A randomized, observational thermographic study of the neck region before and after a physiotherapeutic intervention

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Abstract – To date there are just a few physiotherapeutic studies using technical monitoring and measurement methods like thermography, sonography or MRI. Thermography relies on the fact that every person's heat signature is unique and that the infrared radiation emitted by the skin is closely related to the local body temperature. Medical infrared imaging is a non-invasive, fast and low-cost diagnostic approach and can be used to measure and visualize the surface temperature of the human skin in real time with very high resolution. These facts make thermography a promising and quickly developing technique for diagnostics of different diseases, including inflammations, tumors as well as numerous neurological disorders.
The aim of this study was examine the spatial and temporal properties the heat emission of the shoulder and neck region, before and after a physiotherapeutic intervention. Basic statistical aspects of the individual variations in the thermal response induced by the exercise were addressed as well.
According to the experimental design, 20 healthy participants (aged between 19 and 29) were thermographically examined during a two weeks period. The participants were randomly separated, into the “intervention group” and the “control group”. The division was not gender-specific. According to the developed experimental protocol, three images of every participant were taken with a VarioCam HiRes camera (InfraTec GmbH, Dresden) equipped with an objective JENOPTIK IR 1.0/25 LW R2 (Jenoptik Co., Jena) over an eight-minute period. During this time, participants of the intervention group were instructed by the examiner to do an exercise with repeated isometric-contractions of neck muscles.
In general, a cooling of the skin due to exposure to a colder (room) environment was observed for all the participants, with a mean magnitude of 0.14°C in the intervention group and 0.42°C in the control group. Although the statistical significance threshold was not achieved (p value was 0.069 for 5% significance level) due to the small group size, the study allowed us to develop a systematic quantitative approach to evaluate the temperature distribution patterns as well as maximum temperatures. The thermographic method showed itself as a reproducible one and the results were found consistent.
For following studies, more data of the participants (vital parameter, core body temperature etc.) should be collected to facilitate the analysis of the measured values. Additionally, more participants should be included into the study.

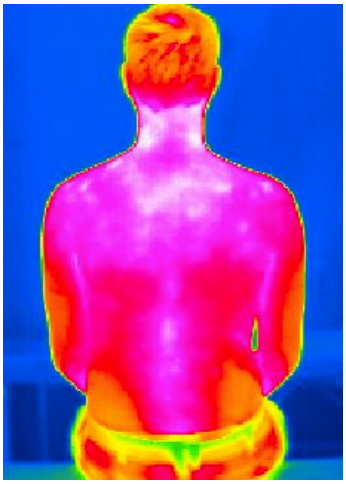

Fig. 1: An infrared image of a participant after the eight-minute period.

Related References

[1] B.B. Lahiri, B. Subramainam, J. Philip. "Medical applications of infrared thermography: A review". *Infrared Physics & Technology. p*. 222 – 232, July 2012.

[2] Bouzas Marins, Gomes Moreira, Pinonosa Cano. "Time required to stabilize thermographic images at rest". *Infrared Physics & Technology*, p. 30-35 May 2014.

[3] dos Santos, da Silva, de Souza Junior. „Thermographic: a tool of aid in physical therapy". *Manual Therapy, Posturology & Rehabilitation Journal*, p. 364-371 22. December 2014.

[4] E.F.J. Ring, K. Ammer. "The Technique of Infrared Imaging in Medicine". *Thermology International*, p. 1 – 13, February 2000.

[5] E.F.J Ring, K. Ammer, A. Jung. „*Standardization of Infrared Imaging".* San Francisco, CA, USA: IEEE Engineering in Medicine and Biology Society, 2004.

[6] Fernandez Cuevas, Marins, Lastras. "Classification of factors influencing the use of infrared thermography in humans: A review". *Infrared Physics & Technology*, p. 28 - 55 March 2015.

[7] Fernandez-Cuevas, Ismael. "*Validity, Reliability, and Reproducibility of Skin Temperature in Healthy Subjects Using Infrared Thermography".* Faculty of Sciences for Physical Activity and Sport (INEF), Bd. Measuring the Skin, Universidad Politécnica de Madrid (Spain): Springer International Publishing Switzerland 2015, 2016.

[8] Costa, Ana C. S. "*Intra and inter-rater reliability of infrared image analysis of masticatory and upper trapezius muscles in women".* Universidade Metodista de Piracicaba (UNIMEP), Piracicaba, Brazilian Journal of Physical Therapy. 17(1):24-31, 2013.

[9] K. Ammer, E.F.J. Ring. „Standart Procedures for Infrared Imaging in Medicine". [Hrsg.] Joseph D. Bronzino, Donald R Peterson Mary Diakides. *Medical Infrared Imaging. Principles and Practice.* s.l.: CRC Press, Taylor & Francis Group, p. 32-1 - 32-9, 2012.

[10] Niu, Lui, Hu. "Thermal Symmetry of Skin Temperature: Normative Data of Normal Subjects in Taiwan". *Chinese Medical Journal*, p. 459 – 468, March 2001.

[11] Zaproudina, Nina. "*Reproducibility of infrared thermography measurements in healthy individuals".* s.l.: PHYSIOLOGICAL MEASUREMENT, 29/ 515-524, 2008.

[12] Mathies, H. 1983. *Rheumatologie A* . Berlin: Springer-Verlag, 1983. ISBN-13:978-3-642-68648-1.

[13] Redaktion, Pschyrembel. 2014. *Pschyrembel.* Berlin: deGruyter, 2014. ISBN 978-3-11-033997-0.

[14] Schünke, M. 2007. *Prometheus Lernatlas der Anatomie.* Stuttgart: Georg Thieme Verlag, 2007. ISBN 978-3-13-139522-1.

[15] Vollmer, M. 2010. *Infrared Thermal Imaging.* Germany: Wiley-VCH GmbH & Co. KGaA, 2010. ISBN: 978-3-527-40717-0.

[16] Zalpour, Christoff. 2010. *Anatomie/Physiologie für die Physiotherapie.* München: Elsevier, 2010. ISBN-13: 978-3437453021.