

INFLUENCE OF POSITION AND STIMULATION PARAMETERS ON INTRACORTICAL INHIBITION AND FACILITATION IN HUMAN TONGUE MOTOR CORTEX

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Background

- Transcranial magnetic stimulation (TMS) is a non-invasive technique to assess descending corticomotor pathways in human tongue motor cortex
- Paired pulse TMS (ppTMS) can be used to assess short-interval intracortical inhibitory (SICI) and facilitatory (ICF) networks
- With a subthreshold conditioning stimulus (CS) followed by suprathreshold test stimulus (TS), SICI and ICF can be studied with different interstimulus intervals (ISIs)
- Very few study relates SICI and ICF to motor function for cranial muscles

Aims

The aims of the present study were:

- To examine the influence of body positions (recline and supine), ISI between the CS and TS
- To examine the influence of different intensities of the CS on the degree of SICI and ICF

Materials and methods

Participants

- In Study 1 and 2, fourteen and seventeen healthy volunteers participated respectively

Methods

- ppTMS was applied to the "hot-spot" of the left tongue motor cortex
- Motor evoked potentials (MEPs) were recorded from the contralateral tongue muscles
- In Study 1, single pulse and 3 ppTMS ISIs: 2, 10 and 15 ms were applied 8 times each in three blocks (TS: 120%, 140% and 160% of resting motor threshold (rMT); CS: 80% of rMT) in two different positions (recline and supine) randomly
- In study 2, single pulse and four different ppTMS ISIs: 2.0, 2.5, 3.0 and 3.5 ms were applied 8 times each in randomized order in two blocks (CS intensity of 70% and 80% of rMT respectively)
- The peak to peak amplitude of averaged MEPs were analyzed with analysis of variance

Results

Study 1

- There was an overall effect of body position ($P=0.049$). Recline position was significantly different from supine position ($P=0.050$) (Fig. 1)
- There was an overall effect of TS intensities ($P=0.004$) and ISI ($P<0.001$). 160% TS was significantly different from 120% TS intensities ($P=0.003$) showing higher MEP amplitudes (Fig. 2)

- SICI was present during ppTMS stimulation with 2.0 ms ($P=0.021$) and significant ICF with ISI of 10 ms ($P=0.050$) and 15 ms ($P=0.010$) compared with single pulse stimulation (Fig. 2)
- There was also significant interaction between TS intensities and ISIs ($P=0.002$)

Single sweep motor evoked potentials

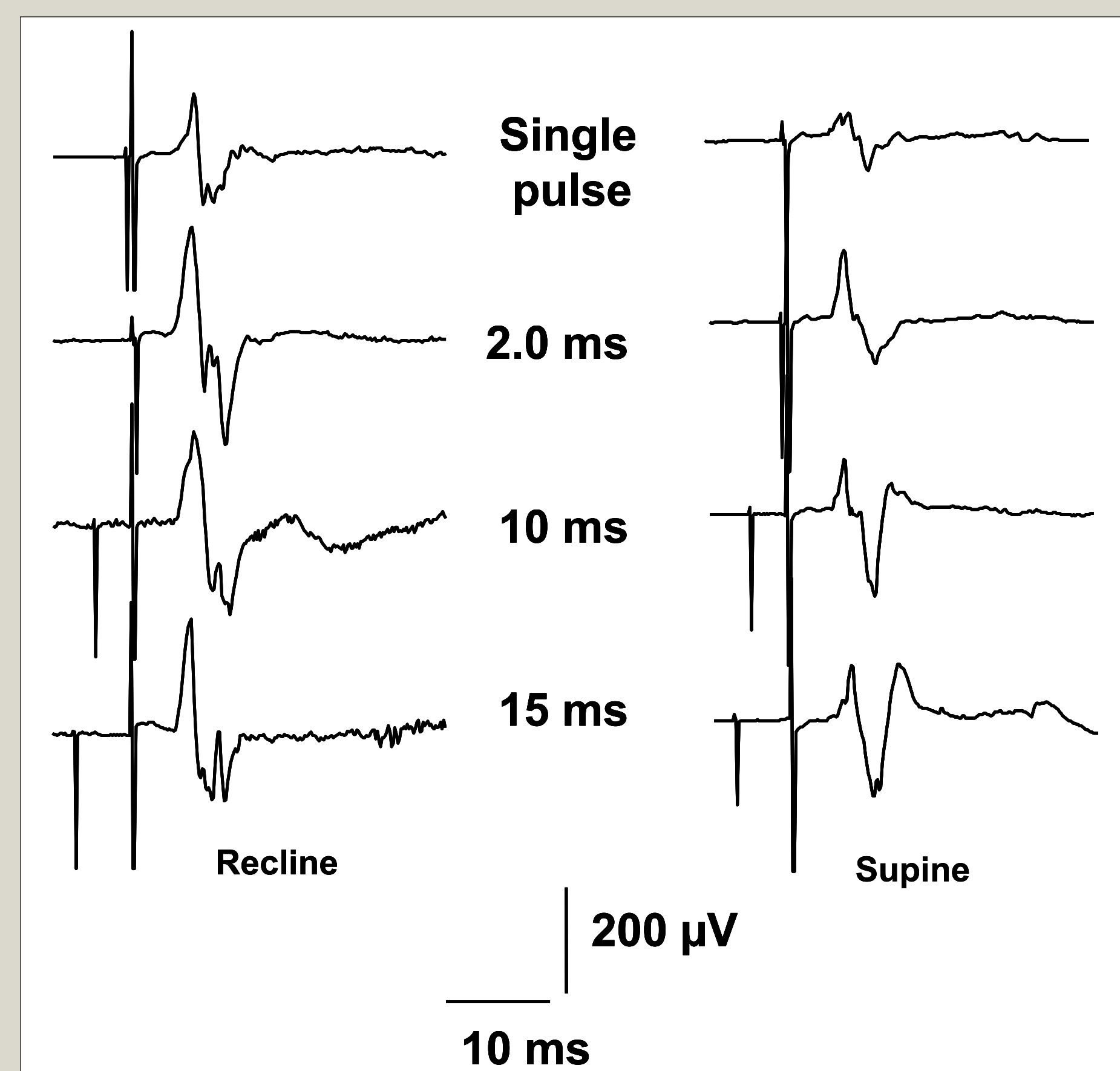


Fig. 1. Example of single (last) sweep tongue motor evoked potentials from the contralateral side of the tongue dorsum at two different body positions (recline and supine) evoked by paired-pulse transcranial magnetic stimulation (ppTMS). Different interstimulus intervals of 2, 10, 15 ms and single stimulation were applied.

Study 2

- There was no significant difference in MEPs between the two CS intensities (70% and 80% of rMT) but there was an overall effect of ISI on MEP amplitudes ($P<0.001$) (Fig. 3)
- SICI was present during ppTMS stimulation with 2.0 ms ($P=0.003$), 2.5 ms ($P=0.002$), 3 ms ($P<0.001$) and 3.5 ms ($P<0.001$) compared with single pulse stimulation (Fig. 3)

Motor evoked potentials

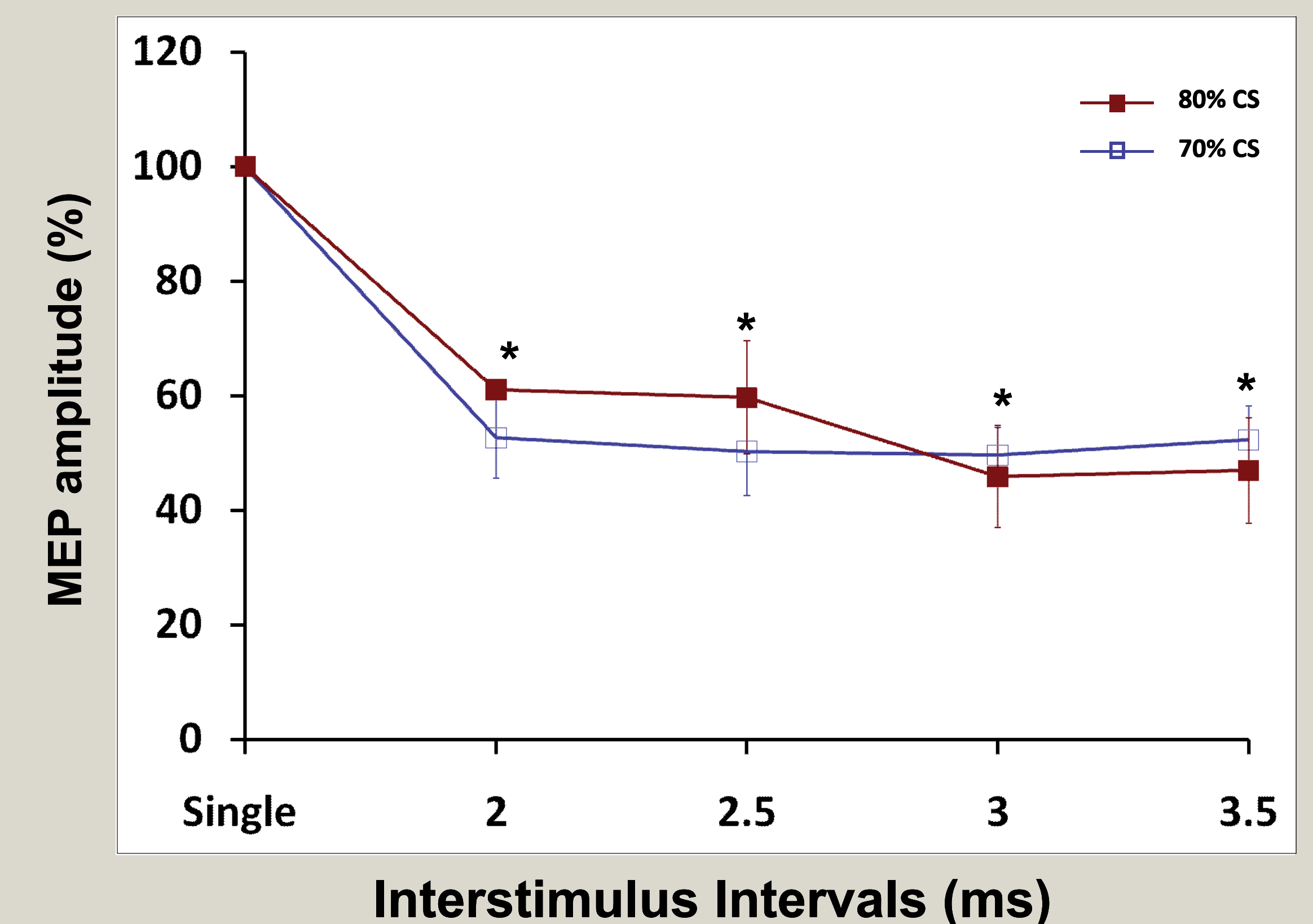


Fig. 3. Mean \pm SEM motor evoked potentials (MEPs) from paired-pulse transcranial magnetic stimulation (ppTMS) normalized to single pulse TMS. Two different stimulus intensities of the conditioning stimulus (CS) were applied with different interstimulus intervals (Single pulse, ppTMS with ISIs: 2.0, 2.5, 3.0, and 3.5 ms) between the CS and test stimulus. *indicates significant short-interval intracortical inhibition (SICI) ($P<0.003$).

Motor evoked potentials

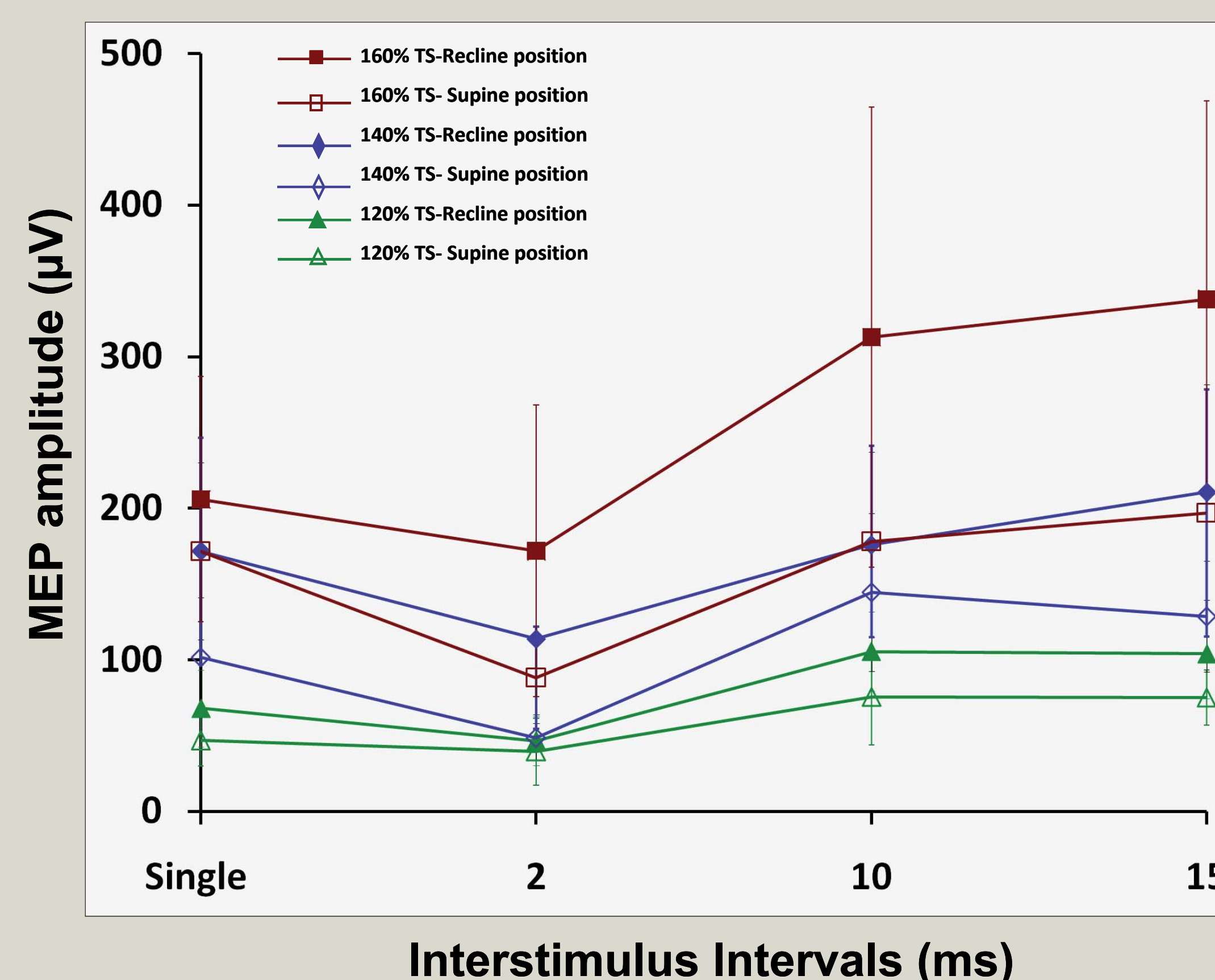


Fig. 2. Mean \pm SEM absolute motor evoked potentials (MEPs) from paired-pulse transcranial magnetic stimulation (ppTMS) and single pulse TMS. Three different stimulus intensities of the test stimulus (TS) were applied with Single pulse, ppTMS with ISIs: 2.0, 10, 15 ms) between the TS and conditioning stimulus (80% of resting Motor Threshold (rMT)). *indicates over all significant difference from single pulse ($P<0.001$).

Conclusions

- Recline body position evoked bigger MEPs than in supine position
- Significantly greater ICF was evoked with 120% TS compared with 140% and 160% TS intensities
- None of the two stimulus intensities of the CS in study 2 were superior to the others in inducing intracortical modulatory effects
- These methodological results may be applied in future studies on the effect of tongue training on SICI and ICF in the tongue motor cortex not only to standardize stimulus parameters but also for body position during TMS measurements