

## Repetitive Transcranial magnetic stimulation(rTMS)

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
Boggio et al., 2006 PEDro score: N/A	No Score (single subject study)	Real rTMS: 1 x 20-minute session of rTMS at 1Hz, over the primary motor cortex of the unaffected hemisphere, 900 pulses  vs.  Sham rTMS: Almost identical to real rTMS however a sham coil was used. (control)	After real rTMS session (2 months after sham treatment, which showed no changes) and at 4-month follow up: (+) Fingers & thumb range of motion (measured by angle of extension) (+) Resting motor threshold in non-affected hemisphere (-) Spasticity (Ashworth Scale) (-) Mood (visual analog scale)
Brighina et al., 2003 PEDro score: N/A	No Score (pre-post study)	7 sessions of rTMS at 1Hz, 90% of resting motor threshold, over the unaffected hemisphere, every other day for 2 continuous weeks, 900 pulses per session.	Immediately post treatment and 15 days post treatment compared to 15 days pre treatment and immediately before treatment began: (+) Length judgment of prebisected lines (+) Line bisection task (+) Clock drawing
Carey et al., 2007 PEDro score: N/A	N/A (pre-post)	1 x 10-minute session of rTMS at 6 Hz and 90% of resting motor threshold (RMT) over the motor cortex over the unaffected hemisphere followed immediately by 10 minutes of rTMS at 1 Hz and 90 % of RMT over the same area.	Immediately post treatment and at follow up over the next 5 week days: (-) Seizure during treatment (-) Wechsler Adult Intelligence Scale-third edition (-) Beck Depression Inventory-Second edition (+) Tiredness, head ache, anxiety, nausea reported by some patients on the treatment day (assessed with an interview) (-) NIH Stroke Scale (-) Hopkins Verbal Learning Test-Revised, Significant impairment in word recall memory

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			was found at post-test but returned to normal score at follow-up
Chang et al., 2010 PEDro score: 8	8	<p>Real rTMS: High frequency rTMS (10Hz at 90% resting motor threshold) over the primary motor cortex of the affected hemisphere combined with motor training (reaching and grasping exercises)</p> <p>+ Usual care (n=18)</p> <p>vs.</p> <p>Sham rTMS: Identical to real rTMS except that rTMS coil was held 90 degrees to the scalp</p> <p>+ Usual care (n=10) (control)</p> <p>Treatment details: Both groups received 10 sessions of treatment over 2 weeks, as well as usual care 3hrs daily, as scheduled.</p>	<p>At 2 weeks (immediately post-treatment):</p> <p>(+) Arm score of the Motricity Index</p> <p>(-)* Fugl-Meyer Assessment –upper limb score</p> <p>(-) Grip strength</p> <p>(-) Box and Block Test</p> <p>(-) Leg score of the Motricity Index</p> <p>(-) Fugl-Meyer Assessment – lower limb score</p> <p>(-) Functional Ambulation Category</p> <p>(-) Barthel Index</p> <p>At 3 months post-stroke:</p> <p>(-)** Arm score of the Motricity Index</p> <p>(-) Fugl-Meyer Assessment –upper limb score</p> <p>(-)* Grip strength</p> <p>(-) Box and Block Test</p> <p>(-) Leg score of the Motricity Index</p> <p>(-) Fugl-Meyer Assessment – lower limb score</p> <p>(-) Functional Ambulation Category</p> <p>(-) Barthel Index</p> <p>* This study may not have been adequately powered to find significant between-group findings, and it is important to note that within-group pre-post improvement was found for real rTMS group, but not sham rTMS group.</p> <p>** A significant group by time interaction was found in favour of real rTMS, suggesting that</p>

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			real rTMS may have resulted in additional improvements that lasted at 3 months after onset of stroke.
Dafotakis et al., 2008 PEDro score: N/A	No Score (repeated measures study)	Real rTMS: 10-minute session of rTMS at 1Hz, 100% of resting motor threshold to the motor cortex of the unaffected hemisphere  vs.  Sham rTMS: Identical to real rTMS, however coil was held over the vertex of the brain (control)  Note: Treatment and control scenarios were separated by a 120-minute washout period.	Post treatment: (+) Efficiency of grip force scaling of the paretic hand (+) Spatio-temporal scaling coupling between grip and lift forces of the affected hand (-) Interference of lifting ability of the unaffected hand
Emara et al., 2010 PEDro score: 9	9	Low-frequency rTMS (n=20) vs. High-frequency rTMS (n=20) vs. Sham rTMS (n=20)  Treatment details: Each intervention took place over 10 consecutive daily sessions followed by standard rehabilitation.	At 2 weeks (post-treatment), 4, 8 and 12 weeks: Low-rTSM and high-rTMS vs. sham rTMS: (+) Activity Index* (+) Modified Rankin Scale (-) Mini-Mental State Examination  *Measures activities of daily living.

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Fregni et al., 2006 PEDro score: 6	6	<p>Real rTMS: 5 sessions over 5 days of rTMS at 1 Hz and 100% of resting motor threshold, for 1200 pulses over a continuous 20-minute train, over the unaffected hemisphere. (n=10)</p> <p>vs.</p> <p>Sham rTMS: Almost identical to real rTMS, however a false coil was used. (n=5; control)</p>	<p>Immediately post treatment and at 2 week follow-up compared to baseline: (+) Motor function of the affected hand (simple reaction time, choice reaction time, the Jebsen-Taylor Hand Function Test and the Purgue Pegboard Test) (+) Resting motor threshold (+) Correlation between motor function improvement and improvement in spasticity (as measured by the Ashworth Scale)</p>
Izumi et al., 2008 PEDro score: N/A	No Score (quasi-experimental study)	<p>Real rTMS: 1 session per week for 4 weeks at 10Hz*, 80% of resting motor threshold over the primary motor cortex of the affected hemisphere (n=5)</p> <p>vs.</p> <p>Sham rTMS: Identical to real rTMS, however coil was held at a 45 degree angle away from the head (n=4; control)</p> <p>* Although the study does not explicitly state that 10Hz was used for rTMS, several indicators point to this being the appropriate frequency.</p>	<p>At the end of 4 weeks (immediately post intervention) and at a 1-week follow up. (-) Bruunstrom's protocol (-) Manual Function Test* (-) Modified Ashworth Scale* (-) Stroke Impairment Assessment Set (-) Barthel Index *While no significant between group differences were found, a strong tendency towards significance was found for the Manual Function Test and wrist flexion as measured by the Modified Ashworth Scale.</p>

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Kakuda et al., 2011 PEDro score: N/A (pre-post study)	N/A (pre-post study)	Low-frequency rTMS over the unaffected motor cortex + Intensive occupational therapy  Treatment details: 22 x 20-minute sessions over 15 days	At 15 days (post-treatment):  (+) Fugl-Meyer Assessment –upper extremity (+) Wolf Motor Function Test  Note: While patients improved significantly overall, patients in stage 4 improved significantly more than those in the other 2 stages on the FMA, and patients in stage 3 improved significantly less than those in the other 2 stages on the WMFT.
Khedr et al., 2005 PEDro score: 7	7	Real rTMS: 1 x 10-minute sessions per day for 10 days of rTMS at 3Hz over the affected hemisphere, at 120% resting motor threshold of the unaffected hemisphere + Standard physical and medical therapies (n=26)  vs.  Sham rTMS: Identical to real rTMS however the coil was angled away from the head + Standard physical and medical therapies (n=26; control)	Immediately post treatment and at 10 day follow up: (+) Scandinavian Stroke Scale (+) Barthel Index (+) NIH Stroke Scale (-) Motor Evoked Potential (+) Higher percentage of independent patients (Barthel Index greater or equal to 75) (+) Higher percentage of patients having only mild disability (Scandinavian Stroke Scale 50 to 58) (-) Correlation between clinical recovery and changes in motor evoked potentials At 10-day follow up only: (+) Higher percentage of independent patients (Barthel Index greater or equal to 75) (+) Higher

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			percentage of patients having only mild disability (Scandinavian Stroke Scale 50 to 58)
Khedr et al., 2010 PEDro score: 8	8	Low-frequency rTMS over the oesophageal motor cortex of both hemispheres (n=11) Vs. Sham rTMS (n=11)  Treatment details: Both treatments took place 10 minutes every day for 5 consecutive days.	At 5 days (post-treatment) and 2 months (follow-up): LMI group: (+) Dysphagia (+) Barthel Index (-) National Institute of Health Stroke Scale (-) Grip strength Other brainstem infarction: (+) Dysphagia (-) Barthel Index (-) National Institute of Health Stroke Scale (-) Grip strength
Kim et al., 2006 PEDro score: 7	7 (cross-over study)	Real rTMS: 1 session of 8 trains x 20 pulses of 10 Hz rTMS, 80% of resting motor threshold, over the primary motor cortex of the unaffected hemisphere. + Sequential motor practice task (pushing the corresponding buttons of a 7-digit sequence shown on a screen, using paretic fingers) vs. Sham rTMS: Identical to real rTMS, however the magnetic coil was held at a 90 degree angle to the scalp. + Sequential motor practice task (control)	Immediately post-treatment: (+) Movement accuracy (measured by the sequential motor practice task - see column to the left) (+) Movement time (measured by the sequential motor practice task) (+) Mean peak amplitude of motor evoked potential
Kim et al., 2010 PEDro score: 9	9	High-frequency rTMS over the left prefrontal cortex (n=6) Vs. Low-frequency rTMS over the left prefrontal cortex	At 2 weeks (post-treatment): High-frequency rTMS vs. both low-frequency and sham rTMS.

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		(n=6) Vs. Sham rTMS (n=6)  Treatment details All three groups received 10 consecutive sessions over 2 weeks.	(-) Seoul Computerized Neuropsychological Test (-) Tower of London Test); (-) Barthel Index (+) Beck Depression Inventory  Note: No significant differences were found when other group comparisons were made.
Kirton et al., 2008 PEDro score: 8	8	Real rTMS: 20 minutes of rTMS over the motor cortex of the the unaffected hemisphere, at 1 Hz, 100% of resting motor threshold, 1200 stimuli, once per day for 8 days. (n=5)  vs.  Sham rTMS: almost identical to real rTMS, however the magnetic coil was held perpendicular to the scalp (n=5) (control)	At 1-day follow-up: (+) Grip strength (measured by a dynamometer) (+) Melbourne Assessment of Upper Extremity Function  At 1-week follow-up: (+) Grip strength (measured by a dynamometer) (-) Melbourne Assessment of Upper Extremity Function
Koganemaru et al., 2010 PEDro score: 5 (randomized crossover study)	5 (randomized cross-over trial)	Medium-frequency rTMS over the affected primary motor cortex (rTMS) vs. Extensor motor training (EMT) vs. Both interventions combined (rTMS+EMT).  Treatment details:	Within-group differences following 1 treatment session: (+) Modified Ashworth Scale* (-) Pinch force (-) Grip strength (-) Active range of motion rTMS+EMT only Following 8 weeks of additional rTMS+EMT

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		All patients underwent each intervention for 1 session, in addition all patients continued with rTMS+EMT for 8 additional weeks.	(+) Modified Ashworth Scale (+) Pinch force (+) Grip strength (+) Active range of motion  Note: Between-group comparisons were not reported; therefore results of this study were not used to inform levels of evidence.
Lieperta et al., 2007 PEDro score: 7	7 (cross-over study)	Real rTMS: 1200 pulses of rTMS at 1Hz, 90% of resting motor threshold over the primary motor cortex of the unaffected side. 1 x 20-minute session. vs. Sham rTMS. Sham rTMS was almost identical to real rTMS, however a sham coil was used. (control)	Immediately post-treatment: (+) Nine Holes Peg Test (-) Grip strength (measured by a dynamometer)
Lim et al., 2010 PEDro score: N/A (quasi-experimental)	N/A (quasi-experimental)	rTMS: 900 pulses of low-frequency rTMS (1Hz at 90% resting motor threshold) over the parietal area of the left side (unaffected hemisphere) + Behavioural therapy (n=7) vs. Behavioural therapy only (n=7) (control) Treatment details: Both groups received behavioural therapy for 5 x 30-minute sessions per week for 2 weeks. In addition the	At 2 weeks (immediately post-treatment): (+) Line bisection test (left-sided line-set) (-) Line bisection test (right-sided line-set, centred line-set) (-) the Albert test (left columns, right columns, center columns)



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		intervention group received rTMS group immediately prior to behavioural therapy.	
Mally & Dinya, 2008 PEDro score: N/A	No Score (pre-post study)	<p>All groups below received rTMS with 1 Hz at 30% of 2.3T twice a day for 1 week. 100 stimuli per session.</p> <p>Group A: Patients who had movement in the paretic arm that could be evoked by a TMS pulse to either hemisphere of the brain.</p> <p>Group B: Patients who had no paretic arm movement evoked from either side of the brain; the pathway to the healthy arm was stimulated from where visible movement could be evoked by a TMS pulse.</p> <p>Group C: Patients who had paretic arm movement that could only be evoked from the contralateral side of the brain by a TMS pulse.</p> <p>Group D: Patients had paretic arm movement that could only be evoked from the ipsilateral side of the brain by a TMS pulse.</p>	<p>At 1 week (immediately post intervention), 1 month and 3 months:</p> <p>Group A: (+) Finger spasticity (-) Upper and lower extremity movement (-) Functional movements</p> <p>Group B: (+) Finger spasticity (+) Upper and lower extremity movement (+) Functional movements</p> <p>Group C: (+) Finger spasticity (+) Upper and lower extremity movement (-) Functional movements</p> <p>Group D: (-) Finger spasticity (-) Upper and lower extremity movement (-) Functional movements</p>
Mansur et al., 2005 PEDro score: 8	8 (cross-over study)	Real rTMS A: 600 pulses at 1Hz, 100% of resting motor threshold to the primary motor cortex of the unaffected hemisphere vs.	<p>Post intervention: Real rTMS to the primary motor cortex vs. sham rTMS</p> <p>(+) Simple reaction time of the hand (+) 4-choice reaction time of the hand (+) Purdue Pegboard test</p>

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Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
		<p>Real rTMS B: 600 pulses at 1Hz, 100% of resting motor threshold to the premotor cortex of the unaffected hemisphere.</p> <p>vs.</p> <p>Sham rTMS: Almost identical to real rTMS to the primary motor cortex, however a sham coil was used. (control)</p> <p>Treatment program: Patients with stroke received 1 session of each treatment, in random order, with a 1-hour washout period between each. Healthy controls received no treatment, however they were tested at the same time as patients (baseline and then 3 times, with one hour between testing).</p>	<p>(-) Finger tapping test Real rTMS to the premotor cortex vs. sham rTMS.</p> <p>(-) Simple reaction time (-) 4-choice reaction time (-) Purdue Pegboard test (-) Finger tapping test</p> <p>Note: As expected, healthy controls (who received no treatment) showed no significant changes in any assessment.</p>
Naeser et al., 2005 PEDro score: N/A	N/A (pre-post)	rTMS at 1Hz and 90% of resting motor threshold to the anterior portion of the right Broca's area, 5 x 20 minutes per week for 2 weeks.	<p>Immediately Post-treatment: (+) Snodgrass and Vanderwart picture naming (+) Snodgrass and Vanderwart reaction time</p> <p>At 2 weeks: (-) Boston Naming test (20 first items) (+) Boston Diagnostic Aphasia Exam [BDAE] (Animal Naming subtest) (-) BDAE (tool/implements subtest)</p> <p>At 2 months: (+) Boston Naming test (20 first items) (+) BDAE (animal naming subtest) (+) BDAE (tool/implements subtest)</p> <p>At 8 months: (-) Boston Naming test (20 first items)</p>

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			(+) BDAE (tool/implements naming) (-) BDAE (subtests Animal Naming)
Pomeroy et al., 2007 PEDro score: 7	N/A (Randomized feasibility study)	<p>Real rTMS: 5 blocks of 40 stimuli at 1 Hz and 120% resting motor threshold, over the affected hemisphere with 3-minute interval between blocks. 1 session per day over 8 days.</p> <p>+</p> <p>Real voluntary muscle contraction (VMC): repeated flexion and extension of the elbow for 5 minutes. 1 session per day, over 8 days. (n=6)</p> <p>vs.</p> <p>Real rTMS</p> <p>+</p> <p>Placebo VMC: looking at 20 diagrammatic drawings of stationary upper limbs at 15-second intervals during 5 minutes. 1 session per day, over 8 days. (n=5)</p> <p>vs.</p> <p>Placebo rTMS: Same as real rTMS however less than 5 % of the magnetic field was used.</p> <p>+</p> <p>Real VMC (n=9)</p>	<p>After 10 days (2 days post treatment):</p> <p>(-) Action Research Arm Test</p> <p>(-) Torque about the paretic elbow (measured by a isokinetic dynamometer)</p> <p>(+) Motor-evoked potentials in biceps and triceps (in favour of real rTMS + real VMC vs. sham rTMS + placebo VMC)</p>

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		vs.  Placebo rTMS + Placebo VMC (control; n=7)	
Shindo et al., 2006 PEDro score: N/A	N/A	Low frequency rTMS (.9Hz at 95% of resting motor potential) over the posterior parietal cortex of the unaffected hemisphere for 6 sessions over 2 weeks.	2 to 6 weeks post treatment: (+) Behavioral Inattention Test* (-) Brunnstrom Stage (-) Barthel Index (-) Mini-Mental State Examination or the Revised Hasegawa Dementia Scale Highest scores were between week 2 and 4 weeks post treatment.
Takeuchi et al., 2005 PEDro score: 7	7	rTMS over the contralesional primary motor cortex (1Hz, 90% resting motor threshold) for 25 minutes + Motor training (n=10)  vs.  Sham stimulation + Motor training (n=10; control)	Immediately after treatment: (+) Pinch acceleration (-) Pinch force (+) Correlation between improvement in pinch acceleration in the real rTMS group and the reduced duration of abnormal transcallosal inhibition in the contralesional primary moter cortex 30 minutes post-rTMS: (-) Pinch acceleration (-) Pinch force

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			(-) Correlation between improvement in pinch acceleration in the real rTMS group and the reduced duration of abnormal transcallosal inhibition in the contralesional primary motor cortex
Takeuchi et al., 2009 PEDro score: 7	7	<p>Low-frequency rTMS over the unaffected motor cortices (low-rTMS) (n=10)</p> <p>vs.</p> <p>High-frequency rTMS over the affected motor cortex (high-rTMS) (n=10)</p> <p>vs.</p> <p>Bilateral rTMS over both motor cortex (Bi-rTMS) (n=10)</p> <p>Treatment details: Each group received a single session of rTMS followed by motor training</p>	<p>Following rTMS (post-1), following motor training (post-2), and 7 days follow-up (post 3):</p> <p>Post-1: Bi-rTMS vs. high-rTMS: (+) Pinch acceleration (-) Pinch force</p> <p>Note: No other significant between-group differences were found at post-1.</p> <p>Post-2 and post-3: Bi-rTMS vs. high-rTMS: (+) Pinch acceleration (+) Pinch force</p> <p>Bi-rTMS vs. low-rTMS: (-) Pinch acceleration (+) Pinch force</p> <p>Low-rTMS vs. high-rTMS (+) Pinch acceleration (+) Pinch force</p>
Talelli et al., 2007 PEDro score: 4	4 (cross-over study)	iTBS: Single session of rTMS given as excitatory theta burst stimulation over the affected hemisphere	Behavioural measures: Before treatment, 7 minutes, 20 minutes and 30 minutes post-

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		<p>vs.</p> <p>cTBS: Single session of inhibitory TBS over unaffected hemisphere</p> <p>vs.</p> <p>Sham stimulation</p> <p>Note: Sham stimulation was only used as a control for behavioural measures, not cortical excitability measures.</p>	<p>treatment:</p> <p>iTBS vs. sham stimulation: (+) Simple reaction time* (-) Grip strength (-) Choice reaction time</p> <p>cTBS vs. sham stimulation: (-) Simple reaction time (-) Grip strength (-) Choice reaction time</p> <p>Cortical excitability, measured before treatment (t0), during the 20 minutes post treatment (t1), and sometime after treatment when the effect was expected to fade (t2).</p> <p>iTBS (t1 vs. t0) (+) Cortical excitability</p> <p>cTBS (t1 vs. t0) (-) Cortical excitability</p> <p>*Simple reaction time for iTMS was significantly shorter than for cTMS only at T1, but not T2 and T3, thus it is not compared in this table.</p>