ADVANCED TEST HEAD IN VOLTAGE MAPS MEASUREMENT PROCESS

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Received 30 April 2015; accepted 07 May 2015

1. Enhanced skin impedance mapping

This contribution points out the enhanced possibilities using an improved test head for electrical impedance mapping of human skin. Deviating from the established standard test device the principle of single tip placement is done no longer manually but pneumatically. On one hand under these circumstances the measurement is more objective because the telescopic electrode placement and contacting follows the controllable and appropriately applied pressure, exactly. On the other hand, the test head as a whole is placed by a fixing unit allowing a certain tracking while application. The pneumatic principle and the defined traction of head unit will lead to a more sophisticated mapping of human skin voltages.

2. Investigation boundaries

The investigations on human skin impedance map have followed the traditional acupoint assumptions given by the Traditional Chinese Medicine herein chosen as Li1 to Li5. In the area covered by these acupoints mentioned before Voll guessed three additional points carrying certain body's diagnostic information, each. The location of these points has been considered in the laboratory observation, too.

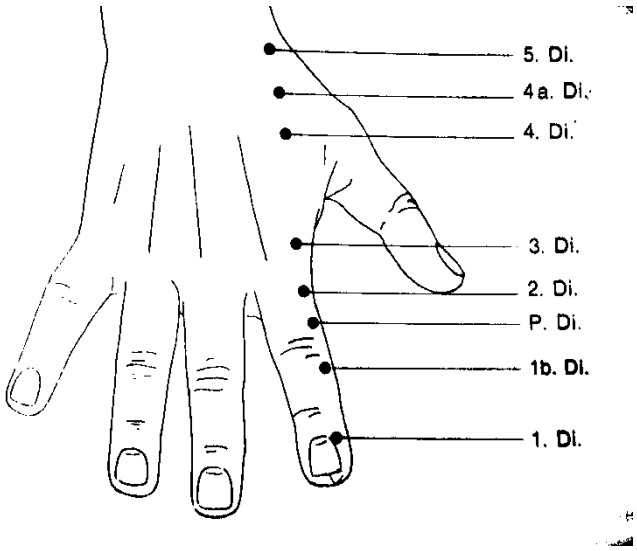


Fig.1:*Acupoints and diagnostic points according to Voll.*

3. Extrinsic factors

The investigations already done were suffering on a certain lack of precision since the traction and its angle has been performed manually. The pneumatic electrode was able to decrease this uncertainty significantly concerning the force criteria. The angle of application remained undefined so far.

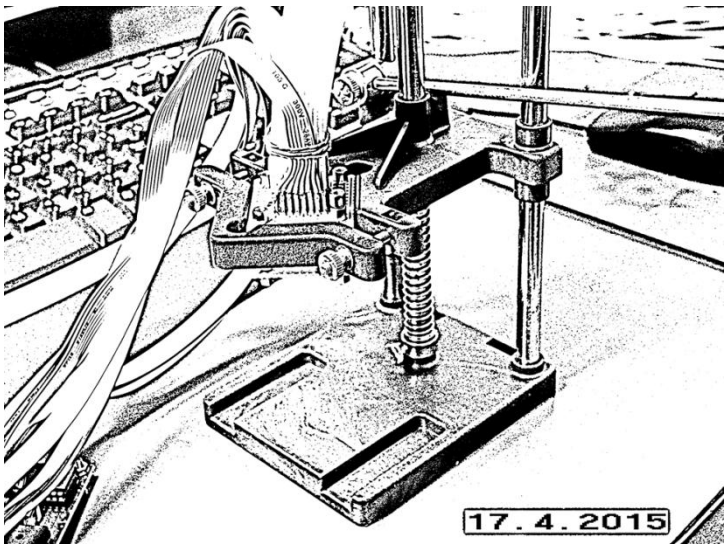


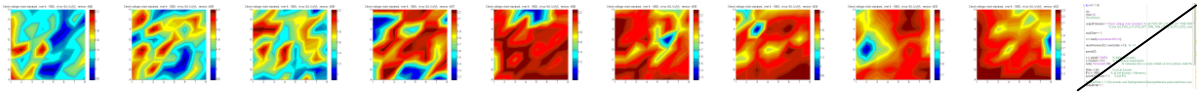
Fig.2:*Traction unit*

4. Intrinsic factors

Per definition the intrinsic factors of measurement are those concerning the methods of mapping procedure. Primarily the force of application and the frequency of the test steps have been considered. The force of application was varied by choosing the pressure range between 3.5 bar and 5 bar in 0.5 bar steps. The optimum of recognition appears around 4.5 bar.

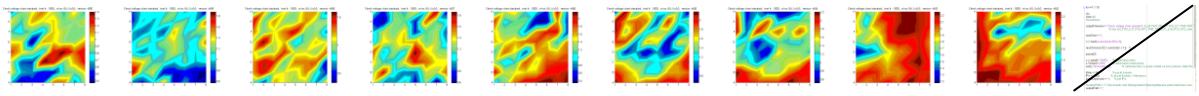
Table1: 2014-03-20 Pneumatic Head, Li1 to Li5 Mapping, Single Step, defined Reference Points, Pressure Variation

3.5 bar Test precondition:**0.5 mm** tip diameter



N°540	N°539	N°538	N°537	N°536	N°535	N°534	N°533	N°532	N°531
									cancelled

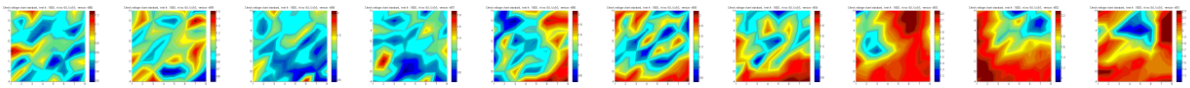
4.0 bar Test precondition:**0.5mm** tip diameter



N°550 N°549 N°548 N°547 N°546 N°545 N°544 N°543 N°542 N°541

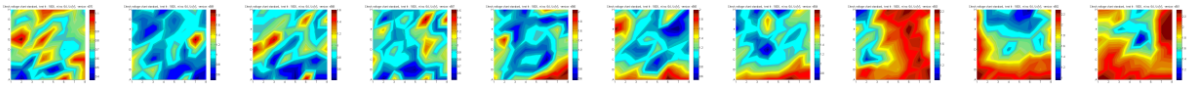
cancelled

4.5 bar Test precondition:**0.5 mm** tip diameter



N°560 N°559 N°558 N°557 N°556 N°555 N°554 N°553 N°552 N°551

5.0 bar Test precondition:**0.5 mm** tip diameter



N°570 N°569 N°568 N°567 N°566 N°565 N°564 N°563 N°562 N°561

Fig. 3. Skin irritation degree depending on applied forces.

The frequency has been defined by doubling the frequency from 1.000 Hz on. The basic impedance behaviour is obvious, but recognition differences are recognizable, too.

Some results are in Tab.1 and 2 and will be detailed disscussed during presentation.

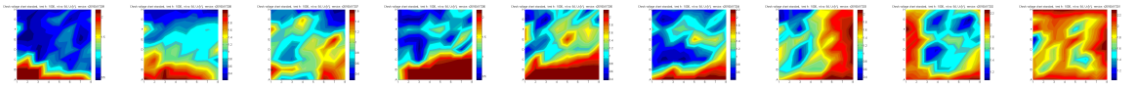
5. Conclusion

The correlation between the traditional acupoints and the diagnostic points according to Voll shall be investigated under variation of both intrinsic and extrinsic factors furthermore. Improving automatized measuring device and method our team had the opportunity to unfold the position and the shape of certain active points on the human skin surface and measure their voltage maps in an advanced way. There was continuity in this

paper with our previous research of various parameters and conditions influencing the process of voltage/impedance map measurements. Thanks to the construction and the structural advantages of the pneumatic measuring probe the dynamic range of the measured map is improved, significantly [1,2].

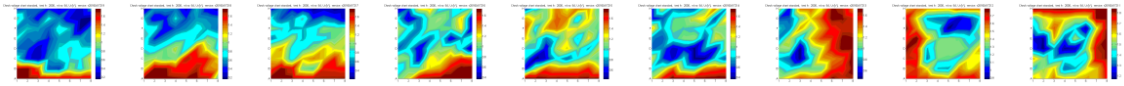
Table 2: 2014-04-17 Pneumatic Head, Li1 to Li5 Mapping, Single Step, defined Reference Points, Frequency Variation, 4.5 bar

1.000 Hz Test precondition:**0.5 mm** tip diameter



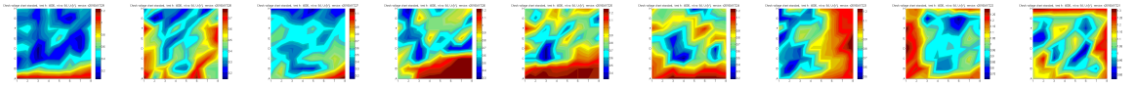
N°--- N°209 N°208 N°207 N°206 N°205 N°204 N°203 N°202 N°201

2.000 Hz Test precondition:**0.5mm** tip diameter



N°--- N°219 N°218 N°217 N°216 N°215 N°214 N°213 N°212 N°211

4.000 Hz Test precondition:**0.5mm** tip diameter



N°--- N°229 N°228 N°227 N°226 N°225 N°224 N°223 N°222 N°221

6. Acknowledgements

This work was supported under the VEGA grant No.1/789/12 by Ministery of Education, Slovak Republic.

7. References

[1] M. Kukučka and Z. Krajčušková, "Automatized multi-electrode voltage map measurement of active points on skin," In: Communications: Scientific Letters of the University of Žilina, vol. 13, No.1. , 2011,p. 51-55.

[2] M. Kukučka, Z. Krajčušková, V. Stopjaková, D. Ďuračková and A. Weisze, "Advanced calibration in voltage maps measurement process," In: Radioelektronika 2014: Proceedings of 24th International Conference. Bratislava, Slovak Republic, April 15-16, 2014, Bratislava, FEI STU, 2014. - ISBN 978-1-4799-3714-1. - ISBN 978-1-4799-3713-4. - ISBN 978-1-4799-3715-8, 2014, pp. 303-306.