Bilateral Movement Practice in Stroke Motor Rehabilitation

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Introduction

- Upper limb recovery after stroke
  - 20%~80% incomplete recovery
  - Dependent on initial impairment

(Morris et al., 2008)

- Upper limb dysfunction in stroke
  - Paresis, loss of manual dexterity
    - ⇨ Activities of daily living (ADL)
      - Feeding, dressing/undressing, bathing etc.

(Cauraugh & Summers, 2005)

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- Neural plasticity (brain reorganization)

+ Motor learning approaches (motor experience)

⇨ Motor recovery

- Activity-dependent motor interventions
  - Constraint-induced movement therapy (CIMT)
  - Bilateral movement training (BMT)

(Schaechter, 2004)

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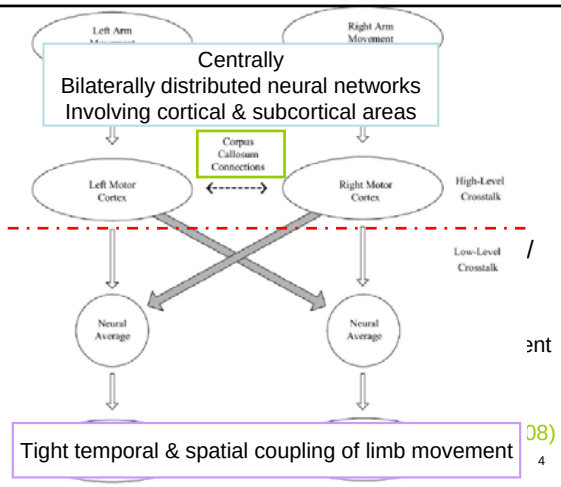

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- Several studies
  - Therapeutic bilateral training programs

⇨improve short- & long-term unilateral performance of the hemiplegic arm in patients in the chronic poststroke period

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- Methodologic limitations
  - Small RCTs (Cauraugh & Kim, 2002; Luft et al., 2004)
  - Case series (Mudie & Matyas, 1996, 2000; Stinear & Byblow, 2004)
  - Single-group design (Whitall et al., 2000)

⇨Only limited evidence exist to support bilateral training as a rehabilitation strategy

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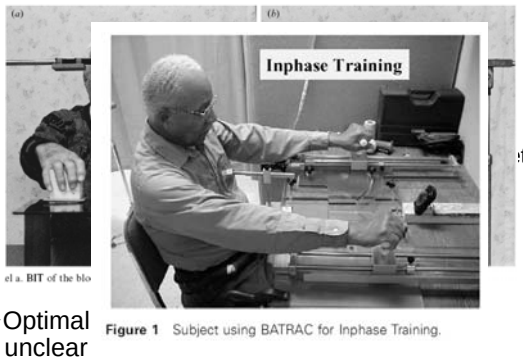
- 

Figure 1 Subject using BATRAC for Inphase Training.

⇨Optimal unclear

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- Initial severity
- Natural recovery
- Upper limb impairment influences poststroke health-related quality of life (HRQOL)
- Intensity, duration

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Purpose

- Comparing effects of bilateral simultaneous movement training (BMT) to conventional training (CT)
- on recovery in stroke patients which mild to moderate chronic hemiparesis
- in terms of upper limb motor performance, independence in ADLs, and HRQOL

[International Classification of Functioning, Disability and Health framework (WHO, 1999)]

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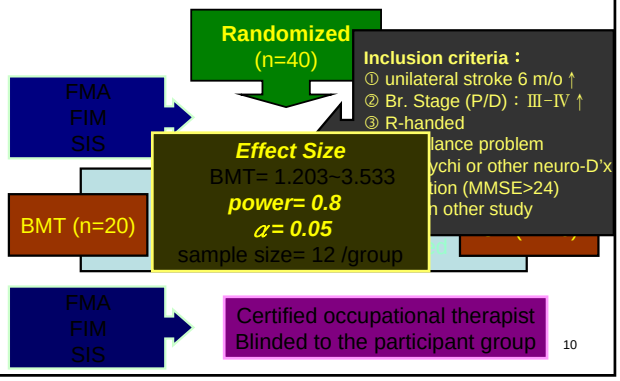
Methods
Participants



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Methods
Outcome measures

- Fugl-Meyer Assessment (FMA)

⇨ Motor impairment
  - 3-point ordinal scale; upper limb part score (66)
  - Divided FMA into
    - Proximal part: shoulder, elbow, and forearm
    - Distal part: wrist and hand

(Duncan et al., 1983; Gladstone et al., 2002)

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- Functional Independence Measure (FIM)

⇨Independent participate in ADLs
  - 6 subscale: self-care, sphincter control, transfer, locomotion, communication, & social cognition
  - 18 items;7-point ordinal scale (126)

(Kidd et al., 1995, Law, 1997)

- Stroke Impact Scale (SIS) ⇨ QOL
  - 59 item self-report scale (ver.3); 5-point ordinal scale
  - 8 functional domains: strength, memory, emotion, communication, ADLs/IADLs, mobility, hand function, & participation

(Ducan et al., 2003)

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Methods
Interventions

- BMT
  - Two upper limbs simultaneously, but independently of each other
  - Reaching, grasping, lifting, placing etc.
- CT
  - Control for duration & intensity
  - Less specific but active therapy: hand function, coordination, balance, compensatory practice etc.

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BMT




CT




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Methods
Statistical Analysis

- Analysis of covariance (ANCOVA)
  - Test the effects of the BMT group
    - Covariate: pretest score (FMA [P/D], FIM, & SIS)
      - Controlling pretreatment differences
    - Independent variable: group (BMT & CT)

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Results
Characteristics of participants

	BMT (n=20)	CT (n=20)	*p*
Gender	♂17；♀3	♂16；♀4	0.07
Age	50.46±10.11	50.70±13.93	0.34
Months since stroke	17.10±20.42	21.90±25.47	0.77
Side of lesion	L 9；R 11	L 13；R 7	0.15
MMSE	28.91±1.58	27.42±1.88	0.05
Brunnstrom stage (P)	Ⅲ-Ⅳ 3 Ⅳ 8 Ⅴ 9	Ⅲ-Ⅳ 2 Ⅳ 9 Ⅴ 9	0.36
Brunnstrom stage (D)	Ⅲ-Ⅳ 3 Ⅳ 8 Ⅴ 9	Ⅲ-Ⅳ 3 Ⅳ 9 Ⅴ 8	0.36

Results
Descriptive and inferential statistics on outcome measures

	BMT (n=20)		CT (n=20)		ANCOVA	
	pretest	posttest	pretest	posttest	*F(1, 38)*	*p*
FMA (total)	45.50±10.35	52.25±9.05	49.75±12.10	50.95±12.79	17.30	.001*
Proximal	29.25±6.54	32.80±5.62	33.60±6.60	34.05±6.72	9.91	.003*
Distal	16.25±5.68	19.45±4.51	16.15±6.52	16.9±6.84	7.77	.004*
FIM	116.70±12.83	119.15±10.71	114.30±10.27	116.65±8.34	.88	.354
SIS	64.36±15.77	64.22±15.55	64.36±9.33	64.92±13.08	.08	.777
strength	39.69±22.61	42.50±15.26	45.63±15.59	47.81±16.13	1.94	.153
memory	81.61±15.86	83.04±16.22	84.32±13.51	88.57±12.99	1.04	.359
emotion	62.78±20.76	56,77±19.33	63.61±12.52	62.36±14.63	1.90	.160
communication	89.46±15.17	91.97±12.79	90.18±17.30	88.21±19.53	.96	.389
ADL	66.63±21.65	68.13±20.44	66.13±17.52	65.00±20.00	.56	.460
mobility	86.67±11.21	86.53±18.74	83.89±19.05	82.36±20.85	1.50	.232
hand function	36.00±30.50	43.25±33.88	32.00±30.67	36.25±31.03	.38	.542
social participation	52.03±34.42	41.56±31.82	48.59±24.43	48.75±27.68	1.62	.210

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Discussion

- Compare the effects of bilateral movement training and conventional training on upper limb outcome, ADL, and HRQOL in poststroke chronic hemiparesis patients
- Partially consistent with study hypothesis
  - BMT improved overall upper limb performance (FMA [overall, proximal, distal]) to a greater extent than CT (based on NDT, compensatory practice, & functional activities with affected or both upper limbs)

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- Consistent with previous studies
  - BMT emphasize mass practice on functional tasks
    - provide sensory feedback to promote motor skill re-aquirisition

(Hesse et al., 2003; Desrosiers et al., 2005; Waller et al.,2004; Whitall et al., 2005)

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- Beneficial effects on FMA did not corroborate some previous studies
  - Diverse
    - Methodologies
      - small sample size, acute/ subacute patients
    - Treatment protocols
      - intensity/ duration [0.3-2,25 hr/d, 3-5d/wk, 2-8wks]
    - Treatment forms
      - proximal/ distal parts, tasks or augment sensory input
    - Outcomes
      - kinematics, WMFT, BBT, BI, UMAQS, TMS, EMG

(Morris et al., 2008; Mudie & Matyas, 2001; Richard et al., 2008; Lewis & Byblow, 2004)

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- Speculated neural effect
  - Simultaneous activation of both hands
    - Reduce intracortical inhibition & increase intracortical facilitation in both hemispheres
    - Additional facilitation in the affected hemisphere (vs. affected alone)
    - Positive effects for affected upper limb movement pattern and motor skills

(Stinear & Byblow, 2002; Waller et al., 2008; Waller & Whitall, 2008)

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- BMT did not show obvious enhancement on ADL [FIM] and HRQOL [SIS]
  - Similar to previous studies (other ADL related measures; other HRQOL related measures)
    - BMT did not emphasize forced use of affected hand
      - Compensate with unaffected hand (pretest)
    - BMT had fewer experiences on tasks relevant for real-world life
    - ADL have fewer bilateral symmetrical and simultaneous tasks (vs asymmetrical)
    - Associated with small change in HRQOL scores

(Luft et al., 2004 [UMAQS]; Morris et al., 2008 [BI, Norttingham Health Profile])

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Study limitation
Future research

- Mild to moderate chronic hemiparesis
  ⇨ generalization population
- Immediate and long-term effects
- Outcome measure
  - Activity-based: Box and Block Test, Action Research Arm Test, Wolf Motor Function Test
  - Objective measures: Kinematic analysis (motor control mechanism), neuroimage (neural reorganization)
- lesion side, site & size, motivation, chronicity, severity, sensitivity of clinical measures

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Conclusion

- Bilateral movement training compared with conventional training
  - In similar treatment intensity of patient-therapist interactions and therapeutic activities
    - 2 hours/day, 5 days/week, for 3 weeks
  - Support BMT as a rehabilitation strategy to improve upper limb (proximal and distal parts) motor skills

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Thanks for your listening!

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