underweight subjects there is a trend to improved stimuli recognition. Comparing, however, anorectic women against underweight women, the anorectic patients with a lower BMI have increased sensory detection thresholds (figure 3).

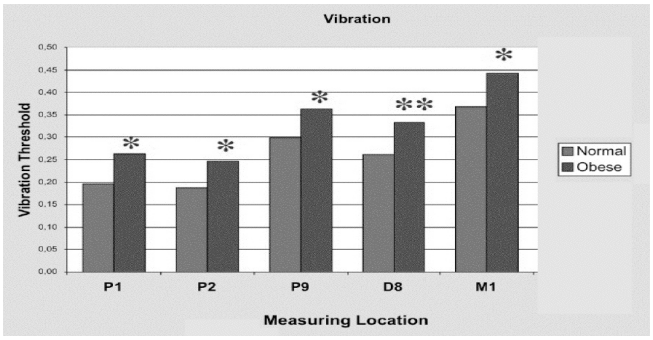

Figure 1: Vibration thresholds (arbitraray units) in 41 normal and 37 overweight subjects (* p<0.05, ** p<0.01).

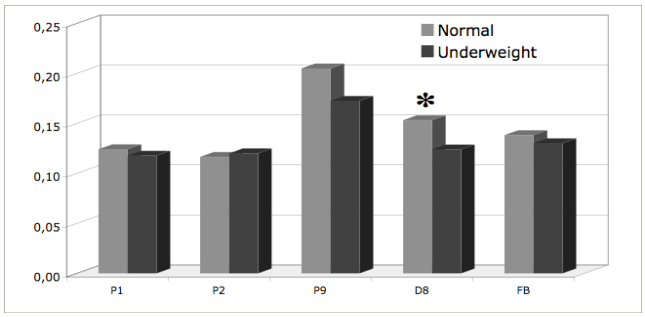

Figure 2: Vibration thresholds (arbitraray units) in 22 normal and 17 underweight subjects (* p<0.05).

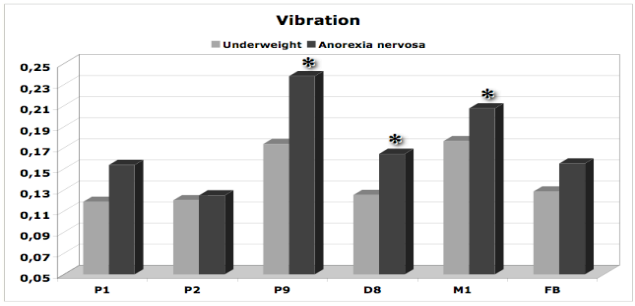

Figure 3: Vibration thresholds (arbitraray units) in 17 underweight and 14 anorexia patients (* p<0.05).

CONCLUSIONS

The results from the first two studies suggest that additional subcutaneous fat is an important factor for worse perception scores. However, the lower perception ability of the anorectic patients against an underweight subject group with a higher BMI also suggests, that higher brain structures of the Central Nervous System also play an important role in the recognition of mechanical stimuli to the skin.

REFERENCES

1. Perry, SD., W.E. McIlroy, and B.E. Maki , Brain Research **877**, 401-406, 2000.
2. Hennig, E. M., T. Beierle, and T. Sterzing, Touch sensitivity thresholds across the dorsal and plantar surfaces of human feet. Proceedings of the 13th Biennial CSB Conference, Halifax, Canada, p. 65, 2004.