Online edition : ISSN 2436-1089
The Humanic Science Abstract 2021.12 Vol.2 No.1

The Humanic Science Abstract

2021.12

Vol.2 No.1

Biofunctional Finding Organization, NPO
NPO法人生体機能探査推進機構

THE HUMANIC SCIENCE ABSTRACT
VOL.2 NO.1

<CONTENTS>

[LETTER]

[LETTER]

Estimation of Shoulder Stiffness State from Images by Analyzing Hemoglobin Concentration in the Peri-Trapezius Muscles

KIYOKAWA Takuma[1], TSUMURA Norimichi[2]

< Abstract >

This study investigates shoulder stiffness, its mechanism, and objective evaluation methods. Three healthy males lifted a 10 kg block with images taken before and after, and VAS assessments. Results suggest a link between hemoglobin changes and blood flow in assessing shoulder stiffness. Further research with more subjects and individual factors is needed to validate these findings.

Key words: Hemoglobin VAS Shoulder Stiffness

1 Introduction

In the course of daily life, body movements and posture can sometimes be a cause of symptoms or conditions in the neck and shoulder musculoskeletal system. Among these, "shoulder stiffness" consistently ranks high in terms of prevalence in surveys of basic national health conditions. While the term "shoulder stiffness" is considered specific to Japanese and Asian language cultures, similar symptoms are often recognized in other countries as neck pain, frequently accompanied by associated symptoms and conditions. Generally, shoulder stiffness encompasses subjective sensations such as stiffness, discomfort, heaviness, and pain, primarily occurring in the neck and upper trapezius muscles. It can also manifest with symptoms like headaches and nausea. Furthermore, it may appear as an initial symptom of cervical shoulder arm syndrome or even more severe conditions such as angina or myocardial infarction. Commonly known causes include maintaining the same posture for extended periods, poor posture like slouching, and exposure to cold air conditioning.

The mechanism behind shoulder stiffness is believed to be the sustained tension in the trapezius muscles and surrounding muscle groups, leading to vasoconstriction, resulting in localized circulatory impairment, oxygen deficiency, nutrient deficiency, and lactic acid accumulation in the peripheral circulation. These

[1] TOHTO University, Faculty of Human-Care at Makuhari
1-1, Hibino,Mihama-ku, Chiba-city, Chiba-prefecture, 261-0021/ takuma.kiyokawa@tohto.ac.jp

[2] Chiba University, Graduate School of Science and Engineering
1-33, Yayoi-cho, Inage-ku, Chiba-city, Chiba-prefecture, 263-8522

factors are thought to stimulate these muscle groups.

However, the definitive diagnosis and treatment methods for shoulder stiffness remain uncertain, with subjective symptom management being the primary approach. Therefore, objective evaluation is considered highly valuable in clinical practice. Consequently, analyzing images of the trapezius muscles and their surrounding muscle groups, estimating blood flow from hemoglobin levels, and understanding the condition of muscle fatigue contribute to our understanding of shoulder stiffness.

In this study, we aimed to replicate the act of lifting heavy objects while standing, induce muscle fatigue, and estimate shoulder stiffness from the obtained images.

2 Experimental Method

We selected three healthy male subjects in their twenties for this study. The subjects were subjected to exercise stress in the laboratory, where they were required to lift a load (approximately 10 kg concrete block for building construction) from a chair 42 cm high, with the right hand lifting from above and the left hand supporting from below. They had to perform this action ten times continuously within one minute. We took images of the upper back of each subject just before, immediately after, and ten minutes after the exercise.

Additionally, at the time of photographing, we assessed subjective information such as discomfort, stiffness, and pain in the neck and shoulders by selecting body parts and using the Visual Analogue Scale (VAS).

3 Analysis Method

The captured images underwent pigment component separation, and hemoglobin pigment concentration was used for analysis. For estimation in this study, we used hemoglobin concentration from the peri-trapezius area on the right and left sides of the trapezius muscle.

4 Results

Figure 1 illustrates the changes in hemoglobin concentration for the subjects, while Figure 2 shows the changes in VAS for each subject.

5 Discussion

The changes in hemoglobin concentration for all subjects exhibited similar patterns, with a decrease immediately after exercise stress followed by an increase. This aligns with changes in blood flow, which is considered a cause of shoulder stiffness. Furthermore, the

Figure 1 Changes in Hemoglobin Concentration

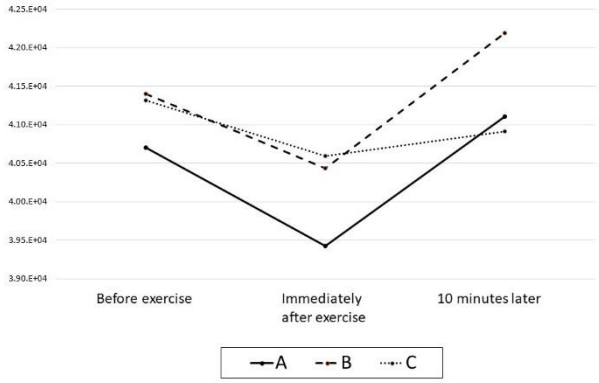
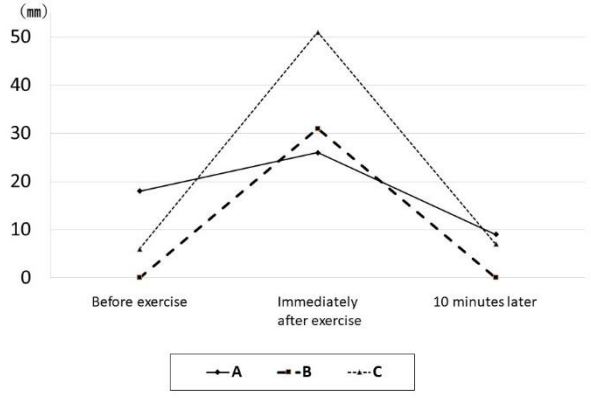


Figure 2 Changes in VAS



subjective assessments based on VAS values generally mirrored the changes in blood flow. From these observations, we suggest that non-contact estimation of hemoglobin levels can be a valuable tool for estimating shoulder stiffness.

6 Conclusion

In this study, we examined whether it is possible to estimate the state of shoulder stiffness from images by analyzing the changes in hemoglobin concentration in the peri-trapezius muscles of three subjects subjected to exercise stress. We also observed a tendency of alignment between image-based estimation and subjective indicators. However, since we did not investigate individual lifestyle histories or past experiences with shoulder stiffness, this study remains preliminary. Further research involving the collection of basic information and an increased number of subjects is necessary.

References

１) Ministry of Health, Labour and Welfare. "National Survey of Living Conditions in the 28th Year of Heisei Era". http://http://www.mhlw.go.jp/toukei/saikin/hw/k-tyosa/k-tyosa16/dl/04.pdf (2018.5.10)

２) N. Tsumura et al., "Image-based skin color and texture analysis/synthesis by extracting hemoglobin and melanin information in the skin", ACM Transactions on Graphics, vol.22, pp.770-779 (2003).

[Reception : 1, Dec, 2021]
[Accept : 13, Dec, 2021]

Title ： The Humanic Science Abstract Vol.2 No.1 誌名：The Humanic Science Abstract 第 2 巻第 1 号

Edit ： Biofunctional Finding Organization, NPO (BFO) 編集：NPO 法人生体機能探査推進機構（BFO）

Date ： 24, December, 2021 発行：令和 3 年 12 月 24 日

Issuing Authority ：Biofunctional Finding Organization, NPO (BFO) 発行所：NPO 法人生体機能探査推進機構（BFO）

MIT, 1-1, hibino, mihama-ku, Chiba-shi, Chiba-ken, Japan, 261-0021 〒261-0021 千葉県千葉市美浜区ひび野 1-1 幕張国際研修センター

Contact 連絡先： biofunctional.finding.org@gmail.com

Cover Design：KIYOKAWA Takuma