Cervical myelopathy screening focusing on finger motion using noncontact sensor

October 14 2021

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Cervical myelopathy (CM) results from compression of the spinal cord in the neck and causes difficulty moving the fingers and unsteady gait. As patients with early-stage CM have minimal subjective symptoms and are difficult for non-specialists to diagnose properly, the symptoms can be aggravated before patients are diagnosed with CM by a specialist. Therefore, the development of screening tools is required to realize the early diagnosis and treatment of CM.

A research team led by Drs. Koji Fujita, a lecturer at Tokyo Medical and Dental University, and Yuta Sugiura, an associate professor at Keio University, combined a finger motion analysis technique using a non-contact sensor and machine learning to develop a simple screening tool for CM.

In this study, the team focused on changes in finger motion caused by CM. In the 10-second grip and release test, which is a conventional diagnostic test for CM, a subject repeats grip and release actions as many times as possible in 10 seconds. The test simply measures the number of grip and release actions and does not focus on changes in finger movements characteristic for patients with CM, such as wrist movements to compensate for difficulty moving the finger. Leap Motion (Ultraleap Ltd.), a sensor capable of real-time measurement of finger movements, can be used to extract such movements more precisely. The researchers expected that CM can be predicted using machine learning combined with the Leap Motion sensor. A subject sitting in front of Leap Motion connected to a laptop computer with arms extended was instructed to grip and release the fingers 20 times as rapidly as possible. Finger movements during this test were captured by the Leap Motion sensor, displayed on its screen in real time, and recorded as data. They recruited 50 patients with CM and 28 subjects who did not have CM. Time-series data on their finger movements acquired by Leap Motion were converted into frequency domains, which were subjected to machine learning using a support vector machine. Finally, the accuracy

of the results was high as indicated by a sensitivity of 84.0%, a specificity of 60.7%, and an area under the curve of 0.85. This level of accuracy is equivalent or superior to that of CM diagnosis by specialists based on physical findings.

The tool developed by the team allows for non-specialists to screen people for the possibility of having CM. The screening test results can be used to encourage those with suspected CM to seek specialist's attention for early diagnosis and early treatment initiation. A goal of this research is to prevent disease aggravation which can cause decline in the physical functioning and social loss.

More information: Takafumi Koyama et al, Cervical Myelopathy Screening with Machine Learning Algorithm Focusing on Finger Motion Using Non-Contact Sensor, *Spine* (2021). DOI: 10.1097/BRS.0000000000004243

Provided by Japan Science and Technology Agency

Citation: Cervical myelopathy screening focusing on finger motion using noncontact sensor (2021, October 14) retrieved 4 May 2024 from https://medicalxpress.com/news/2021-10-cervical-myelopathy-screening-focusing-finger.html

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