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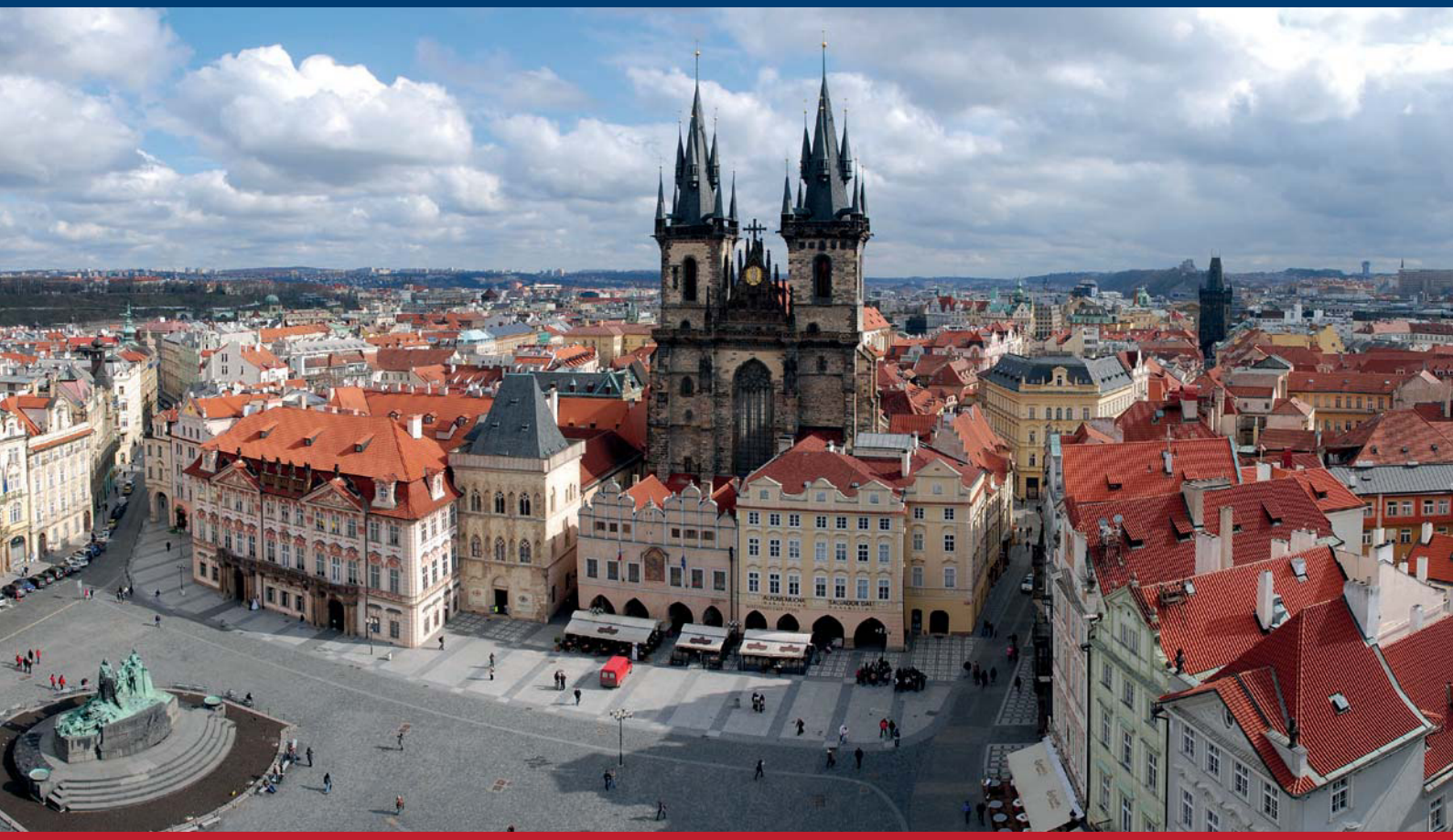

ABSTRACT BOOK

Partnerships: Masaryk University, Faculty of Medicine, Brno; Institute of Health Information and Statistics; Czech Wound Management Association; Ministry of Health of the Czech Republic

EUROPEAN PRESSURE ULCER ADVISORY PANEL

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Characterization of skin integrity by quasi-static mechanical impedance device

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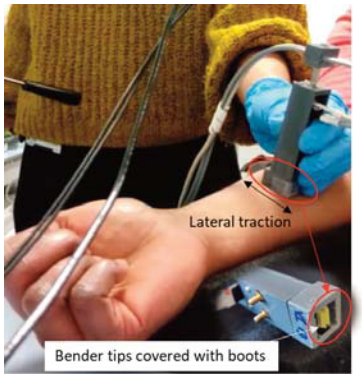
Introduction: Early detection of pressure ulcers is essential to reduce treatment costs. Biomechanical characterization of soft tissue/ skin has received increased interest [1]–[3], as they may reveal dysfunction or underlying damage. To better understand how skin biomechanics are related to the risk of pressure ulcers, we developed a portable device to characterise the quasi-static viscoelasticity of skin. To justify the feasibility of the device as a diagnostic tool, we damaged the skin with tape stripping to simulate the presence of a pressure ulcer.



Methods: To study the influence of tape stripping on skin biomechanics, 8 healthy participants (3 males, 5 females), with an average age of 34 years (27-41 years) were recruited. Skin biomechanics of the forearm were characterized using the quasi-static mechanical impedance device (Fig. 1). The device was composed of a pair of piezoelectric benders, which can deform skin laterally.

To characterize quasi-static viscoelasticity of the skin, a loading pattern of step-hold-sinusoidal was applied [4]. The skin was first stretched laterally to a baseline strain of 4.2% and held for 10 s. Then, a sinusoidal displacement was applied to the skin for 10 periods at 1 Hz, with a strain amplitude of 0.8%. Skin responses before, after insulting (tape stripping 25 times), and after 30 min of recovery were measured.

Fig. 1 Skin measurements with the quasi-static mechanical impedance device. The piezoelectric bender tips were insulated by a pair of boots.

Results: Dynamic modulus analysis was employed to deduce skin parameters. The median complex modulus of the forearm is 165 kPa (78-452 kPa). The median loss tangent value is 0.29 (0.23- 0.49).

To study the changes in biomechanics due to insulting, all the data were normalized by their baseline values. As shown in Fig. 2, tape stripping tends to lower the complex modulus, except for participant 6. While loss tangent is increased after, except for participant 8. A recovery time of 30 minutes is insufficient for most of the participants.

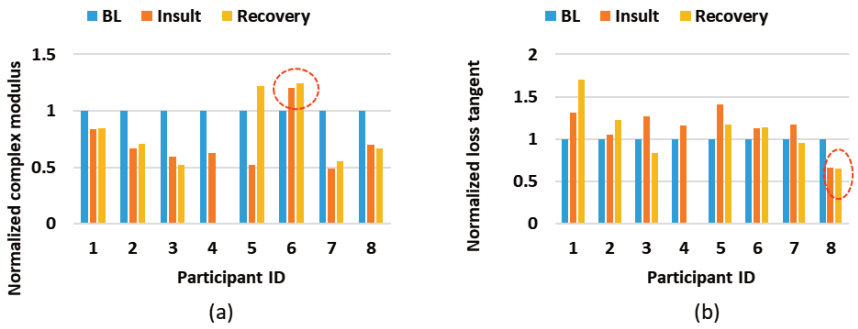


Fig. 2 Dynamic modulus analysis. (a) Normalized complex modulus. (b) Normalized loss tangent. The blue bar ("BL") represents baseline value, the orange bar ("Insult") represents data measured after tape stripping, and the yellow bar ("Recovery") represents data measured after 30 min of recovery time. Data were normalized by the baseline values. Recovery data of participant 4 are missing.

Conclusions: Preliminary results show that the quasi-static mechanical impedance device can detect the skin changes after tape stripping, with a decreased complex modulus and an increased loss tangent. Tests on a larger group of participants are required to confirm this conclusion.

References

[1] *Wang et al., doi: 10.1109/IEMBS.2006.260070.*
[2] *Dagdeviren et al., doi: 10.1038/nmat4289.*
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[4] *Babaei et al., doi: 10.1016/j.jmbbm.2016.12.013.*