TOWARDS OBJECTIVISATION OF PAIN: RESEARCH AND DEVELOPMENT OF PAIN STIMULUS DEVICE

Kotryna Šileikytė (1), Julius Griškevičius (1)

1. VILNIUSTECH university, Lithuania

Introduction

Pain is described as a sensation that occurs when nerve endings, which are mostly in the skin, are irritated. The feeling of pain is caused by various stimuli, such as: stabbing, pressure, excessive heat in one place, stretching, shock. However, there is a difference in the response to pain. When the pain signal reaches the spinal cord, it is passed on to the brain, where the pain signal turns into pain [1]. All brain activity induced by stimuli can be monitored using devices such as an electroencephalograph (EEG) [2] and nuclear magnetic resonance imaging (MRI) [3] equipment. Hence, causing pain as an irritant in the aforementioned studies helps to study brain activity. The feeling of pain is judged very subjectively, therefore various scales and methodologies [4] have been introduced to quantify pain. However, there is no unanimous decision on how to assess the pain, necessitating a study using a multi-contact tactile pain stimulus device that would allow the physician / investigator to cause pain to the subject in a controlled manner using pneumatically actuated stimulus. Functional MRI – based pain research requires MRI – compatible device, since current devices like digital pressure algometers allowing to measure pressure pain threshold are not compatible [5,6]. The device allows replicating the same amount of load on all subjects when the load is applied at different points to assess the individual human response during functional MRI study.

Methods

The study was conducted in two stages. The first stage comprised of laboratory tests, where the pressure dependence of the load in kilograms per square cm (kg/cm^2) was measured to estimate what air pressure is required to maintain a particular load. The second was studies with subjects to find out how particular load values are related to an individual pain threshold in subjects. Laboratory tests were performed using a BIOPAC MP36 signal acquisition and processing system and variable pressure sensor SS12LA, when the load is increased every 50 grams to reach one kilogram. It was checked with six volunteers (mean age ± standard deviation 23 ± 3.933) were recruited in the study. Following inclusion in the study criteria have been defined: persons have no complains of skin irritation and did not experience additional pain in the hand areas. The study was performed by placing the hand in a box in which one of the mechanical stimuli was randomly triggered at different places on hand 20 times to avoid predictability and increase accuracy. Each time, the subject had to assign a pain value, ranging from 1 to 10, where 1 means no pain, 5 moderate pain and 10 extreme pain. A statistical review was performed.

Results

The results of the study are best seen in the diagram presented in Fig. 1 between the load size and pain scales.

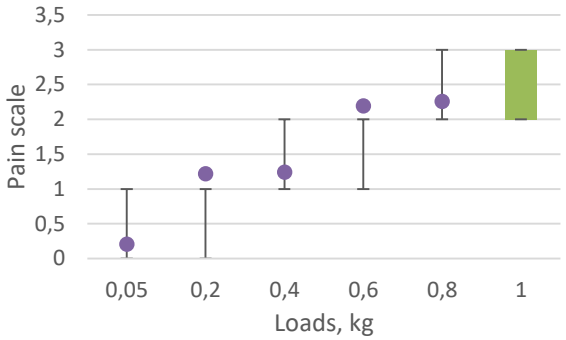

Figure 1: The distribution of pain scale results for the assigned loads.

Pagal koreliacijos koeficientus, kurie yra

Conclusions

The study shows that the pneumatic pain stimulator device we offer is suitable for crushing constant and equal amounts of load, making it suitable for use in fMRI studies because it is compatible. However, there are limitations in this study because the number of subjects was small and also, the maximum value of the pain scale was not reached.

References

1. Roberts et al, Medical Life Sciences, 2020.
2. Tu et al, J frontiers in Computational Neuroscience, 2014.
3. Brown et al, J Pain, 19:1-21, 2018.
4. Ramirez et al, Pain scales, 2020.
5. Park et al, J Ann Rehabil Med, 412-417, 2011.
6. Computerized Pressure Algometer, 2020.