UNIVERSITI TEKNOLOGI MARA

NON-INVASIVE EVALUATION OF MYOGLOBIN OXYGENATION STATES USING FUNCTIONAL NEAR INFRARED SPECTROSCOPY (FNIRS)

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

This thesis describes an investigation of the myoglobin oxygenation states measured by non-invasive functional near infrared spectroscopy (FNIRS). This non-invasive evaluation could extract much information using a safe non-invasive method in order to diagnose the level of oxygenation status throughout human body. There are two important studies in this thesis and there are from simulation and experimental in vivo using FNIRS. At first, Monte Carlo simulations with Modified beer lambert law have been performed to determine light propagation based on (1) variation of epidermis thickness layer (0.001, 0.002, 0.004, 0.02 and 0.2 cm), (2) variation of fat thickness layer (0.1 - 0.2 cm) and (3) variation of oxygenation (0-55%) at dermis and muscle layers for spectral range from (600 - 900 nm). Next, derived measurement of muscle oxygenation and deoxygenation from myoglobin were examined during the exercise, before and after exercise by each volunteers. Muscle oxygen consumption (MVO_2) is calculated based on arterial Venous Occlusion Test (VOT) and acts as important reading to assess the myoglobin oxygenation especially from myoglobin signal at regional fatigues level under isometric exercises. Maximum isometric contraction is based on One Repetition Maximum (1RM) measurement at (0, 10, 30 and 50%) of isometric exercise on flexor digitorum superficialis (FDS) muscle using FNIR spectroscopy. Based on the simulation result, the change in optical density is significantly decreased and the linearity of measurement characteristics is clearly distorted by the presence of a larger thickness layer of epidermis about maximum 0.2 cm. This study attempt to show a suitable modelling of light propagation passing into deeper layer since there is no a lot of different of absorbance for fat thickness 0.1 cm and 0.2 cm. Apart from that, the experimental result showed deoxygenated myoglobin (Mb) increase with a faster rate during moderate and heavy level of isometrics contraction due to the rapid increase in oxygen extraction from local blood capillary into muscle tissues. Thus, this result may help us to prove that our human muscle is transparent to this near infrared region and might be useful tool for detecting oxygen status in muscle from living people either athletes or working people.

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TABLE OF CONTENTS