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## Role of Primary Motor Cortex on Implicit and Explicit Motor Sequence Learning

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**Objective**
The facilitation of primary motor cortex (M1) is known as the target to improve the motor function in patients with brain disorder using repetitive transcranial magnetic simulation (rTMS). There are two types of motor learning process such as the implicit and the explicit motor learning. Comparing the effect of rTMS between these two motor tasks is critical for determining the mechanism of rTMS-induced facilitation of motor learning process. In this study, we investigated to effects of rTMS over M1 during two different motor learning tasks to demonstrate the role of M1 during implicit or explicit motor learning process.

**Materials and Methods**
Ten healthy volunteers (6 men, mean age 28.5 years) were enrolled. All participants received two high-frequency rTMS with motor learning task in random order over the non-dominant M1 with more than a 48-hours washout period. The motor learning task provided with a serial reaction time task (SRTT) with five fingers of non-dominant hand after high-frequency rTMS. In the implicit and explicit motor learning task, the participant learned the order of sequence implicitly and explicitly, respectively. The reaction time (RT) of SRTT and the amplitude of motor-evoked potentials (MEPs) were assessed before (T0), immediately after (T1), and 24hr after rTMS with motor task (T2). The improvement ratio in RT and amplitude of MEPs were compared between the implicit and explicit motor learning task.

**Results**
The RT showed a significantly improvement at T1 and lasted to T2 in each motor learning task, respectively ($p<0.05$). The amplitude of MEPs in each motor learning task was significantly higher at T1 than at T0 ($p<0.05$), and there was no significantly difference between T0 and T2 in each motor learning task (Table 1). The improvement ratio of RT at

T1 in the implicit motor learning task was significantly higher than that in the explicit motor learning task ($p<0.05$, Fig. 1).

**Conclusion**

The results of this study demonstrated that the high-frequency rTMS with motor task might be more effective in the implicit motor learning than the explicit motor learning. Therefore, the implicit motor learning task could be considered preferentially for motor task with rTMS.

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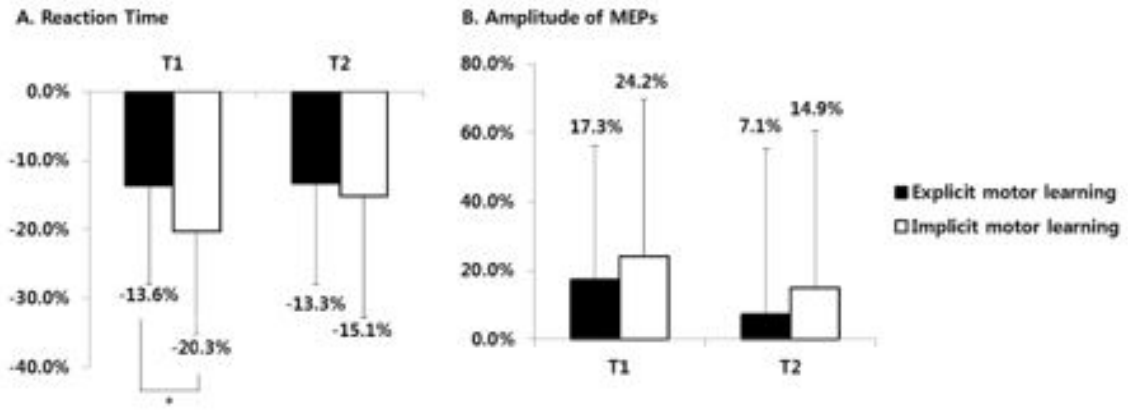
Table 1. Changes of reaction time and cortical excitability in each motor learning task

| | | Value (mean±SD) | | |
|---|---|---|---|---|
| | | T0 | T1 | T2 |
| Reaction time (ms) | Explicit motor learning | 352.8±51.7 | 302.7±57.6* | 304.0±61.4* |
| | Implicit motor learning | 336.2±35.7 | 276.1±68.5* | 285.6±61.4* |
| Amplitude of MEPs (uV) | Explicit motor learning | 1064.5±583.5 | 1212.3±579.5* | 1014.6±525.8 |
| | Implicit motor learning | 890.5±533.8 | 963.6±454.5* | 917.5±639.8 |

*p<0.05, comparison with T0

MEPs, motor-evoked potentials




*p<0.05, between the implicit motor learning task and the explicit motor learning task

Figure 1. Improvement ratio of reaction time and cortical excitability in each motor learning task