

# Effects of transcutaneous auricular vagus nerve stimulation on cortical excitability

Yeo Joon Yun, MD<sup>1</sup>, Youho Myong, MD<sup>1,2</sup>, Byung-Mo Oh, MD, PhD<sup>1,3</sup>, Jae-Jun song, MD, PhD<sup>4,5</sup>, Chi Kyung Kim, MD, PhD<sup>6</sup>, Han Gil Seo, MD, PhD<sup>1</sup>

<sup>1</sup>Department of Rehabilitation Medicine, Seoul National University Hospital  
<sup>2</sup>Department of Biomedical Engineering, Seoul National University College of Medicine  
<sup>3</sup>Institute on Aging, Seoul National University  
<sup>4</sup>Department of Otorhinolaryngology-Head and Neck surgery, Korea University  
<sup>5</sup>Neurive co., Ltd.  
<sup>6</sup>Department of Neurology, Korea University Guro Hospital and College of Medicine



## Background

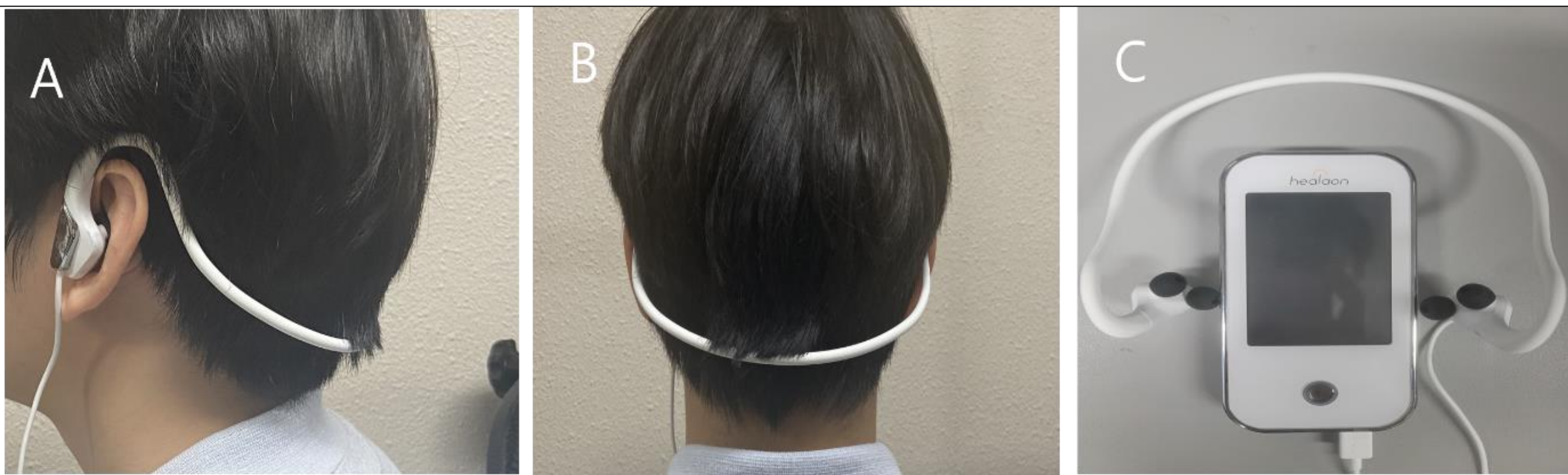
- ✓ Vagus nerve stimulation (VNS) has recently been reported to exert additional benefits for functional recovery in patients with brain injury. However, the mechanisms underlying these effects have not yet been elucidated.

## Objective

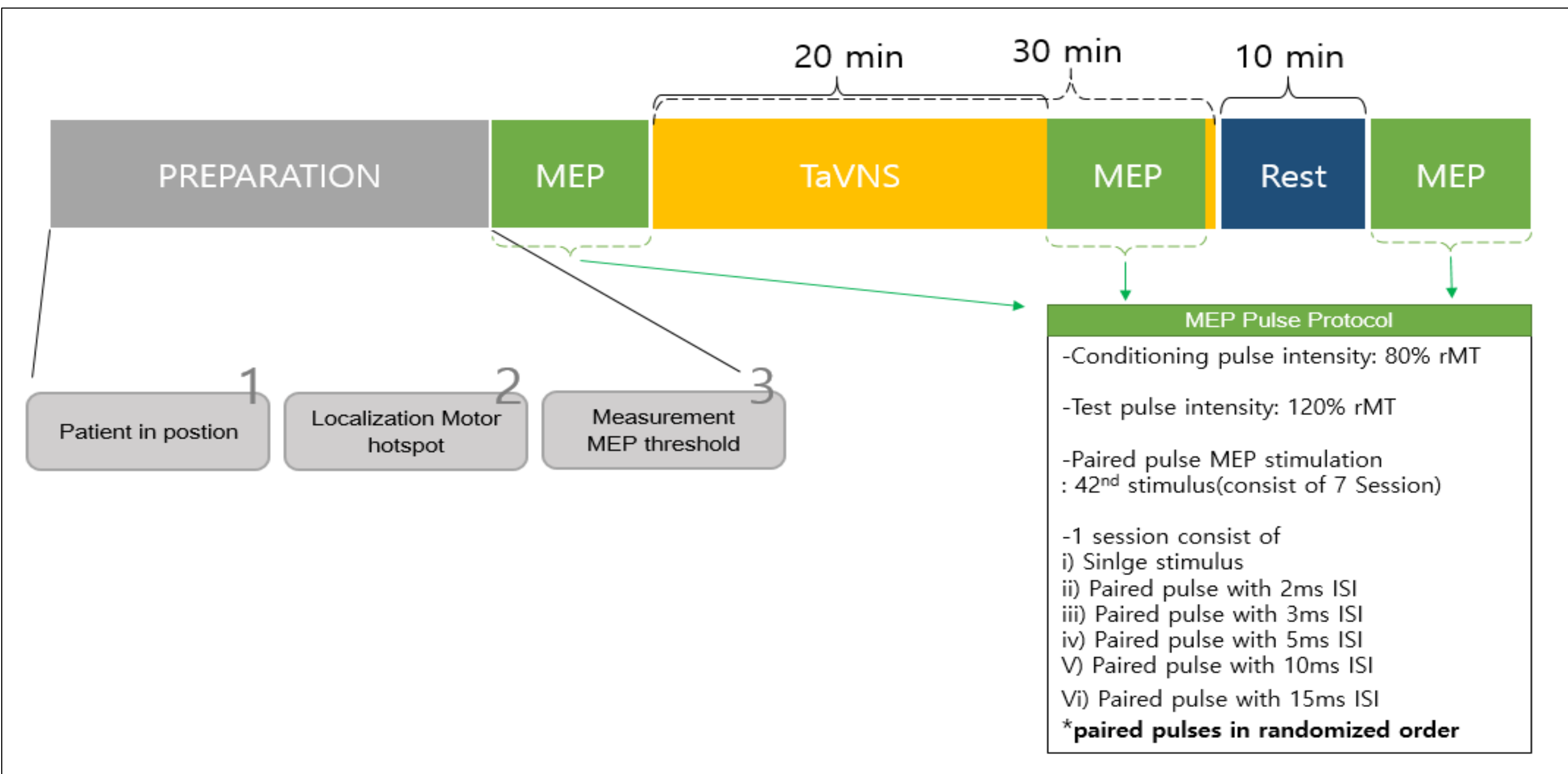
- ✓ This study examined the effects of transcutaneous auricular VNS (taVNS) on cortical excitability in healthy adults.

## Methods

- ✓ We recorded subthreshold and suprathreshold single- and paired-pulse motor-evoked potentials (MEPs) in the right hand muscles of 16 healthy adults by stimulating the left primary motor cortex.
- ✓ Inter-stimulus intervals (ISIs) were set at 2ms and 3ms for intra-cortical inhibition (ICI), and 10ms and 15ms for intra-cortical facilitation (ICF).
- ✓ TaVNS was applied to the cymba conchae of both ears for 30 min and the intensity of taVNS was set to a maximum tolerable level up to 1.95 mA (Figure 1).
- ✓ MEPs were measured before stimulation, 20 min after stimulation, and 10 min after the cessation of stimulation (Figure 2).



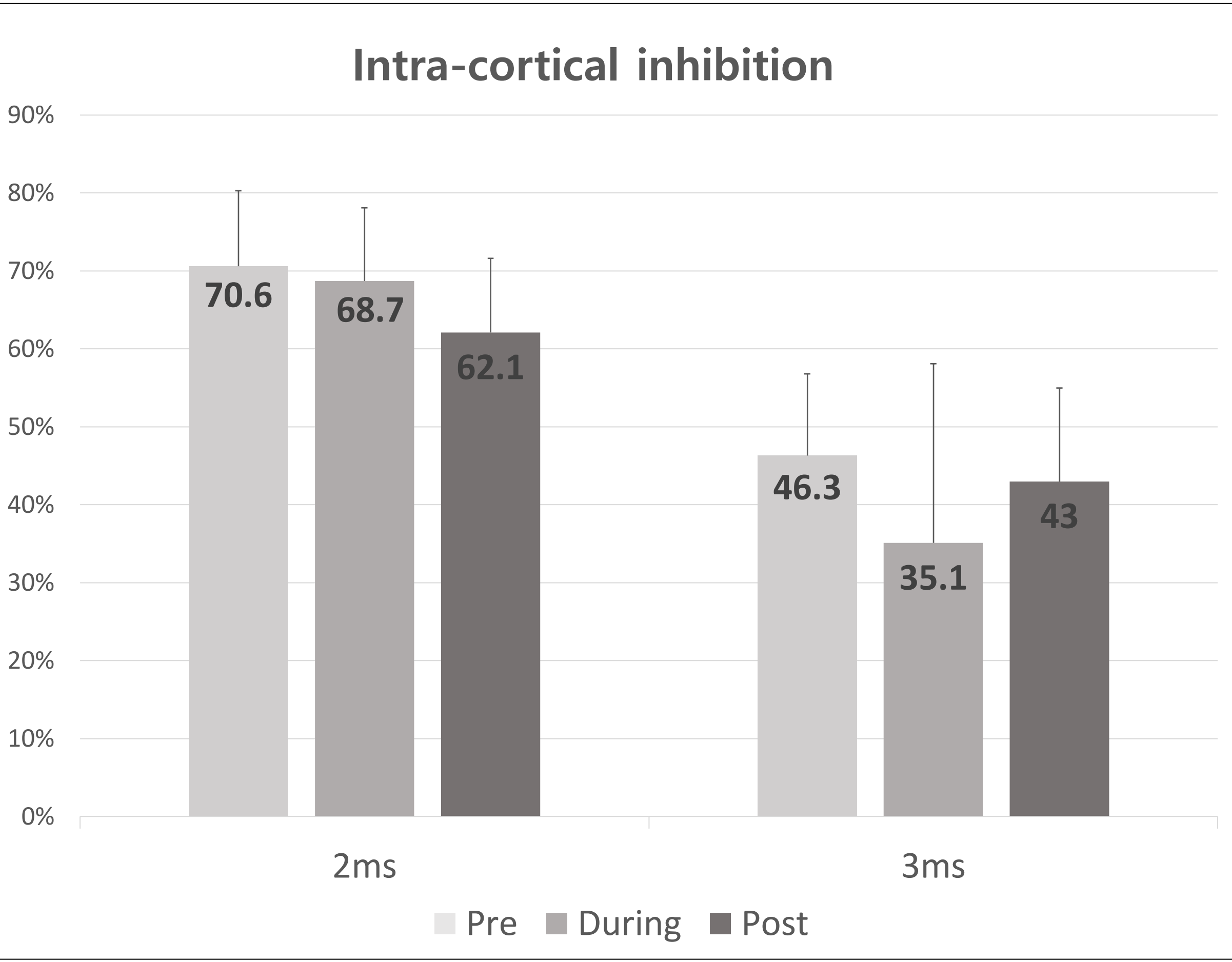
**Figure 1.** Overview of the stimulation conditions. (A), (B) The taVNS applied to the cymba conchae of the both ears. (C) The Healaon device used for taVNS



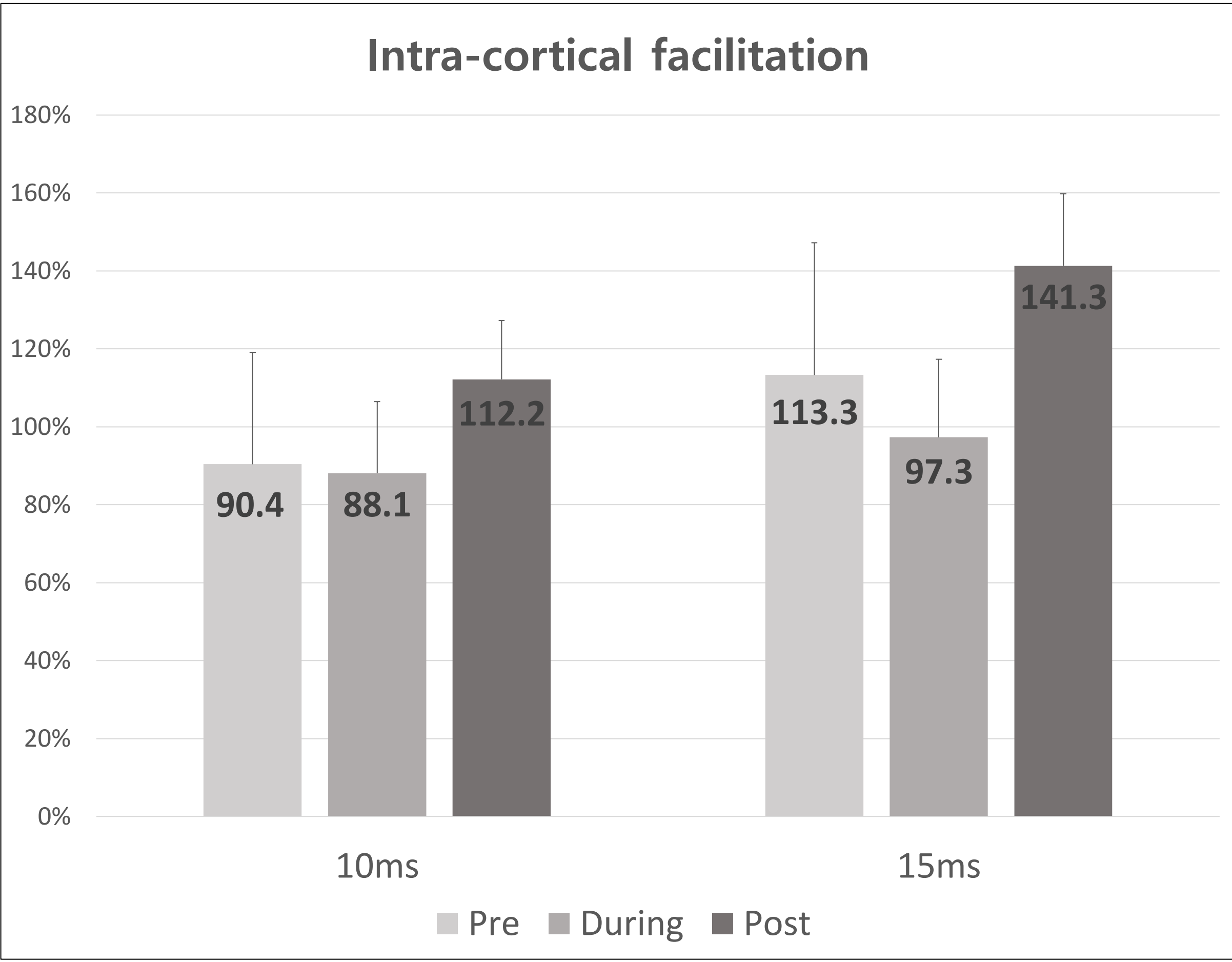
**Figure 2.** Overview of the single study protocol: After preparation, three MEP measurements were taken: before taVNS, 20 minutes after stimulation begins, and 10 minutes after stimulation ends. The paired pulse stimulation consists of seven sessions, each containing six stimuli in a random order

## Results

- ✓ The participant's age was  $33.25 \pm 7.08$  years, and 9/16 were male.
- ✓ No statistically significant changes were observed in the mean values of the single-pulse MEPs before, during, or after stimulation.
- ✓ Although the ICF showed an increasing trend post-stimulation, the changes in ICI and ICF were not significant, primarily because of the substantial inter-individual variability (Figure 3,4).



**Figure 3.** ICI values pre-, during-, and post-taVNS in 16 participants. Error bars represent the standard error of the mean.



**Figure 4.** ICF values pre-, during, and post- taVNS for the 16 participants. Error bars represent standard errors of mean.

## Conclusions

- ✓ The effect of taVNS on cortical excitability varied in healthy adults.
- ✓ An increase in ICF was observed after taVNS, although the difference was not statistically significant.
- ✓ Our findings contribute to the understanding of the mechanisms by which taVNS is effective in patients with brain disorders.