

FOR IMMEDIATE RELEASE

Successful extraction of Alzheimer's-type dementia finger-tapping pattern

Opening the way to developing a simple screening test for the early detection of dementia

Tokyo, May 19, 2016 – The National Center for Geriatrics and Gerontology (“NCGG”) in Japan has succeeded in identifying an index finger-thumb tapping pattern unique to Alzheimer's-type dementia*¹ through clinical research focusing on the rhythmical movement of both hands (Figure 1). This result was achieved using a waveform analysis technique for finger-tapping movement developed by Hitachi, Ltd. (TSE:6501) which allows a variety of tapping patterns to be extracted from the measurement data on motor ability using the magnetic sensors, such as the discrepancy in contact time between the fingers. This achievement opens the way to advancing tests for the early detection of Alzheimer's-type dementia.

With an increasingly aging society, the number of patients with Alzheimer's-type dementia continues to grow each year. Early detection would allow early intervention with medical treatment to slow the progress of the disease; however, as the symptoms are difficult to distinguish from other symptoms of aging such as forgetfulness, in reality many patients only get to the hospital after the symptoms have become severe. Further, while there are already many types of early detection screening tests*² for Alzheimer's-type dementia such as blood, olfactory and tablet device-based questionnaires recreating medical interview, the stress on the patient such as pain during blood sampling, test duration, etc. was an issue. Low stress tests are available, such as cognitive assessment based on measurement of one-hand finger movement using a tablet device or pushing buttons, but have not been able to yield sufficient accuracy. Thus, a simple but highly accurate low-stress screening test that would contribute to the early detection of Alzheimer's-type dementia, help improve quality-of-life of patients, and reduce medical and nursing costs, is needed.

NCGG and Hitachi began clinical research in 2013 to validate the effectiveness of measuring thumb and index-finger movement of both hands for the early detection of Alzheimer's-type dementia drawing on the knowledge that the coordination between the right and left hemisphere of the brain in response to noise becomes slower in patients with severe dementia. Specifically, NCGG conducted measurement using UB1,*³ a magnetic sensor-type finger-tapping equipment (non-medical; Figure 2) developed by Hitachi in 2010, and analyzed the results using the waveform analysis technique also developed by Hitachi. NCGG was able to successfully extract an index finger-thumb tapping pattern unique to

Alzheimer's-type dementia, and assessed the characteristics of the finger-tapping movement with high accuracy.

Results of the assessment and the analysis technique applied are as follows:

1. High correlation between finger-tapping movement and the severity of dementia
NCGG measured the finger-tapping movement in a group of 23 participants diagnosed with pre- or developed Alzheimer's-type dementia and a group of 22 healthy aged participants, and found a high correlation with MMSE^{*4} scores, a common medical questionnaires for dementia screening, also conducted on the 2 groups. A significant difference was found between the dementia and healthy groups when the finger-tapping movement (Figure 1) was conducted alternately between the two hands (Figure 3). No relationship was found between the dementia and measurement of finger-tapping movement of one hand only. The high correlation with MMSE scores was identified for two characteristics: (a) the variation in phase difference^{*5} when the finger-tapping movement is performed simultaneously by both hands ($r^{*6} = -0.78$), and (b) the variation in duration of contact between the index finger and the thumb when the tapping movement is performed alternately between the right and left hand ($r = -0.71$, Figure 4). It is believed that the measurement results captured the deterioration in the ability to coordinate rhythmical movement in both hands resulting from the atrophy of the corpus callosum^{*7} and basal ganglia^{*8} due Alzheimer's-type dementia.
2. Development of highly accurate technique to analyze finger movements of both hands
Hitachi developed an analytical technique to capture multiple characteristics from the waveforms measured from the finger-tapping movement of both hands, and provided NCGG with the software. In addition to the 21 basic characteristics of finger-tapping movement available such as the distance opened between the fingers, tapping speed and phase difference of the two hands that can be measured with UB1, the new software also assesses an the additional 23 characteristics including the duration of contact between fingers and the degree of similarity between the movement waveforms of both hands, indicative of deterioration in two-handed rhythmical movement. This enhanced capability enables highly accurate assessment of various characteristics of finger- tapping movement.

As UB1 is safe, easily fitted and requires only 15 seconds for measurement, it provides a low-stress means for assessment. NCGG and Hitachi intend to collect and analyze a greater sample of data on finger-tapping movement to further validate the effectiveness of this assessment method with the aim of establishing a simple screening test for the early detection of Alzheimer's-type dementia.

Details of this achievement will be published in a paper on the 20th May 2016 in the Japanese Journal of Comprehensive Rehabilitation Science (http://www.rehabili.jp/jjcrs/index_e.html). This research was conducted with the approval of the Ethics Committee of NCGG.

- *1 Alzheimer's-type dementia: A type of dementia characterized by symptoms such as memory loss, recognition difficulty and poor judgment. More than half of dementia patients are this type.
- *2 Screening test: A preliminary test to determine the necessity of thorough medical examination.
- *3 UB1: A magnetic sensor type device for measuring motor ability of the fingers (non-medical equipment). Hitachi Maxell, Ltd. (TSE:6810) is currently developing the next-generation model, "UB2" (non-medical equipment) which it intends to make available to research institutions from July 2016. Due to its smaller size, UB2 will be able to conduct measurement more smoothly and also provides for Wi-Fi connectivity. The software provided with UB2 will be able to extract the same characteristics obtained from the analysis software in this study, thus enabling advanced assessment.
- *4 Mini Mental State Examination (MMSE): A 30-point questionnaire to assess recognition and memory abilities. A score of 23 or less is considered indicative of the probability of dementia.
- *5 Phase difference: The discrepancy between finger tapping movement of the right and left hand. One cycle of finger-tapping by the right hand is defined as 360° and the discrepancy with the cycle of the left hand is described as an angle in relation to this value.
- *6 Correlation coefficient (r): A statistical coefficient describing the strength of the association between two sets of data; ranging from +1 for 100% positive correlation to -1 for 100% negative correlation.
- *7 Corpus callosum: A bundle of nerve tissue connecting the right and left hemisphere of the brain.
- *8 Basal ganglia: A region of the brain associated with many functions including the coordination of movement.



Fig.1 Finger tapping movement

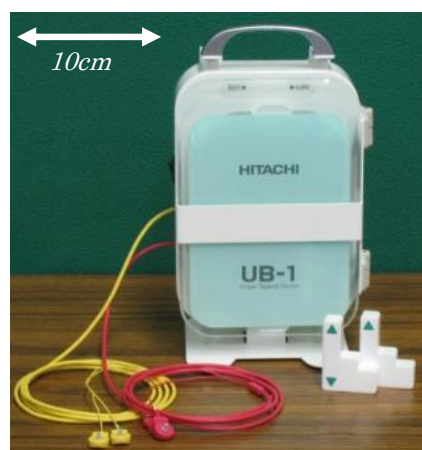


Fig.2 Magnetic sensor-type finger tapping equipment, UB1

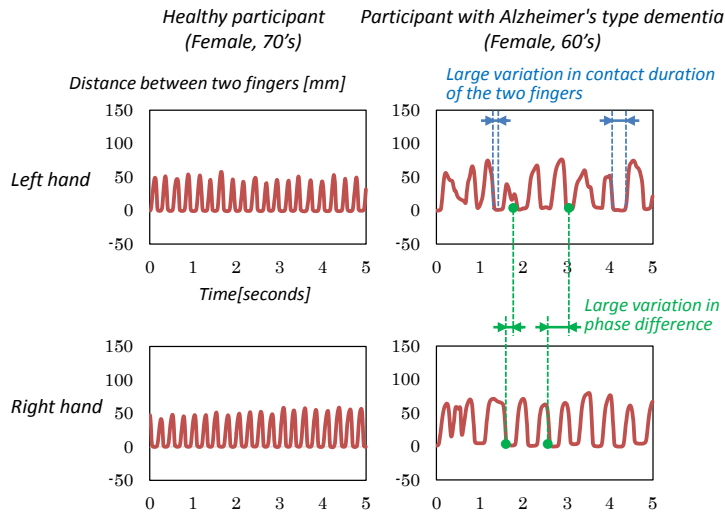


Fig.3 Typical waveforms obtained from finger-tapping movement with alternating hands

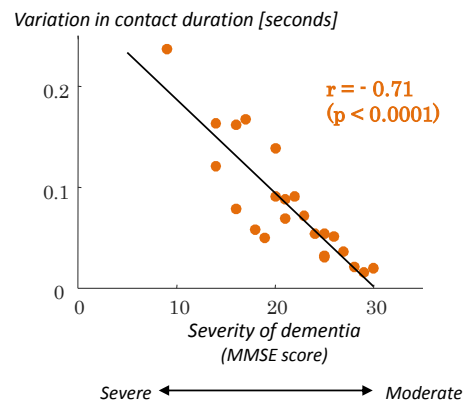


Fig.4 Correlation between finger-tapping characteristics and severity of dementia

About the National Center for Geriatrics and Gerontology

We dedicate ourselves to the promotion of the physical and mental health of the elderly, so that they can achieve a life-long independence, and the improvement of the health and welfare for the people and the society. The hospital and the research institute work together to provide high-quality health care and perform relevant clinical research for the elderly, while giving top priority to the human dignity and rights. The hospital, in particular, provides advanced-, or pioneering-medical care, new functional recovery therapy, under a comprehensive and holistic approach. The research Institute, in cooperation with the hospital, performs an ample range of surveys and research projects on aging and geriatric diseases, social sciences, and development of new medical technology. The center works with administrative organization or institutes for health and welfare of the elderly, to improve their functional capabilities in their daily life. The center also applies its fruitful results to other countries, develops educational and training methodology as well as provides useful programs to raise the quality of care and policy for the elderly.

About Hitachi, Ltd.

Hitachi, Ltd. (TSE: 6501), headquartered in Tokyo, Japan, delivers innovations that answer society's challenges. The company's consolidated revenues for fiscal 2015 (ended March 31, 2016) totaled 10,034.3 billion yen (\$88.7 billion). The Hitachi Group is a global leader in the Social Innovation Business, and it has approximately 335,000 employees worldwide. Through collaborative creation, Hitachi is providing solutions to customers in a broad range of sectors, including Power / Energy, Industry / Distribution / Water, Urban Development, and Finance / Government & Public / Healthcare. For more information on Hitachi, please visit the company's website at <http://www.hitachi.com>.

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