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► **To cite this version:**

Aurélien Descatoire, Virginie FEMERY, Pierre Moretto. PLANTAR PRESSURE REDISTRIBUTION AFTER A HIGH AND LOW UNLOAD. *Journal of Biomechanics*, 2007, S2 (40), pp.S177. 10.1016/S0021-9290(07)70173-2 . hal-04363952

HAL Id: hal-04363952

<https://hal.science/hal-04363952v1>

Submitted on 4 Jan 2024

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PLANTAR PRESSURE REDISTRIBUTION AFTER A HIGH AND LOW UNLOAD

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INTRODUCTION

Currently, diabetic foot disorders are considered as one of the major problem of public health care. Excessive local plantar pressures are a major risk factor for the development of foot ulcers. It seems that a high unload (30% or 40%) of an at risk area would involve significant overload under other anatomical foot locations [1]. De vita and Bates [2] suggested that a 5% variation of ground reaction force would be biomechanically meaningful which could avoid any plantar pressure repercussion.

The aim was to study the plantar pressure consequences after a high and a 5% unload by using a new biofeedback device.

METHODS

The feedback device is intended to cue the subjects to initiate a new walking gait strategy. Two insoles (right and left) were customized comprising 8 Paromed hydrocells. The hydrocell consists in a capsule filled with incompressible fluid, which involves a pressure from the different components of the ground reaction force. So, during a foot ground contact, the force action $F(x,y,z)$ involves a pressure, which is identical at any point inside the hydrocell.

The visual feedback, which was returned to the subject through a control screen, consisted of a plantar footprint visualization of the locations of each sensor. To the right of the plantar footprint, a scale of colours, from blue to green to red, marked the intensity of the pressure exerted under each location.

The auditory feedback functioned as an alarm and was triggered with the visual feedback when the local pressure under the selected area exceeded a previously determined threshold, the critical peak pressure.

Each channel could be selected separately to unload precisely and return the feedback under the area considered relevant.

Eight healthy subjects first performed a walking test on a treadmill to record the peak plantar pressure distribution in "Normal" conditions (NC). Then, two conditions were tested. The "No Biofeedback" condition (NBC), the subject had to unload metatarsal 1 freely. For the "Biofeedback" condition (BC), the subject was told to unload M1 by $5\% \pm 2.5\%$, taking the feedback signals into account. The unload condition was applied to the right foot only. From the recording, we computed peak plantar pressure (PPP) at each of the 7-sensor locations for each foot.

RESULTS

Results in Figure 1 present the Peak plantar pressure of the three conditions for both feet. The "No Biofeedback" condition involved a 30% unload of metatarsal 1 compared to the "Normal" condition while the "Biofeedback" condition concerned a 7.4% unload.

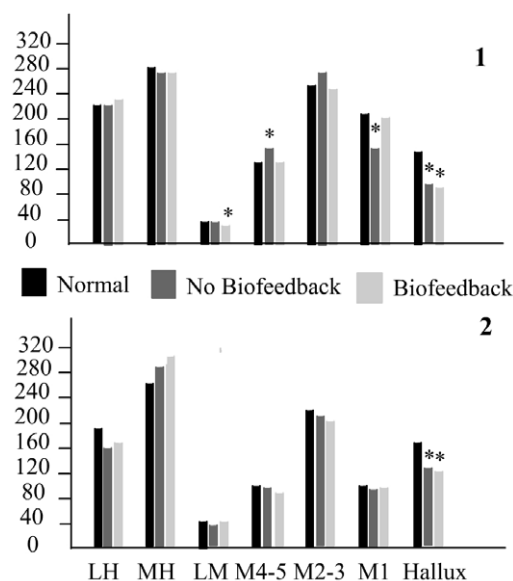


Figure 1: Peak Plantar Pressure in Kilopascal under the 7 sensors locations.

LH: lateral heel, MH: medial heel, LM: lateral midfoot, M: metatarsal head and Hallux; *: Significant PPP differences between NC and NBC or BC; 1: Unload Foot
2: Contralateral Foot.

DISCUSSION

As expected, the "No Biofeedback" condition revealed that subjects freely made a high unload (30%) [1]. It could be that the strategy for making a high unload requires less motor control than for a low unload (7,4%). The increase in accuracy implies a more difficult task [3].

The redistribution of the PPP after a high unload revealed significant increase under M5 another important at risk foot locations for diabetic persons [4]. On the contrary the low unload revealed no significant increase and confirms the possibility to relieve M1 without overloading anatomical foot locations under either foot.

REFERENCES

1. Femery V et al. Arch Phys Med Rehabil **85**, 1724-1728, 2004
2. Devita P and Bates BT. Hum Mov Sci **7**, 73-85, 1988
3. Park S. Percept Mot Skills **94**, 1157-1167, 2002
4. Lavery LA et al. Arch Phys Med Rehabil, **78**, 1268-1271, 1997

ACKNOWLEDGEMENTS

This investigation was supported by funds from the Conseil Régional Nord-Pas de Calais, the Délégation Régionale à la Recherche et à la Technologie du CHRU of Lille and the Institut Régional de Recherche sur le handicap.