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Repetitive Transcranial Magnetic Stimulation: an advanced technology for upper limb rehabilitation in stroke patients – A pilot program
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Introduction
Up to two-third of patients have profound motor impairment despite neurorehabilitation after stroke (Broeks JG et al, 1999). It is desirable to implement innovative and effective interventions to enhance recovery of motor functions. Repetitive transcranial magnetic stimulation (rTMS), which could modify the excitability of motor cortex, has been recognized as a promising intervention for enhancing upper limb functional recovery in stroke patients. A pilot programme to introduce rTMS on upper limb rehabilitation had been launched in Tuen Mun Hospital (TMH) since the establishment of the Safety and Application Guideline in the use of rTMS for Physiotherapists in 2014.

Objectives
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Methodology
Acute and subacute stroke patients (≤ 3 months after stroke onset), with mild to moderate upper limb motor deficits, were recruited from the Rehabilitation Stroke Unit in TMH from July 2014 to December 2015. All patients underwent screening procedures for contraindication. Verbal and written explanation about the treatment was given. Written consent was received from all patients. Rehabilitation physicians provided clinical assessment on patients' medical conditions before administrating rTMS. A reminder stating patients were undergoing rTMS was placed in the chart board to facilitate communication amongst clinicians.   Patients received 1,200 pulses (20 minutes) of 1Hz rTMS at 90% of the resting motor threshold of abductor pollicis brevis in primary motor cortex (M1) of the contralesional hemisphere. Low-frequency (1Hz) rTMS was chosen to suppress the activity in the contralesional hemisphere and thus reducing interhemispheric inhibition in stroke patients. Five sessions of rTMS together with 30 minutes of intensive physiotherapy upper limb

training were given. Fugl-Meyer Assessment for Upper Limb Extremities (FMA-UE) was used to evaluate upper limb motor function. Assessments were done before the first session and after the last session of treatment. Wilcoxon Signed Ranks Test was used for statistical analysis.

Result
Results and outcome   15 stroke patients (10 male and 5 female; mean age: 56.1 ± 9.3 years, ranged from 43 to 72 years) completed the program. The mean time since stroke onset was 25.0 ± 16.2 days (ranged from 6 to 61 days). 10 patients were suffered from cortical or subcortical infarcts and 5 with hemorrhagic stroke. None of the patients reported any adverse effects with rTMS during or after the treatment. After five days of intervention, the mean FMA-UE score increased significantly from 38.5 ± 15.0 to 51.8 ± 15.5 ($Z = -3.41$, $p = 0.001$). The before-and-after treatment effect was large (Cohen's = 0.83).   The preliminary results suggest that the combined rTMS and intensive physiotherapy is safe and effective to promote the upper limb motor function recovery. These promising findings form a basis for larger scale randomized sham-controlled trials to explore the sustained effects of rTMS on enhancing motor functions in stroke patients. This advanced technology could be considered as an adjunctive physiotherapeutic intervention to conventional neuro-rehabilitation.   Reference   Broeks, J. G., Lankhorst, G. J., Rumping K. & Prevo, A. J. (1999). The long-term outcome of arm function after stroke: results of a follow-up study, Disabil Rehabil, 21, 357-364.