신경근육재활 및 전기진단

게시일시 및 장소 : 10 월 18 일(금) 08:30-12:20 Room G(3F)

질의응답 일시 및 장소 : 10 월 18 일(금) 10:32-10:36 Room G(3F)

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Spastic Muscle Monitoring with EMG sensor following Electrical Stimulation in Adults Cerebral Palsy

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Background

Adults with cerebral palsy (CP) experience abnormal muscle tonus due to spasticity. Spasticity aggravates cooperative movements, impairs voluntary motor function, and make them not to perform activities of daily living. Electrical stimulation (ES) is used for people with CP to reduce stiffness and co-activation of antagonistic muscles and to improve the range of motion, muscle strengthening and the timing of coordinated movement. We hypothesize that if ES is applied to the antagonist or agonist muscles at the moment muscle tonus of adults with CP is abnormally high, muscle activation (tonus) will be lowered. So we decided to develop a prototype of EMG sensor based muscle activation monitoring with ES (EMG-stim) for people with CP.

Methods

The prototype is composed of EMG sensor (PSL-iEMG2, Physiolab, Korea), Arduino (Arduino Mega 2560, Arduino, Italy) and electric stimulation generator (G-5230 Massage Electric Physiotherapy Sticker, yiwu yousai daily necessities factory, China), as shown in Fig. 2. G-5230 is a personal low-frequency stimulator of a commercial wellness product. The rating of the electric stimulator is DC 5 V / 50-60 Hz / 9.8 mA. EMG value from the EMG sensor is displayed in the computer screen (PC). We can set the threshold as the EMG value of the abnormally high muscle tonus. When the EMG value reaches the preset threshold, ES is activated. The time and intensity of ES can be adjusted and stored in the Arduino board. After ES is completed, EMG is measured again. After collecting the EMG raw data, we rectify them by Amplitude analysis to express the EMG signal using Root Mean Square (RMS) value to clearly distinguish the degree of muscle activation. In a case study, EMG-stim is applied to the biceps brachii (agonist) in an adult with CP. EMG sensor monitors the muscles activation and the EMG value reaches the threshold (230), ES starts to be transmitted to the target muscles. After ES is carried out for 10 minutes, EMG measurement is performed for 10 seconds to observe the change of muscles activation.

Results

Before ES, muscles activation is high with abnormal muscles tonus, but after ES, muscles activation is lowered, as shown in Fig 1. The RMS value of the EMG signal is lowered in the technical statistics and the boxplot. The result of Willcoxon signed rank is statistically significant ($p<0.05$).

Conclusions

In this study, we find out that we can follow the change of muscle activation of adults with CP through EMG sensor and the muscle tonus is lowered by ES. Therefore, there is a possibility of further research on the development of wearable EMG-stim system depending on muscle tonus for people with CP.

Keywords: EMG monitoring, Spasticity, Muscle Tonus, Electrical stimulation, Cerebral Palsy

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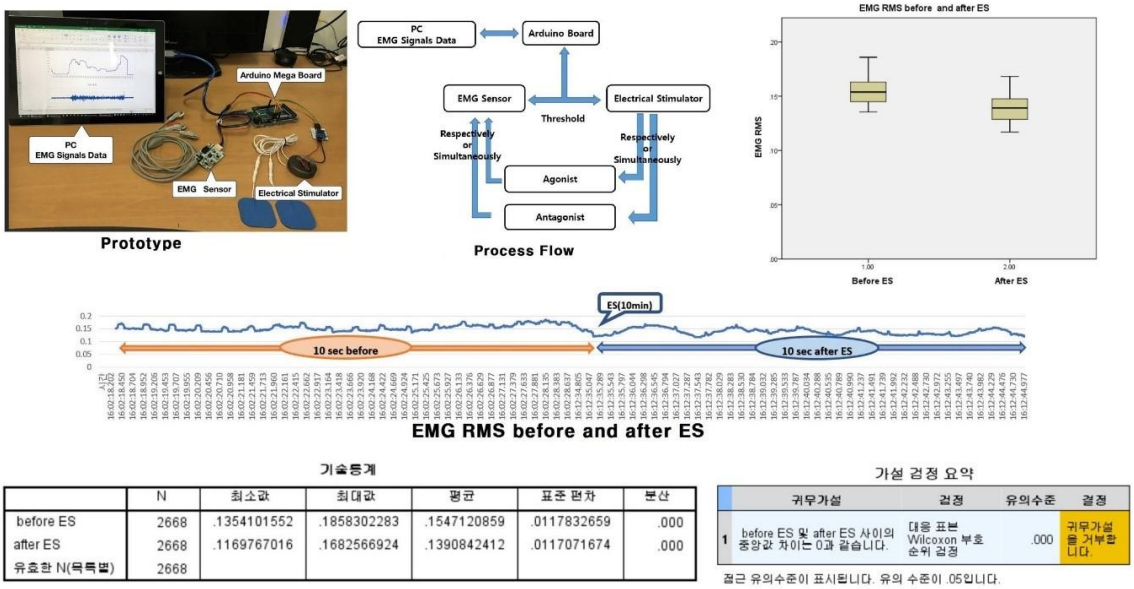

기술통계

	N	최소값	최대값	평균	표준 편차	분산
before ES	2668	.1354101552	.1858302283	.1547120859	.0117832659	.000
after ES	2668	.1169767016	.1682566924	.1390842412	.0117071674	.000
유효한 N(목록별)	2668					

가설 검정 요약

	귀무가설	검정	유의수준	결정
1	before ES 및 after ES 사이의 중앙값 차이는 0과 같습니다.	대응 표본 Wilcoxon 부호 순위 검정	.000	귀무가설을 거부합니다.

점근 유의수준이 표시됩니다. 유의 수준이 .05입니다.

Fig.1 Prototype, Process flow and EMG RMS Graph