Constraint-Induced Therapy Versus Alternative Interventions in Stroke Survivors

强制性使用运动疗法与其它中风康复疗法之比较

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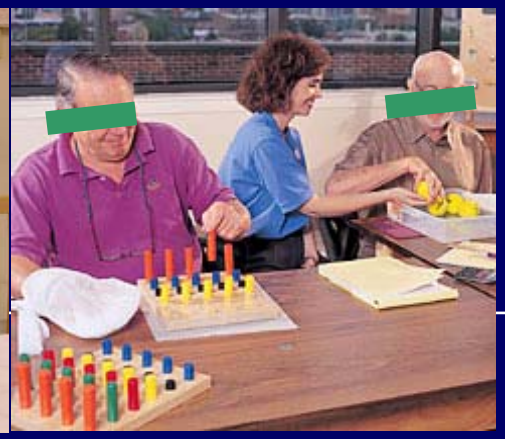
Constraint-Induced Therapy (CIT)
强制性使用运动疗法（迫用疗法）

- To overcome the learned nonuse phenomenon (克服习得性废用)
- Components: constraint (局限健肢), intensive/ repetitive practice (密集重复练习), and task-oriented practice (任务导向练习)
- Numerous studies have shown substantial evidence of the effectiveness of CIT and distributed forms of CIT



Bilateral Arm Training (BAT)
双侧上肢训练

- Mass and repetitive practice of bilateral movements with specific techniques:
  - Robot-assisted therapy (机器人辅助治疗)
  - Repetitive practice of functional tasks (重复练习功能性任务)
- Distributed CIT and BAT share similar key therapeutic elements and both target improvement of the affected UE.
- Unclear whether BAT could be an alternative program (替代疗法) through which to overcome learned nonuse

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Objectives and Research Hypotheses
研究目的与假设

- This study compared the relative effects of distributed CIT vs. BAT vs. control intervention on motor capacity (动作能力), functional performance (功能表现), and quality of life (生活质量).
- We hypothesized that both distributed CIT and BAT would elicit better performance than control intervention.
- Distributed CIT and BAT may produce differential benefits regarding specific outcome measures.

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Participants
受试者

- Sixty patients (44 men and 16 women, mean age = 52 years)
- Inclusion criteria (纳入标准):

(1) > 6 months post onset of ischemic or hemorrhagic stroke

(2) Brunnstrom stage (proximal & distal UE) > III

(3) Considerable nonuse of the affected UE (MAL-AOU < 2.5)

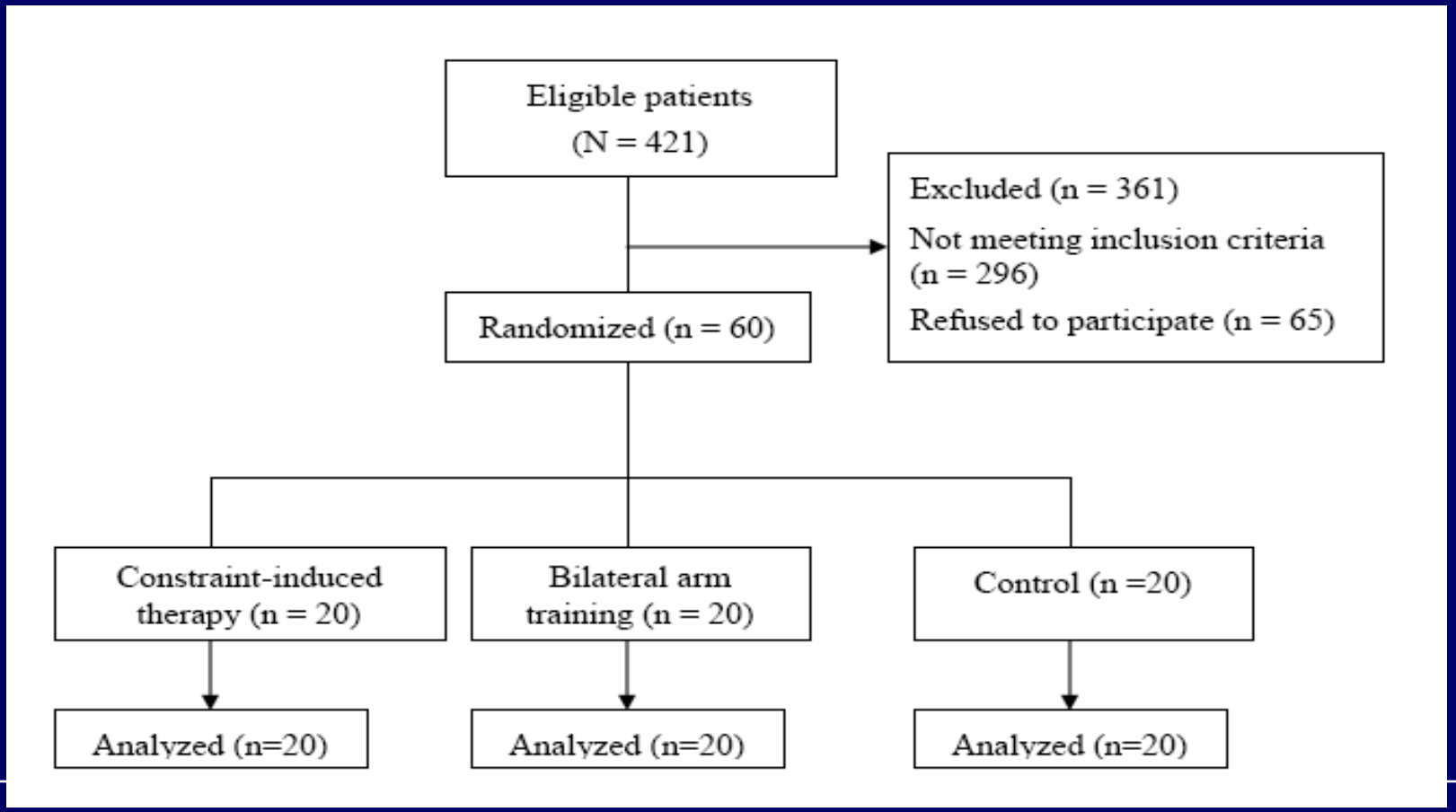
(4) No serious cognitive deficits (MMSE ≧ 24)

(5) No excessive spasticity in any joints of the affected UE

(6) Lack of participation in any experimental studies

(7) No balance problems that may compromise safety during the training

Flow Chart of the Randomization Procedure
随机分配流程图



Intervention protocols 治疗

Distributed CIT Group	BAT Group	Control Group
• Intensive training of the affected UE in functional tasks for 2h/d, 5d/wk for 3 wks • Restriction on the unaffected hand with a mitt for 6h/d, 5d/wk, 3 wks	• Simultaneous movements of both the affected and unaffected UE in functional tasks in symmetric or alternating patterns. • 2h/d, 5d/wk for 3 wks	• Neurodevelopmental techniques, e.g. training for hand function, coordination, and normalizing muscle tone of the affected UE • 2h/d, 5d/wk for 3 wks

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Outcome Measures
疗效评估量表

- Fugl-Meyer Assessment (FMA) (Fugl-Meyer上肢运动功能)
  - To evaluate motor impairments
  - Proximal and distal UE scores
- Motor Activity Log (MAL) (动作活动纪录量表)
  - To measure functional ability and amount of use of the affected arm in real world situations
  - AOU (患肢使用量) and QOM (患肢动作质量) subscales
- Functional Independence Measure (FIM) (功能独立性评价量表)
  - To evaluate daily function
- Stroke Impact scale, Version 3 (SIS) (脑卒中影响量表)
  - To measure changes in quality of life
  - 59-item self-report scale, 8 functional domains

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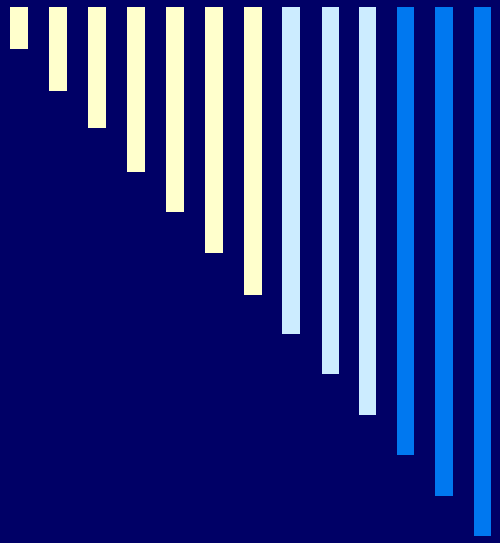
Statistical Analysis
统计分析

- Analysis of covariance (ANCOVA) 共变量分析
  - To test the relative effects of the treatment groups on each variable
- Fisher's LSD tests 事后检定
  - Post hoc comparisons between groups
- Effect size *r* 效应值
  - It was calculated for each variable to index the magnitude of group differences in performance.



Results
结果

No significant differences in the demographic and clinical characteristics of participants in the 3 groups (人口学与临床特征无统计学上之显着差异)

Characteristics	dCIT (n = 20)	BAT (n = 20)	Con (n = 20)	*P*
Gender (male/female)	11/9	12/8	11/9	.93
Age (year)	55.28±9.34	51.58±8.67	50.70±13.93	.40
Side of lesion (right/left)	8/12	11/9	12/8	.42
Months after stroke	21.25±21.59	18.50±17.40	21.90±20.51	.86
Brunnstrom stage of proximal part of UE	5	5	5	.86
Brunnstrom stage of distal part of UE	4	4	5	.77
AOU of MAL	1.03±0.81	1.11±1.09	0.85±1.07	.31
MMSE score	28	29.5	28.5	.12

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FMA Outcomes
(Fugl-Meyer上肢运动功能结果)

- The distributed CIT and BAT showed better performance in the overall and the distal part (上肢远端) score of the FMA than the control intervention.

- The BAT group exhibited greater gains in the proximal part (上肢近端) of the FMA than the distributed CIT and control groups.

	Pretreatment (mean±SD)			Posttreatment (mean±SD)			ANCOVA		
Measures	**dCIT (n=20)**	**BAT (n=20)**	**Con (n=20)**	**dCIT (n=20)**	**BAT (n=20)**	**Con (n=20)**	***F*(2,56)**	***p***	**ES *r***
FMA (overall)	**46.05±8.30**	**45.50±10.35**	**49.75±12.10**	**52.30±7.17**	**52.25±9.06**	**51.25±12.59**	**9.72**	**<.001***	**.51**
FMA (proximal)	**31.45±4.61**	**29.25±6.54**	**33.60±6.61**	**33.70±3.59**	**32.80±5.62**	**34.05±6.58**	**3.88**	**.027***	**.35**
FMA (distal)	**14.60±4.58**	**16.25±5.68**	**16.15±6.52**	**18.6±4.25**	**19.45±4.51**	**17.05±6.79**	**6.30**	**.003***	**.43**

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MAL Outcomes

(动作活动纪录量表结果)

- The distributed CIT group engendered better performance in both subscales of the MAL than the BAT and control groups.

	Pretreatment (mean±SD)			Posttreatment (mean±SD)			ANCOVA		
Measures	dCIT (n=20)	BAT (n=20)	Con (n=20)	dCIT (n=20)	BAT (n=20)	Con (n=20)	*F*(2,56)	*p*	ES *r*
MAL (AOU)	1.03±0.81	1.11±1.09	0.85±1.07	1.76±0.86	1.31±0.95	0.99±1.16	4.77	.012*	.38
MAL (QOM)	1.02±0.74	1.14±0.86	0.90±1.21	1.96±0.85	1.45±1.00	1.16±1.27	5.81	.005*	.41

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FIM Outcomes
(功能独立性评价量表结果)

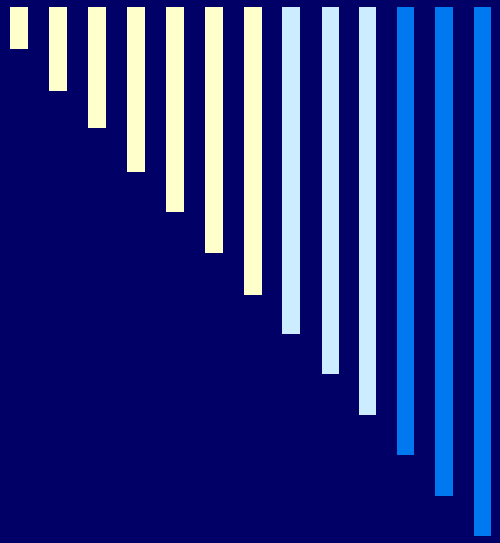
- The distributed CIT group engendered better performance in the locomotion (行走) subtest of the FIM than the BAT and control groups.

	Pretreatment (mean±SD)			Posttreatment (mean±SD)			ANCOVA		
Measures	**dCIT (n=20)**	**BAT (n=20)**	**Con (n=20)**	**dCIT (n=20)**	**BAT (n=20)**	**Con (n=20)**	***F*(2,56)**	***p***	**ES *r***
FIM	**119.4±8.34**	**116.7±12.83**	**114.3±10.27**	**122.05±5.60**	**119.15±10.7**	**116.65±8.34**	**1.06**	**.35**	**.19**
self-care	**39.05±4.39**	**37.05±7.62**	**35.45±7.11**	**39.75±3.43**	**38.65±4.94**	**36.6±6.23**	**.73**	**.48**	**.16**
sphincter	**13.95±0.22**	**13.50±1.82**	**13.80±0.52**	**13.95±0.22**	**13.60±1.79**	**13.85±0.49**	**.34**	**.71**	**.11**
transfer	**20.50±1.40**	**20.15±2.16**	**19.40±1.90**	**20.95±0.22**	**20.05±2.14**	**19.95±1.70**	**1.76**	**.18**	**.24**
locomotion	**12.50±1.40**	**13.10±1.65**	**12.25±1.80**	**13.25±0.85**	**13.05±1.82**	**12.60±1.39**	**3.37**	**.042***	**.33**
communication	**13.60±0.99**	**13.40±1.43**	**13.50±1.24**	**13.75±0.91**	**13.65±0.67**	**13.45±1.57**	**.90**	**.41**	**.18**
social cognition	**19.80±2.98**	**19.50±2.26**	**19.90±2.57**	**20.40±1.76**	**20.15±1.35**	**20.20±2.07**	**.19**	**.83**	**.08**

SIS Outcomes (脑卒中影响量表结果)

- The distributed CIT group rated higher quality of life in the overall, ADL/IADL (基本生活自理能力/工具性日常生活活动), and hand function (手功能) domains of SIS than the control group.
- The distributed CIT group perceived better quality of life in the overall SIS and domains of ADL/IADL and social participation (社会参与) than the BAT group.

	Pretreatment (mean±SD)			Posttreatment (mean±SD)			ANCOVA		
Measures	dCIT (n=20)	BAT (n=20)	Con (n=20)	dCIT (n=20)	BAT (n=20)	Con (n=20)	*F*(2,56)	*p*	ES *r*
SIS	66.26±10.04	64.36±15.77	64.36±9.33	73.29±10.78	64.22±15.55	64.92±13.08	5.86	.005*	.42
strength	50.00±21.07	39.69±22.61	45.63±15.59	57.19±22.88	42.50±15.26	47.81±16.13	1.94	.15	.25
memory	81.96±20.02	81.61±15.86	84.32±13.51	88.04±17.47	83.04±16.22	88.57±12.99	1.04	.36	.19
emotion	60.00±23.49	62.78±20.76	63.61±12.52	62.64±16.31	56.77±19.33	62.36±14.63	1.90	.16	.25
communication	91.79±15.59	89.46±15.17	90.18±17.30	92.68±15.57	91.97±12.79	88.21±19.53	.96	.39	.18
ADLs/IADLs	71.00±16.63	66.63±21.65	66.13±17.52	79.63±13.36	68.13±20.44	65.00±20.00	4.94	.011*	.39
mobility	80.00±14.74	86.67±11.21	83.89±19.05	86.53±14.87	86.53±18.74	82.36±20.85	1.50	.23	.23
hand function	37.50±23.81	36.00±30.50	32.00±30.67	54.75±21.12	43.25±33.88	36.25±31.03	3.40	.040*	.33
participation	57.81±25.05	52.03±34.42	48.59±24.43	64.85±22.40	41.56±31.82	48.75±27.68	3.92	.025*	.35



Discussion
讨论

Main Findings
主要发现

- CIT and BAT groups improved overall and distal UE motor performance to a greater extent than control intervention.
- BAT group demonstrated unique benefits in reducing proximal UE (上肢近端) deficits.
- CIT group perceived improved functional use of the affected UE, as measured by the MAL.
- CIT group showed significantly better performance on the locomotion (行走) subtest of the FIM than the BAT and control groups.
- CIT group rated better scores of overall quality of life (整体生活质量) and the ADL (日常生活活动) domain of the SIS than BAT and control patients.

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Beneficial Effects of BAT

Significantly better motor improvements in the proximal UE (上肢近端)

- One possible explanations:
  - Simultaneous activation of both hands may reduce intracortical inhibition (皮层内抑制) in both hemispheres that may cause an additional facilitation in the affected hemisphere compared to activation of the affected hand alone.

Beneficial Effects of CIT

- Greater improvements in functional ability and use of the affected UE in daily life.
- Better locomotion reflected by the FIM.
- Greater improvements in domains of the SIS.

Possible explanations:

- Overcoming the learned nonuse phenomenon (习得性废用)
- Forced to use (强制性使用) the affected UE to practice daily activities and resolve the possible difficulties that the patients might encounter.
- Increased functional use (功能性使用) of the affected hand may have relieved the negative impact of the non-functioning UE on trunk alignment and balance control, and thus resulted in improved locomotion.

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Summary of Results
结果总结

- Improving proximal UE motor skills: **BAT > CIT**
  (改善上肢近端动作功能)
- Reducing learned nonuse: **CIT > BAT**
  (降低习得性废用)
- Enhancing daily function: **CIT > BAT**
  (增进日常生活活动)
- Improving the overall and some individual domains of quality of life: **CIT > BAT**
  (改善生活质量)

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Limitations
研究限制

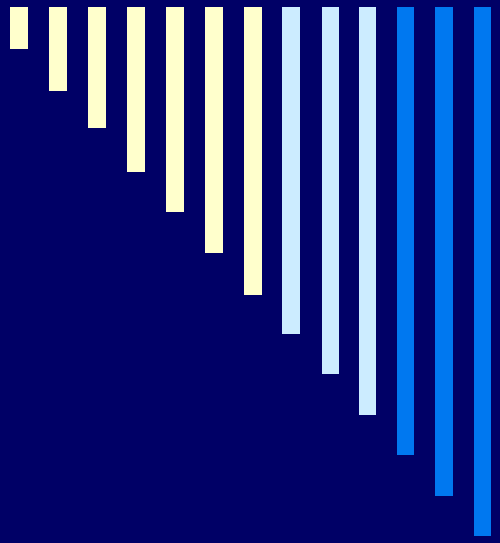
- Treatment effects were measured immediately after treatment:
  - Will the benefits of intervention be retained over time after treatment?
- Lack of motor control mechanisms (动作控制机制) evaluation (e.g., kinematic analysis 运动学分析)

Directions for Further Research
未来研究方向

- To explore the changes in the real lives (真实生活) of the patients after the treatments.
  - Use of a monitoring system (e.g., the accelerometers)
- To study of the combined effects of two training programs vs. a single program in different types of stroke patients（合并疗法之成效）.
- To evaluate the immediate and long-term effects of treatment (立即与长期治疗效果).

Conclusions
结论

- BAT uniquely improves proximal UE motor skills
  (BAT 改善上肢近端动作功能).
- Distributed CIT produced greater improvements in use of the affected UE during daily activities, functional independence in locomotion and quality of life than BAT and control intervention.
  (CIT 改善瘫痪侧手日常生活使用、行走独立程度、生活质量)
- These findings emphasize the need to take domains of outcome measures into consideration when comparing stroke rehabilitation programs.
  (中风康复成效的比较需考虑评定方法)



Distributed CIT 後动作及功能结果之预测因子

Background
研究背景

- Importance of identifying possible predictors (可能的预测因子) for distributed CIT outcomes:
  - To help underscore the factors that may affect treatment outcomes and target individuals who benefit the most from the therapy.
- Evidence regarding predictors of optimal outcomes in stroke patients after CIT is limited and the results are not fully comparable.

Objectives (研究目的)~
To identify predictors of distributed CIT outcomes

- Outcome measures:
  (疗效评估量表)
  - FMA: movement impairments
  - MAL: perceived functional ability of the affected hand
  - FIM: functional performance of daily activities
- 7 Potential predictors:
  (预测因子)
  - Age
  - Sex
  - Side of stroke
  - Time since stroke
  - Spasticity 痉挛 (ASH)
  - Neurologic status 神经功能 (NIHSS)
  - Movement performance of the distal part of the upper extremity (FMA-distal)

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Participations
受试者

Demographic and Clinical Characteristics of the 57 Subjects

Characteristics	Value
Age, mean (SD), y	55.10 (13.99)
Sex, No. (%)	
Female	18 (31.58)
Male	39 (68.42)
Time since stroke, mean (range), mon	12 (0.7-88)
Side of stroke, No. (%)	
Left	32 (56.14)
Right	25 (43.86)
Brunnstrom stage of upper extremity	
Proximal part, median	5
Distal part, median	4
Mini-Mental State Exam, mean (SD)	27 (3.08)
MAL (amount of use), mean (SD)	0.85 (1.01)
Modified Ashworth Scale, mean (SD)	0.52 (0.47)

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Intervention
治疗

Distributed CIT

- Practice of functional tasks using the affected UE for 2h/d, 5d/wk, for 3wks.
- Shaping and repetitive task practice techniques.
- Restraint of the unaffected UE for 2h/d, 5d/wk, for 3wks.

Data reduction & Data analysis
资料精简与分析

- To index improved performance scores:

$$\frac{\text{Improved Score (Posttest} - \text{Pretest)}}{\text{Max Possible Improvement Score}} \times 100\%$$

- Backward stepwise procedure to develop a linear regression model for each outcome measure.
  - Adjusted *R* square, *P*, and regression coefficients (β)

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Results ~ Correlations (相关系数)

Relationships Between the 7 Predictors and the Relative Change Scores of the 4 Outcome Measures

	Pearson *r*			
Predictors	FMA	FIM	AOU	QOM
Age	–0.07	–0.06	–0.25[a]	–0.22[a]
Sex	<0.01	0.17[a]	<0.01	<0.01
Side of stroke	–0.02	0.21[a]	0.15	0.12
[ln] Time since stroke	–0.38[a]	–0.24[a]	–0.29[a]	–0.47[a]
[ln] ASH	–0.28[a]	–0.02	–0.22[a]	–0.19[a]
NIHSS	–0.17[a]	–0.19[a]	–0.37[a]	–0.37[a]
FMA distal part	0.27[a]	0.05	0.34[a]	0.49[a]

[a] $P < .25$.

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Multiple regression
多元回归分析

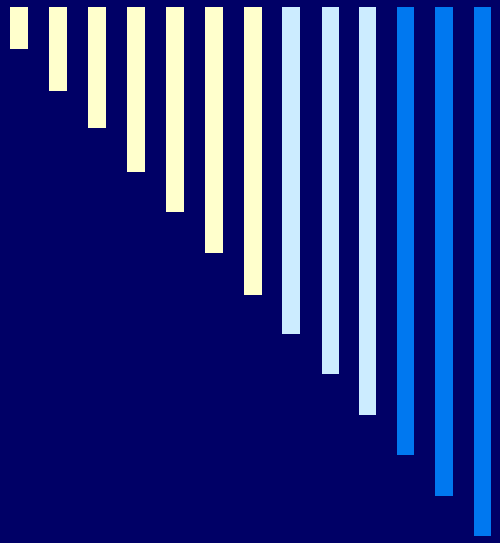
FMA = (0.346) – (0.071)[ln] time since stroke + (0.010)FMA distal part

AOU = (0.301) – (0.004) age + (0.013)FMA distal part

QOM =(0.229) – (0.070)[ln] time since stroke + (0.015)FMA distal part

Backward stepwise multiple regression analyses of the predictors for the outcome measures

	FMA		AOU		QOM	
Adjusted R^2	0.18		0.20		0.43	
F (significance)	7.03 (0.002)		7.98 (0.001)		21.96 (0.000)	
Predictors*	β	P	β	P	β	P
Age (years)			-0.004	0.043		
[ln] Time since stroke (months)	-0.071	0.004			-0.070	0.000
FMA distal part	0.010	0.040	0.013	0.002	0.015	0.000
Constant	0.35		0.30		0.23	



Discussion
讨论

A. Best predictors of distributed CIT outcome: wrist and hand scores (distal subsection) of the FMA	B. No potential predictors emerged for FIM
Possible Reason: • The important role of motor functions in the functional use of UE during daily activities.	**Possible reasons:** • Multi-faceted scale • Increased motor function may not translate into functional gains
• [+ time after stroke] predict: change in motor function (FMA) and quality of movements (QOM) • [+ age] predict: change in amount of use (AOU)	• Other potential predictors need to be considered in future research.

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Conclusions
结论

- This is the first study to investigate the potential demographic and clinical characteristics of stroke that can serve to predict distributed CIT outcomes in motor and functional capacity.
- The best predictor for distributed CIT outcome is distal subsection score (上肢远端动作分数) of FMA.（未来康复试验以远端动作障碍程度分组迫用疗法之受试）

感谢您的聆听


阿妹茶樓


越夜越美

丰子恺（1898－1975）

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