Timing de la rééducation, doses et facteurs pronostiques

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SCIENCES
TECHNOLOGIES
SANTÉ

Objectifs pédagogiques

- Prendre en compte le développement des indicateurs anatomophysiologiques liés à la récupération post AVC
- Comprendre comment sont construits certains modèles prédictifs de pronostic
- Connaitre les limites actuelles de ces modèles
- Comprendre l'utilisation possible des modèles prédictifs pour définir les doses de rééducation

Variabilité de la récupération post AVC (MS)

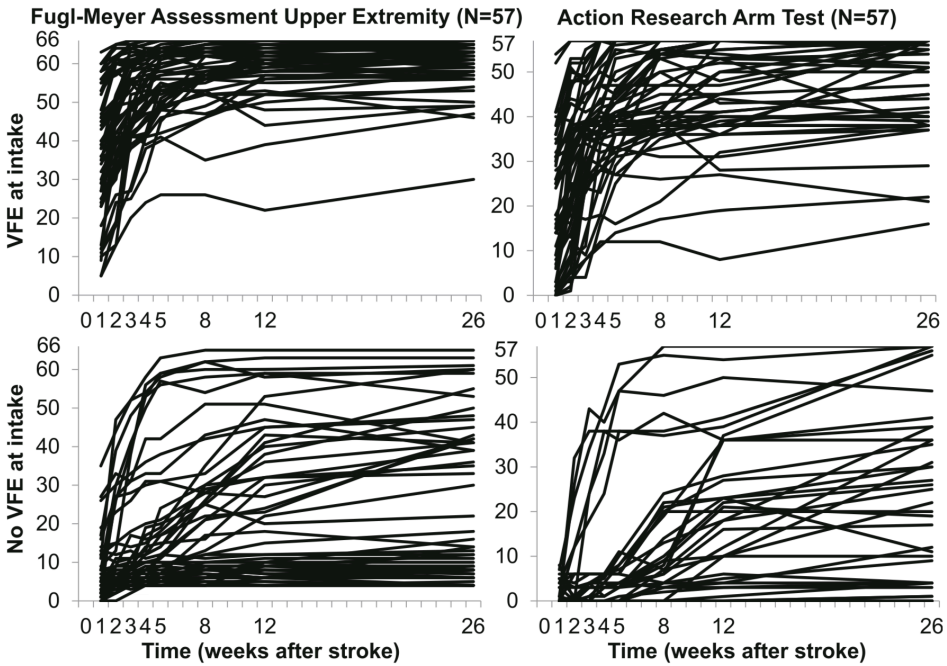

Fig. 1 Individual FMA-UE and ARAT recovery curves for patients with and without Voluntary Finger Extension (VFE). The top two graphs represent the patients with VFE at about 1 week after stroke and the bottom two graphs the patients without VFE. The lefthand two graphs and righthand two graphs represent, respectively, the Upper Extremity motor scores of the Fugl-Meyer Assessment (FMA-UE, score = 0–66, 66 = normal function) and the Action Research Arm Test (ARAT, score = 0–57, 57 = normal capacity)

Winters et al. Trials (2016) 17:468

Critical Period After Stroke Study (CPASS): A phase II clinical trial testing an optimal time for motor recovery after stroke in humans

Alexander W. Dromerick[a,b,1,2], Shashwati Geed[a,b,1], Jessica Barth[a,c], Kathaleen Brady[a], Margot L. Giannetti[a], Abigail Mitchell[a], Matthew A. Edwardson[b], Ming T. Tan[b,d], Yizhao Zhou[d], Elissa L. Newport[b,3], and Dorothy F. Edwards[e,f]

PNAS 2021 Vol. 118 No. 39 e2026676118

Table 2. Demographic characteristics and scores on baseline study measures (n = 72) shown by group

	Total sample (n = 72)	Acute (n = 16)	Subacute (n = 17)	Chronic (n = 20)	Control (n = 19)
Age, y	62.8 ± 11.5	61.8 ± 11.3	63.9 ± 10.8	67.3 ± 9.8	58 ± 12.6
Sex (female)	36 (50)	11 (68.8)	6 (35.2)	11 (55)	8 (42.1)
Race					
Caucasian	10 (13.9)	1 (6.3)	2 (11.8)	5 (25)	2 (10.5)
African American	60 (83.3)	13 (81.3)	15 (88.2)	15 (75)	17 (89.5)
American Indian, Alaskan	0	0	0	0	0
Asian	1 (1.4)	1 (6.3)	0	0	0
Native Hawaiian, Pacific Islander	1 (1.4)	1 (6.3)	0	0	0
Dominant UE affected	33 (45.8)	9 (56.2)	8 (47)	9 (45)	7 (36.8)
Stroke type					
Ischemic	69 (95.8)	16 (100)	17 (100)	17 (85)	19 (100)
Hemorrhagic	3 (4.2)	0	0	3 (15)	0
Total NIHSS	4.9 ± 1.7	4.9 ± 1.9	4.9 ± 2.1	4.6 ± 1.5	5.3 ± 1.6
Total ARAT	15.8 ± 13.8	16.8 ± 16.2	13.4 ± 11.4	20.3 ± 15.7	12.3 ± 10.5
Days from stroke onset to randomization	15.4 ± 4.5	15.6 ± 4	14.8 ± 4.6	15.3 ± 4.4	16.1 ± 5
Hours of study-specific therapy received	19.7 ± 1.7	18.8 ± 2.9	20 ± 0.3	20.2 ± 0.7	—

Baseline demographics of study participants per group. Numbers in parentheses indicate percentages. Categorical variables are shown as counts and percentages; continuous variables are described using means and SDs. Controls received standard rehabilitation; therefore controls' "hours of study-specific therapy received" is empty.

Total NIHSS	4.9 ± 1.7	4.9 ± 1.9	4.9 ± 2.1	4.6 ± 1.5	5.3 ± 1.6
Total ARAT	15.8 ± 13.8	16.8 ± 16.2	13.4 ± 11.4	20.3 ± 15.7	12.3 ± 10.5
Days from stroke onset to randomization	15.4 ± 4.5	15.6 ± 4	14.8 ± 4.6	15.3 ± 4.4	16.1 ± 5
Hours of study-specific therapy received	19.7 ± 1.7	18.8 ± 2.9	20 ± 0.3	20.2 ± 0.7	—

- Chaque groupe (sf contrôle) : 20h de traitement intensif du MS
- Contrôle: traitement habituel (US)
- Chaque groupe traité à des moments différents (aigu, subaigu, chronique)

Influence de la période post AVC sur le résultat des traitements

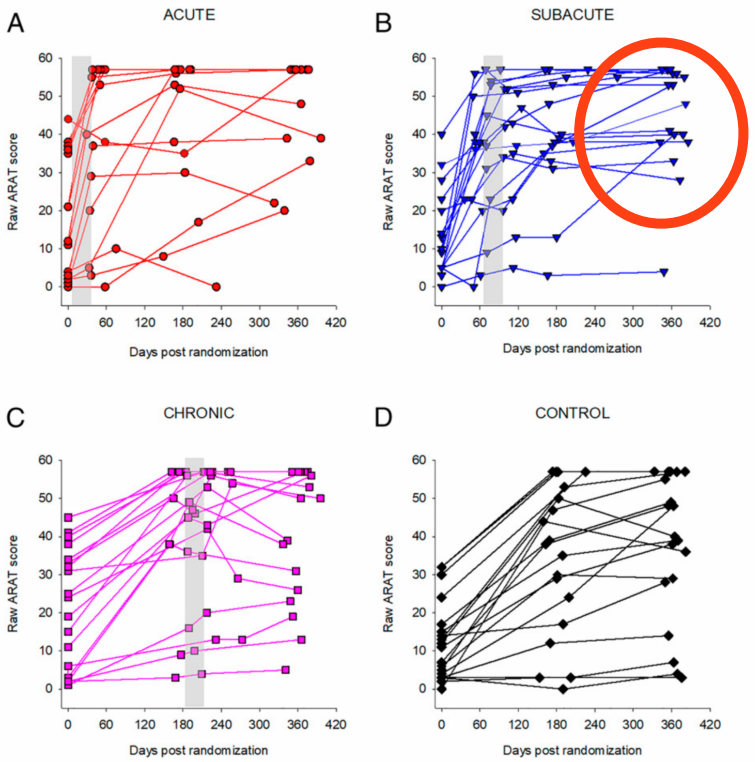

Fig. 3. (*A–D*) Individual trajectories of raw ARAT scores posttroke, by treatment group. Vertical gray bars show average timing of the intervention in each group.

Figure S1. Mean ARAT scores (and standard errors) for each group at baseline, 6month, 12month, pre-treatment, and post-treatment, shown at the average time at which the assessments occurred for the group.

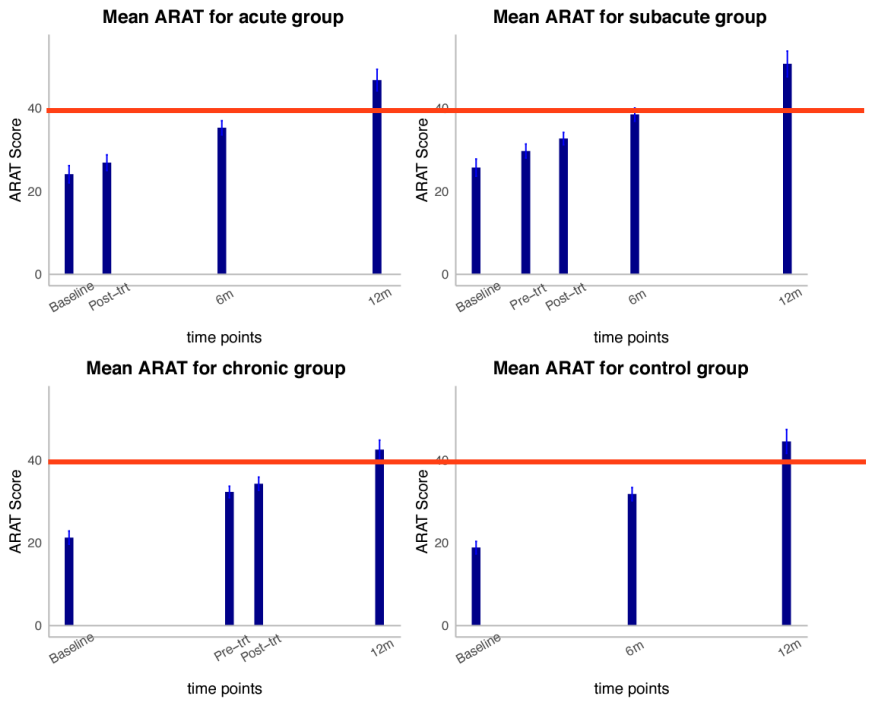

Figure S1. Mean ARAT scores (and standard errors) for each group at baseline, 6month, 12month, pre-treatment, and post-treatment assessments, shown at the average time at which the assessments occurred for the group. Baseline, 6-month, and 12-month assessments occurred at approximately the same time after stroke for all groups. The control group underwent assessments only at these three timepoints. However, because the groups differed in when their intervention was administered, each group underwent their pre- and post-intervention assessments at different time-points during the study period. Baseline and pre-intervention assessment were the same for the acute group; pre-intervention and 6-month assessment were the same for the chronic group. The mean ARAT scores (and standard errors) are plotted at the study group's average day of assessment at each time-point.

Tant à 6 qu'à 12 mois ceux qui ont le meilleur ARAT sont ceux traités entre 3 et 12 semaines post-AVC

Donc

- La récupération post AVC est variable
- Pour une population avec un faible NIHSS, la fenêtre temporelle du traitement détermine le pronostic
- L'étude ICARE (Winstein 2016) ne semble pas montrer qu'une dose plus importante influe sur le pronostic pour les patients ayant une déficience modérée (UEFM moyen 41+/-9 max=56)
- Généralisation?
- Comment définir le traitement adéquat?

DE QUOI PARLE-T-ON?

8

Comment faire une prédiction

- On prend une base de données et on détermine la relation mathématique qui lie les variables entre elles
- Exemple

J. Clin. Med. **2022**, *11*, 3771. https://doi.org/10.3390/jcm11133771

Article

Predictive Validity of the Postural Assessment Scale for Stroke (PASS) to Classify the Functionality in Stroke Patients: A Retrospective Study

Cecilia Estrada-Barranco [1], Ismael Sanz-Esteban [1], Maria José Giménez-Mestre [1], Roberto Cano-de-la-Cuerda [2,*] and Francisco Molina-Rueda [2]

Méthodo

J. Clin. Med. **2022**, *11*, 3771. https://doi.org/10.3390/jcm11133771

Patient's data were collected for study purposes from medical records stored in the hospital database (CE-B). The screened period was from October 2016 to May 2017. All patients having suffered a stroke less than 8 weeks before hospital admission were included in the study if: (1) gait and balance treatment had been identified as a goal by the patient and the rehabilitation team, according to SMART goals [23]; (2) stroke was confirmed by a neurologist using either magnetic resonance imaging or computed axial tomography; and (3) all patients should follow the same individual rehabilitation treatment oriented to gait and balance improvements.

- Sélection selon des critères: < 8 semaines
- Elimination des données manquantes: pas d'évaluation de la PASS: pas sélectionné
- Contrôle du traitement: le même traitement …

Méthodo: outcomes

The PASS scale was used to measure balance, and the Functional Independence Measure (FIM) was selected to assess the functionality of the patients. Scores of both scales were collected at 4 time points during the rehabilitation process: upon admission, at 3 months (subacute state), at 6 months and at 12 months (chronic state)

J. Clin. Med. **2022**, *11*, 3771. https://doi.org/10.3390/jcm11133771

une variable à des dates arbitraires

un modèle statistique (en l'occurence de régression linéaire) pour regarder la relation entre une variable dépendante (à expliquer) et une variable indépendante (explicative)

Résultats

- R^2 est le coefficient de détermination qui définit la qualité de la prédiction
- le test de Kolmogorov Smirnov quantifie la distance entre la courbe réelle et la courbe du modèle.
- Le test de Durbin teste l'autocorrélation des résidus du modèle (normal autour de 2)

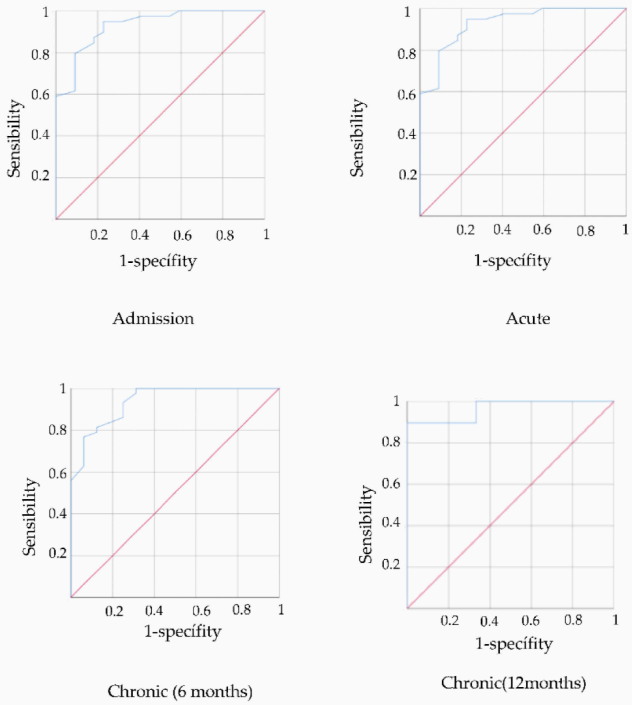

Figure 1. ROC curves predictive validity PASS for functionality in acute, subacute and chronic s

Model	R^2	ANOVA	β	*p*	Durbin	K-S [1]
PASS [2] 0–FIM [2] 0	0.540	<0.001	1.99 (1.52–2.48)	<0.001	2.150	0.200
PASS 3–FIM 3	0.658	<0.001	2.15 (1.75–2.56)	<0.001	2.374	0.060
PASS 6–FIM 6	0.729	<0.001	2.48 (2.078–2.88)	<0.001	1.966	0.162
PASS 12–FIM 12	0.867	<0.001	2.62 (2.29–2.95)	<0.001	1.672	0.082
PASS 0–FIM 12	0.383	<0.001	1.61 (0.96–2.26)	<0.001	1.858	0.141

[1] K-S: Kolmogorov Smirnov; [2] PASS: Postural Assessment Scale for Stroke Patients; [3] FIM: Functional Independence Measure.

J. Clin. Med. **2022**, *11*, 3771. https://doi.org/10.3390/jcm11133771

- Puis choix arbitraire (ou non) d'un seuil pour prédire au dessus ou en dessous: ici MIF< ou >73
- Puis on choisi le seuil de prédiction pour la variable indépendante (ici le PASS) pour la meilleure prédiction (ce seuil est de 17,5 à la phase subaigue et 16,5 à la phase chronique) Rappel : le PASS max=36
- Un PASS>8,5 à l'admission prédit une MIF >73 à 12 mois.

EXISTE-T-IL DES MODELES LIÉS À LA LÉSION?

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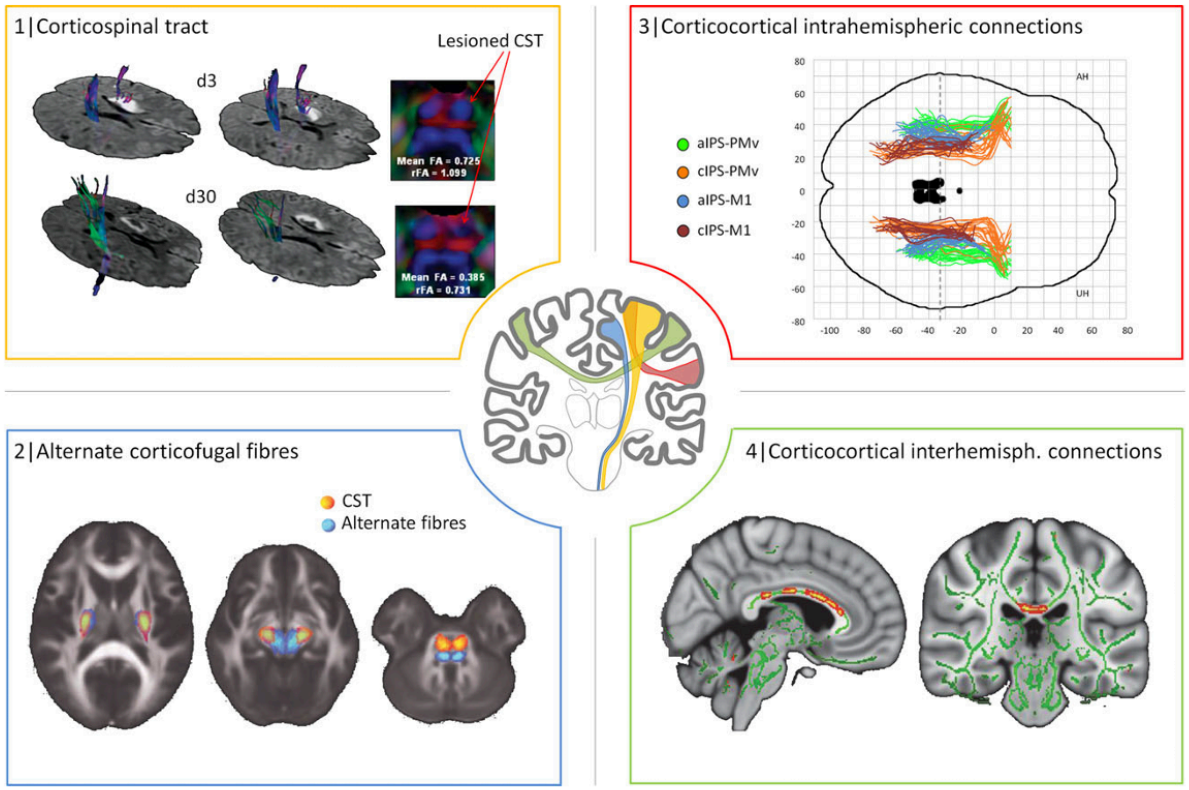
ANNALS of Clinical and Translational Neurology
Open Access
REVIEW ARTICLE

Structural connectivity analyses in motor recovery research after stroke

Philipp Koch[a], Robert Schulz[a] & Friedhelm C. Hummel

Brain Imaging and NeuroStimulation (BINS) Laboratory, Department of Neurology, University Medical Center Hamburg-Eppendorf, Martinistr. 52, 20246 Hamburg, Germany



Corrélation dégénérescence CST et NIHSS

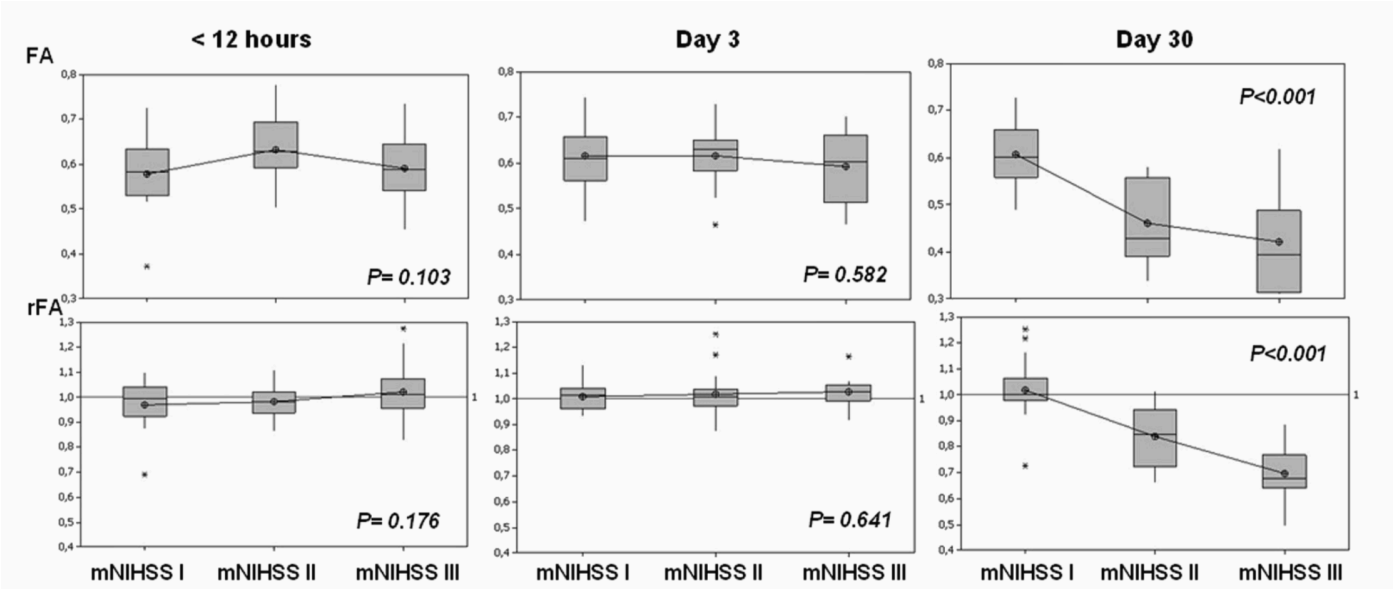


Fig 1. Evolution of mean FA values and rFAs between the affected and unaffected sides in the region of interest in the descending CST at the level of the rostral pons in the function of m-NIHSS categories at admission, day 3, and day 30. Boxplots show median values (horizontal line inside the box), quartiles (box boundaries), and the largest and smallest observed values (lines extending from the box) of FA and rFA. Anisotropy values are clearly lower in patients with motor deficits at 30 days; no differences were found between patients in the m-NIHSS-II and m-NHISS-III groups.

ORIGINAL RESEARCH

Wallerian Degeneration in the Corticospinal Tract Evaluated by Diffusion Tensor Imaging Correlates with Motor Deficit 30 Days after Middle Cerebral Artery Ischemic Stroke

AJNR Am J Neuroradiol 31:1324–30 | Aug 2010

J. Puig
S. Pedraza
G. Blasco
J. Daunis-i-Estadella
A. Prats
F. Prados
I. Boada
M. Castellanos
J. Sánchez-González

DTI et CST

- Nombreux indicateurs corrélés à la fonction motrice ou autre fonction
- La FA peut aussi être diminuée du côté opposé à la lésion (surtout AVC sévères)
- Mais dans quelle mesure les indicateurs mesurés en DTI peuvent prédire la fonction motrice et la récupération après AVC reste un ?

Raisons?

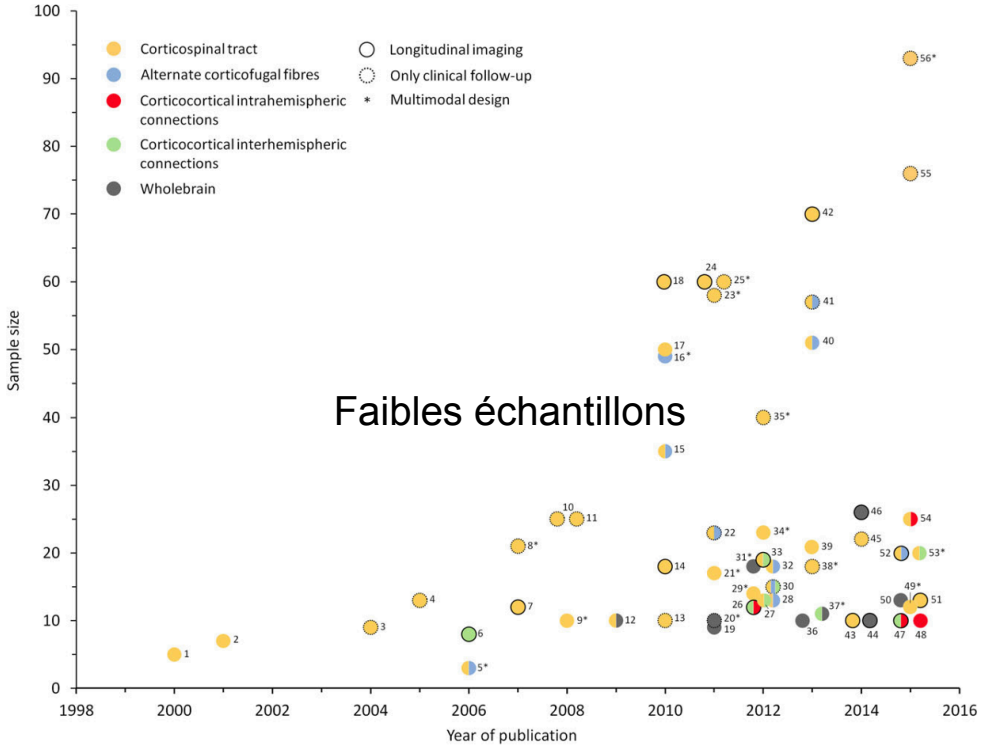


Figure 2. Synopsis of structural connectivity analyses. Individual studies considered in the present review are summarized with the year of publication, the sample size (patients) and their main focus of the structural analyses indicated by the color scheme. Cross-sectional studies are represented by colored dots without any frame; a black frame represents studies with longitudinally repeated imaging. Cross-sectional imaging studies with only clinical/behavioral follow-up are indicated by dotted frames. Notably, the selection of studies included in this study is not supposed to be exhaustive but is rather made to illustrate previous and recent developments in structural connectivity analyses after stroke. In cases of multiple studies of similar sample sizes in 1 year, the representing dots were placed next to each other for illustration purposes. The references are numbered consecutively and listed below with the first author and the year of publication, et al. has been omitted for sake of

Autres tractus descendants (corticofugal tract = cortico-rubro-spinal et cortico reticulo spinal)

Synergistic but independent: The role of corticospinal and alternate motor fibers for residual motor output after stroke

Robert Schulz[a], Eunhee Park[b], Jungsoo Lee[b], Won Hyuk Chang[b], Ahee Lee[c], Yun-Hee Kim[b,c,*,1], Friedhelm C. Hummel[d,e,f,**,1]

NeuroImage: Clinical 15 (2017) 118–124

- Le CST et aMF(alternate motor fibers = fibres motrices non pyramidales) sont individuellement corrélés chez l'AVC avec le pronostic moteur mais ne sont pas corrélés entre eux.
- aMF semble donc jouer un rôle propre

Phase subaiguë (tardive = 3-4 mois post)

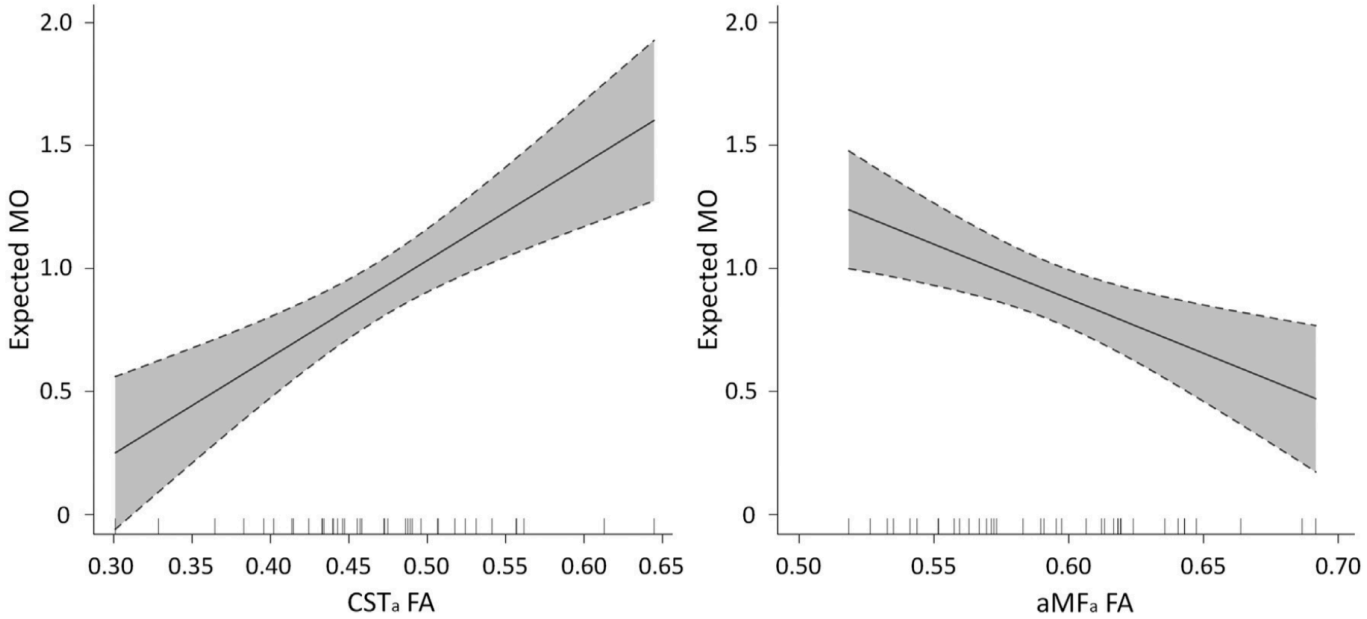
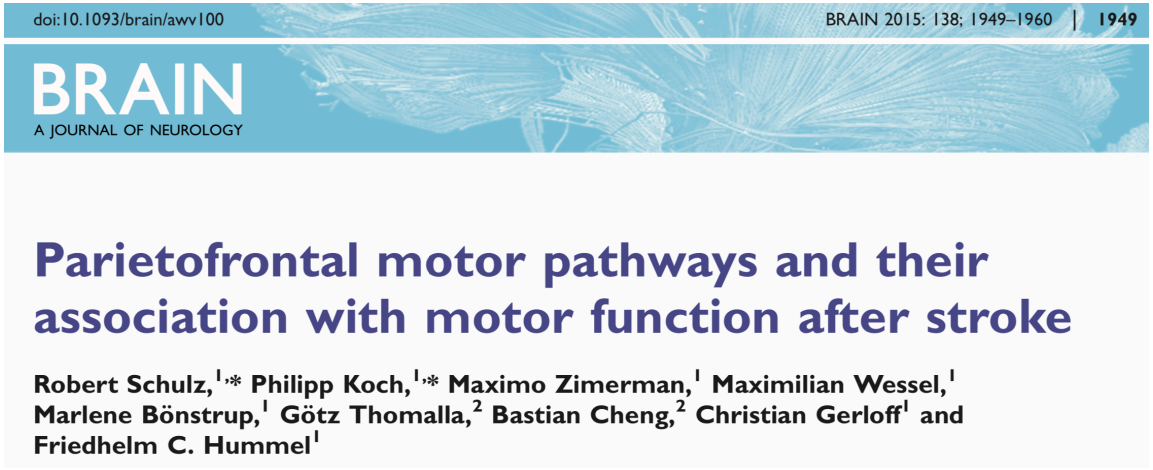


Fig. 3. Structure-function relationship for CST and aMF white matter integrity after stroke.Effect plots for the significant correlation between the tract-related mean FA of the CST and aMF of the affected hemisphere (CST_a: coefficient = 3.93, 95% CI 2.21–5.66, $p < 0.0001$, aMF_a: coefficient = −4.43, 95% CI −7.21–1.64, $p = 0.003$) and the expected residual motor output (MO) after stroke (dimensionless, log-transformed, see Statistics). Plot shows the estimated means (solid lines) with 95% confidence intervals (dotted lines). The rug plots indicate the actually measured tract-related FA values for CST_a and aMF_a.

L'unité de Motor outcome est adimensionnée à partir de l'UEFM

Et les faisceaux cortico-corticaux?



doi:10.1093/brain/awv100 BRAIN 2015: 138; 1949–1960 | 1949

BRAIN
A JOURNAL OF NEUROLOGY

Parietofrontal motor pathways and their association with motor function after stroke

Robert Schulz,[1,*] Philipp Koch,[1,*] Maximo Zimerman,[1] Maximilian Wessel,[1] Marlene Bönstrup,[1] Götz Thomalla,[2] Bastian Cheng,[2] Christian Gerloff[1] and Friedhelm C. Hummel[1]

- Après AVC la fraction d'anisotropie est corrélée à l'index moteur compostite pour certains faisceaux cortico-corticaux:
  - M1-prémoteur, Prémoteur-Anterior IPS
  - Mais pas M1-Anterior IPS ni M1- posterior IPS ou Prémoteur -posterior IPS

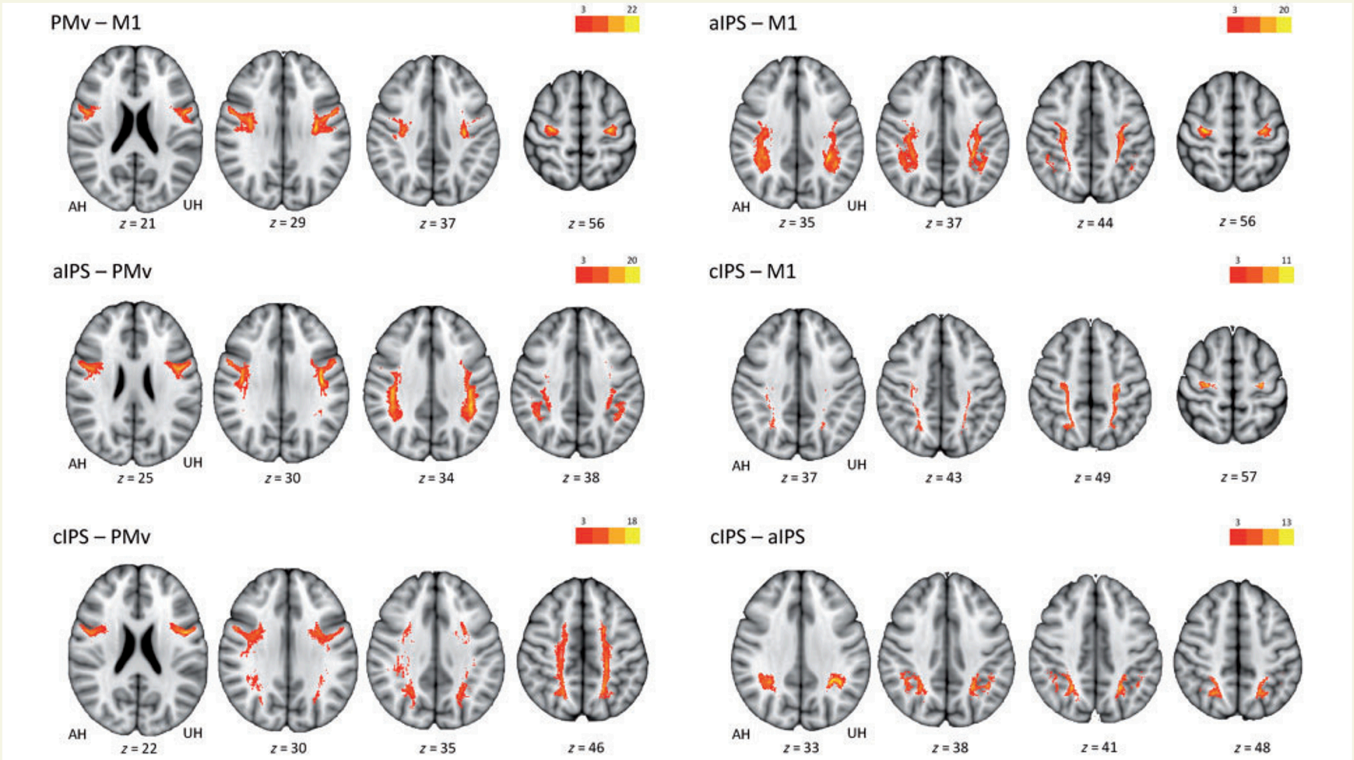


Figure 2 Trajectory variability map for connections of interest in chronic stroke patients. Probable corticocortical connections for the tracts of interest are overlaid on T_1 template in MNI standard space on axial slices with z-values given. Colour bar indicates the number of subjects in which voxels are considered part of the tracts of interest. Note that individual subject-specific binarized tracts of interest were used to calculate tract-related fractional anisotropy and not the group average (for illustration only). Tracts in subjects with left-sided lesions were flipped over the mid-sagital plane. UH = unaffected hemisphere; AH = affected hemisphere; aIPS = anterior IPS; cIPS = caudal IPS; PMv = premotor cortex.

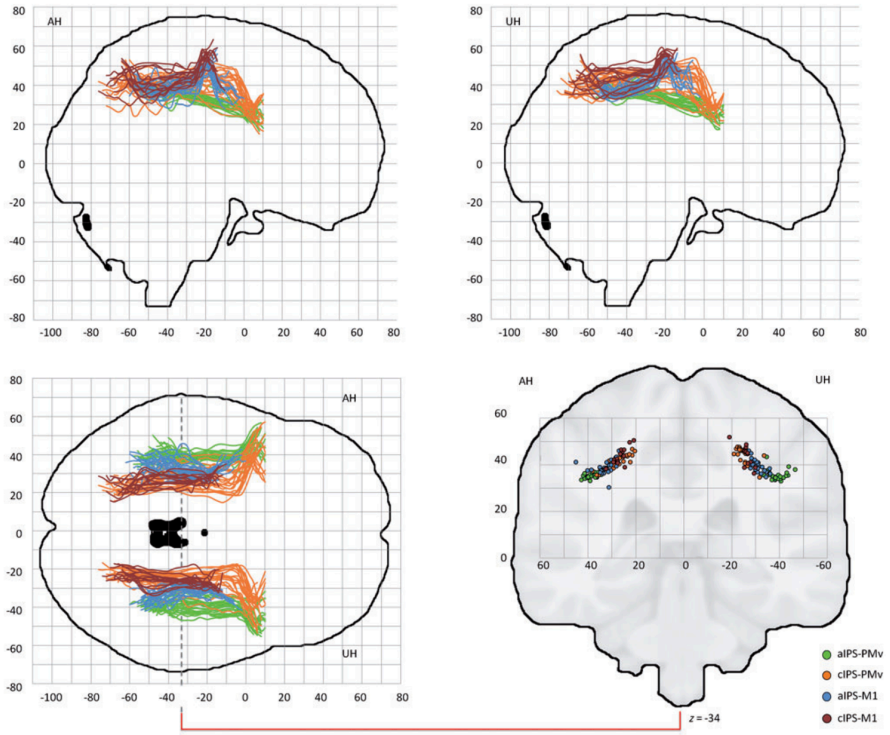


Figure 3 Centre of gravity analysis of parietofrontal connections in chronic stroke patients. Tract-related centres of gravity were calculated for each subject and each tract and threshold from $y = -90$ to $y = 10$ in steps of 2mm. For the final coordinate, centres of gravity were averaged across the thresholds. Notably, only those *y*-values were presented in which more than two thresholds contributed to the final coordinate. The centre of gravity distribution is shown on sagital slices individually for the affected (AH) and unaffected (UH) hemisphere, on one horizontal slice and one coronar slice at $y = -34$ in MNI standard space. Table 2 provides statistics on the centre of gravity analysis at the coronar level. Please note that the caudal course from M1 from $y = -20$ towards higher *y*-values is caused by individual variability of fibres trajectories. aIPS = anterior IPS; cIPS = caudal IPS; PMv = premotor cortex.

23

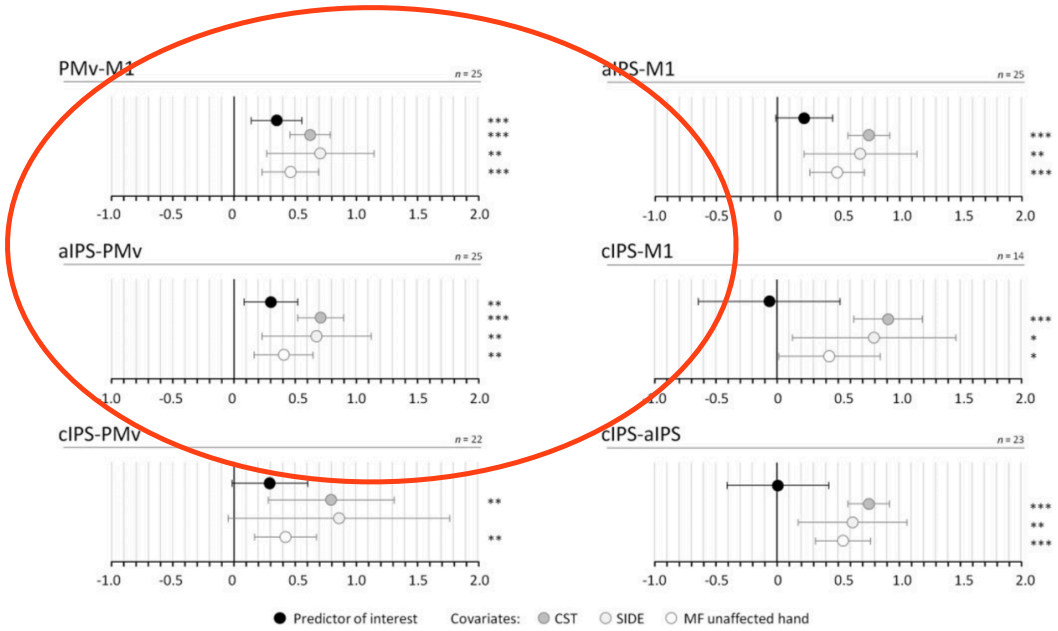


Figure 4 Tract-related white matter integrity of parietofrontal connections and motor function after stroke. Forest plots of the Beta values (± 95% confidence intervals) illustrate the statistical influence of proportional fractional anisotropy values for each tract of interest for residual motor function after stroke. Applying individual generalized linear models, the influence of each tract was adjusted for three covariates: white matter integrity (proportional fractional anisotropy values) of the corticospinal tract (CST), the affected side (SIDE, dominant versus non-dominant hemisphere) and the motor function (MF) of the unaffected hand. aIPS = anterior IPS; cIPS = caudal IPS; PMv = premotor cortex. ***$P < 0.001$; **$P < 0.01$; *$P < 0.05$.

EXISTE-T-IL UN LIEN ENTRE EXCITABILITÉ CORTICO-SPINALE ET PRONOSTIC

Parametres électrophysiologiques et prédiction de l'état moteur

Systematic Review for the Early Prediction of Motor and Functional Outcome After Stroke by Using Motor-Evoked Potentials

Henk T. Hendricks, MD, Machiel J. Zwarts, MD, PhD, Erik F. Plat, MD, Jacques van Limbeek, MD, PhD

Arch Phys Med Rehabil Vol 83, September 2002

Table 3: The Prognostic Value and Clinical Significance of MEPs

Study	Outcome Parameter (Patient No.)	Contingency Tables			Test Properties: Sensitivity	Test Properties: Specificity	Fisher Exact Test	OR (CI)
Hendricks et al[16]	Recovery from paralysis UE (29)		MR+	MR−	71% (38–100)	99% (97–100)	.0002	—
		MEPs +	5	0				
		MEPs −	2	22				
Escudero et al[6]	Recovery from paresis UE MRC score 0–1 (24)				62% (28–95)	99% (97–100)	.0013	—
		MEPs +	5	10				
		MEPs −	3	16				
	Recovery from paresis UE MRC score 2–3 (19)				93% (82–100)	2% (0–22)	.9231	—
		MEPs +	16	2				
		MEPs −	1	0				
Palliyath[19]	Recovery from paresis UE MRC score 1–4 (29)				94% (83–100)	99% (95–100)	.0000	—
		MEPs +	17	0				
		MEPs −	1	11				
Heald et al[7]	Full recovery pinch grip (76)				92% (84–100)	48% (32–65)	.0000	11.96 (3.10–46.12)
		MEPs +	38	18				
		MEPs −	3	17				
	Full recovery arm paresis (76)				92% (83–100)	44% (28–60)	.0002	9.44 (2.47–36.11)
		MEPs +	35	21				
		MEPs −	3	17				
	Full recovery leg paresis (76)				89% (80–98)	50% (32–67)	.0001	8.20 (2.53–26.48)
		MEPs +	41	15				
		MEPs −	5	15				
Functional Recovery								
Heald et al[7]	BI score ≥12 (118)		FR +	FR −	79% (69–89)	58% (30–86)	.0000	5.49 (1.49–20.13)
		MEPs +	51	5				
		MEPs −	13	7				
Escudero et al[6]	BI score ≥12 (50)				77% (63–91)	80% (59–100)	.0000	13.50 (3.03–69.96)
		MEPs +	27	3				
		MEPs −	8	12				

Abbreviations: CI, confidence interval; MR, motor recovery; FR, functional recovery.

Et la rTMS

- Effet de « théta burst » 10 salves de stimulation à haute fréquence (3 impulsions à 50 Hz) appliquées à 5 Hz toutes les 10 s, pour un total de 600 impulsions
- Mesure avant et après de : RMT (rest motor threshold), AMT (active motor threshold = cc isométrique du muscle), MEP amplitude at 120% RMT
- En plus étude fine de l'excitabilité par SICI (short-interval intracortical inhibition) qui mesure l'inhibition par une stim conditionnante (2 et 3ms d'intervalle)

Cerebral Cortex July 2010;20:1523-1528
doi:10.1093/cercor/bhp216
Advance Access publication October 5, 2009

Motor Cortex Plasticity Predicts Recovery in Acute Stroke

Vincenzo Di Lazzaro[1], P. Profice[1], F. Pilato[1], F. Capone[1], F. Ranieri[1], P. Pasqualetti[2,3], C. Colosimo[4], E. Pravatà[4], A. Cianfoni[5] and M. Dileone[1]

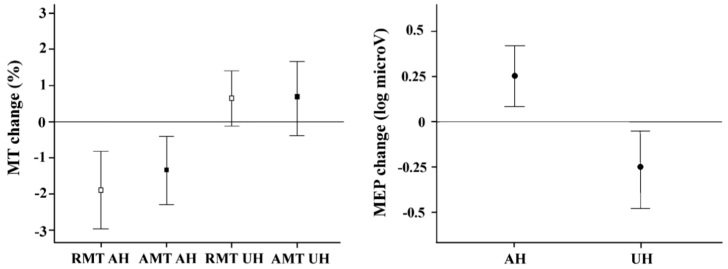


Figure 1. Effects of iTBS on the RMT and AMT (left panel) and on the MEP amplitudes (right panel). The means and 95% CIs (corrected for multiple comparisons) of the after–before differences are represented. When CIs did not cross the 0 reference line, iTBS induced significant changes. Motor thresholds of the UH did not increase significantly per se but increased significantly when compared with the decrease observed in the AH.

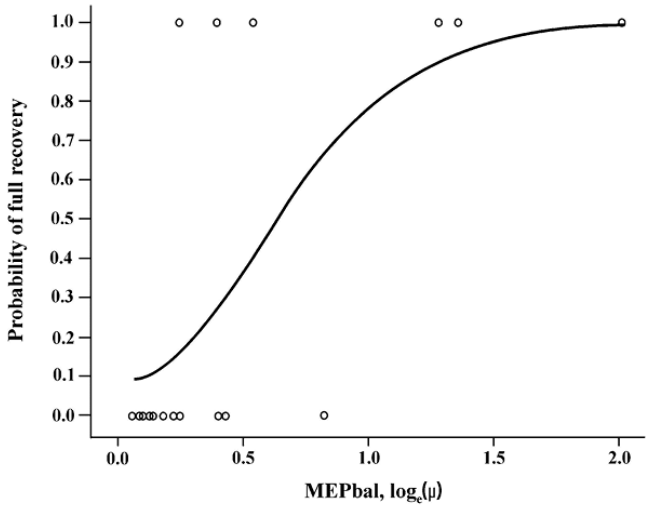


Figure 2. Observed values (open circles) indicating full recovery ($y = 1$) or partial/absent recovery ($y = 0$) against MEPbal. The continuous line represents the estimated logistic curve between the predicted probability of full recovery and the MEPbal values.

Table 3
Bivariate ordinal correlation between clinical status at 6 months and demographic, clinical, and neurophysiological parameters

	mRS (6 months)	
	Spearman's ρ	*P* value
Age (y)	−0.185	0.476
NIHSS at baseline	**0.483**	**0.049**
ASPECTS	−0.031	0.907
Lesion volume	−0.025	0.923
RMT for AH at baseline	−0.122	0.642
AMT for AH at baseline	0.233	0.367
RMT for UH at baseline	−0.193	0.458
AMT for UH at baseline	−0.136	0.602
MEP for AH at baseline	0.230	0.374
MEP for UH at baseline	**0.672**	**0.003**
RMT for AH change after iTBS	0.186	0.474
AMT for AH change after iTBS	−0.123	0.639
MEP for AH change after iTBS	**−0.595**	**0.012**
RMT for UH change after iTBS	0.061	0.817
AMT for UH change after iTBS	0.176	0.500
MEP for UH change after iTBS	0.159	0.543
RMT bal	−0.190	0.465
AMT bal	0.298	0.246
MEP bal	**−0.618**	**0.008**

Note: Significant values ($P<0.05$) are reported in bold.

L'importance de la réduction de l'asymétrie de l'amplitude des MEPs (MEPbal) par rTMS est corrélée au pronostic fonctionnel (modified Rankin Score)

EXISTE-T-IL UN LIEN ENTRE DEFICIENCE MOTRICE ET PRONOSTIC

Katrack 1998

- 71 AVC suivis
  3 mois

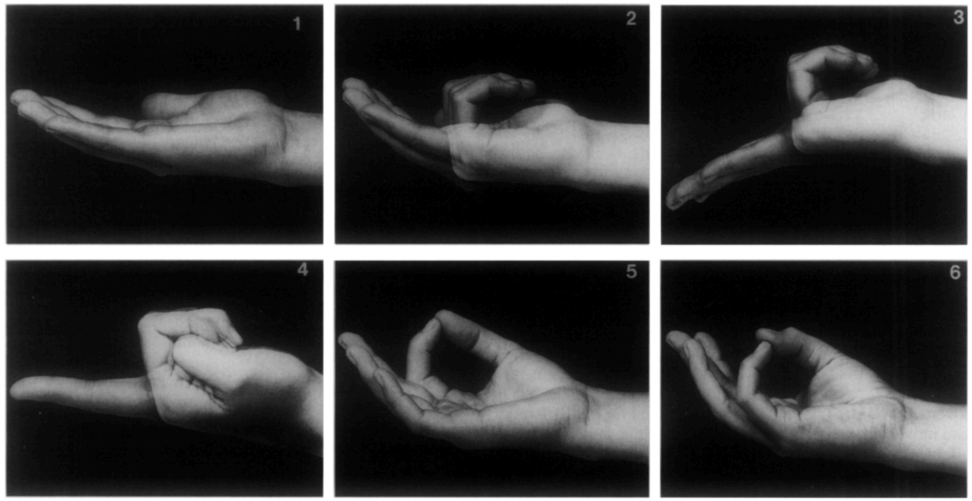


Fig 1. Hand movement scale (1 to 6).

Table 1: Hand Movement Scale

1	No active movement in digits
2	Active flexion of all fingers in synergy only
3	Active flexion and extension of all fingers in synergy
4	Ability to extend the index finger while maintaining the other fingers in flexion
5	Ability to bring the thumb into opposition to the tip of the index finger only
6	Ability to oppose thumb to all fingertips

Katrack 1998

Table 4: Initial Shoulder Shrug as a Predictor of "Good" Hand Movement

Time After Stroke	Odds Ratio (95% Confidence Interval)	*p*	R^2
1mo (n = 51)	7.3 (1.8-30.7)	.006	.143
2mo (n = 40)	7.0 (1.3-37.7)	.024	.125
3mo (n = 37)	6.0 (1.4-25.6)	.015	.129

Table 5: Initial Shoulder Abduction as a Predictor of "Good" Hand Movement

Time After Stroke	Odds Ratio (95% Confidence Interval)	*p*	R^2
1mo (n = 51)	7.5 (1.3-44.3)	.026	.088
2mo* (n = 40)	3.3 (0.65-22.5)	.228	.029
3mo* (n = 37)	1.4 (0.2-10.8)	.773	.007

* Not significant.

Table 7: Initial Shoulder Shrug as a Predictor of Hand Function

Time After Stroke	Odds Ratio (95% Confidence Interval)	*p*	R^2
1mo (n = 47)	13.8 (2.6-73.4)	.002	.227
2mo (n = 36)	5.3 (1.1-24.5)	.033	.107
3mo (n = 31)	11.3 (2.0-45.3)	.006	.220

Table 8: Initial Shoulder Abduction as a Predictor of Hand Function

Time After Stroke	Odds Ratio (95% Confidence Interval)	*p*	R^2
1mo (n = 47)	17.8 (1.8-172.2)	.013	.152
2mo (n = 36)	11.7 (1.2-114.6)	.035	.126
3mo* (n = 31)	3.6 (0.3-44.8)	.320	.026

* Not significant.

Fonction: 4 gestes type saisie d'objets et déplacements

Autres études

- Nijland et al 2010: cohorte 150 sujets: si abduction épaule + extension volontaire des doigts dans les 72h: 98% de récupération d'une forme de dextérité manuelle dans les 6 mois
- Mais *Stinear 2010 Lancet*

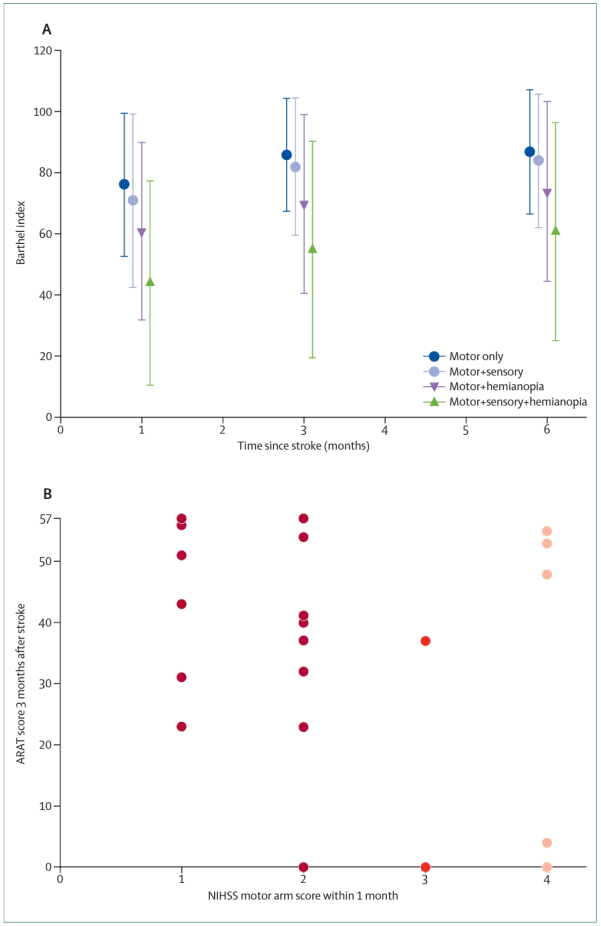


Figure 1: **Relation between initial impairment after stroke and subsequent recovery of function**
The relation is robust when determined in groups of patients, but accurate prognosis for individual patients remains difficult because of between-individual variability. (A) Motor, somatosensory, and visual impairments were documented in 360 patients 14 days after stroke.[4] The predictive power of impairments in these domains for recovery of independence in activities of daily living at 1, 3, and 6 months after stroke was assessed with the Barthel index (mean, SD). The total number of points in the index is 100, but 120 points are shown on the Y-axis for accurate representation of the SD values. Motor impairment was the strongest predictor ($p<0{\cdot}001$), but all features had significant predictive values ($p<0{\cdot}03$). Substantial overlap in scores means, however, that recovery cannot be predicted for individual patients. (B) Upper-limb motor function was assessed in 28 patients at 3 months after stroke with the ARAT.[5] Initial impairment (within 1 month) was assessed with the NIHSS motor arm score by asking patients to hold their paretic arm straight out in front of them for 10 s (1=able to maintain 90° shoulder flexion, but downward drift within 10 s; 2=patient cannot achieve or maintain the position, but there is some effort against gravity; 3=no effort against gravity; 4=no movement). Each data point represents an individual patient (some scores are occupied by multiple data points), and those who initially scored 2 could subsequently achieve any ARAT score—ie, no upper-limb function, complete recovery of function, or anywhere in between. ARAT=action research arm test. NIHSS=National Institutes of Health stroke scale.

Rémy-Néris 2023

LES MODÈLES PREDICTIFS

Prediction of recovery of motor function after stroke

Cathy Stinear

Lancet Neurol 2010; 9: 1228–32

Background Stroke is a leading cause of disability. The ability to live independently after stroke depend

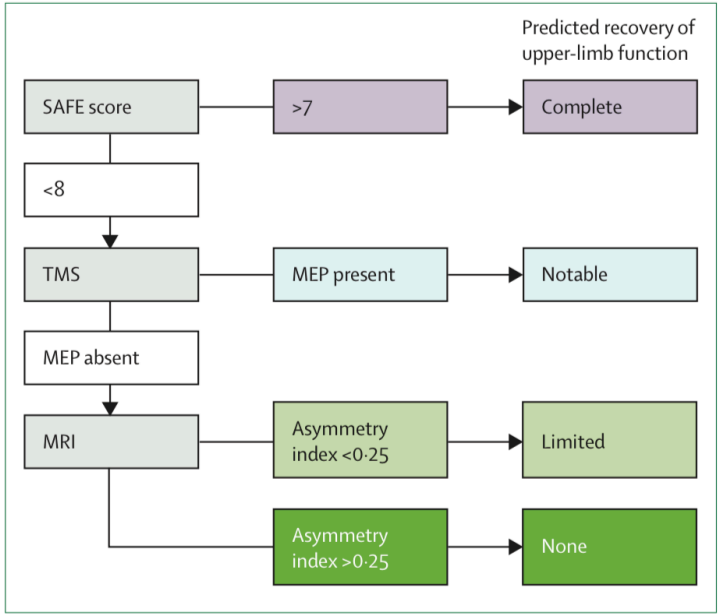


***Figure 2*: Suggested sequence of tests to predict recovery of motor function in patients with subacute stroke**

Predicted recovery of upper-limb function refers to recovery in the weeks after stroke. Although this particular algorithm requires validation, it illustrates a potentially efficient progression from simple to more complex predictive measures, which might be a useful direction for future research. SAFE=sum of the shoulder abduction and finger extension Medical Research Council muscle grades 72 h after stroke. TMS=transcranial magnetic stimulation. MEP=motor evoked potentials in affected upper limb. Asymmetry index=asymmetry index of fractional anisotropy in the posterior limbs of the internal capsules measured with diffusion-weighted MRI.[35]

doi:10.1093/brain/aws146 Brain 2012: 135; 2527–2535 | 2527

BRAIN
A JOURNAL OF NEUROLOGY

The PREP algorithm predicts potential for upper limb recovery after stroke

Cathy M. Stinear,[1,2] P. Alan Barber,[1,2,3] Matthew Petoe,[1,2] Samir Anwar[2,4] and Winston D. Byblow[2,5]

- Population 40 AVC aigue suivis jusqu'à la fin de la phase subaigue
- Critère principal: ARAT à 12 semaines en sachant que l'ARAT est mesuré à 2,6,12 et 26 semaines
- Analyse de la prédiction de l'algorithme sur ARAT à S12 en groupes de sévérité à partir d'une analyse en clusters (combien de clusters faut il pour « bien » discriminer les groupes)

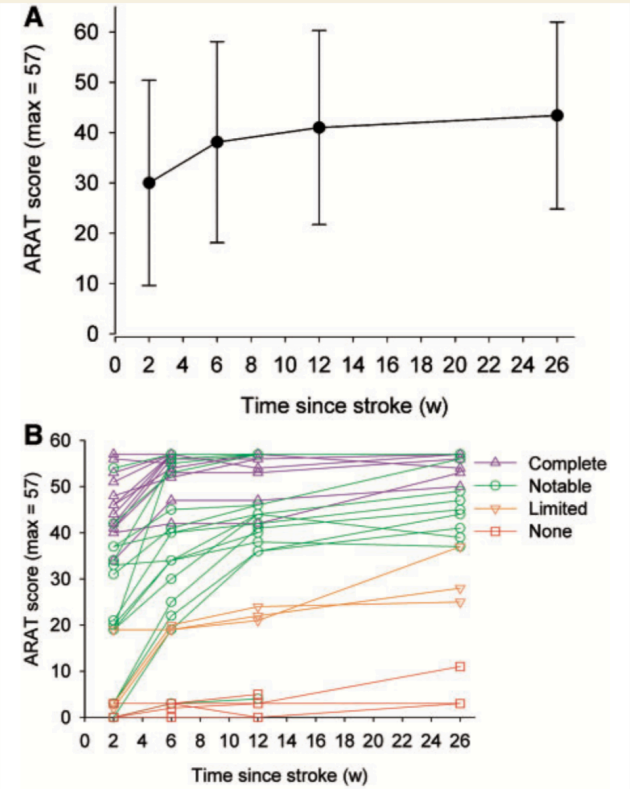
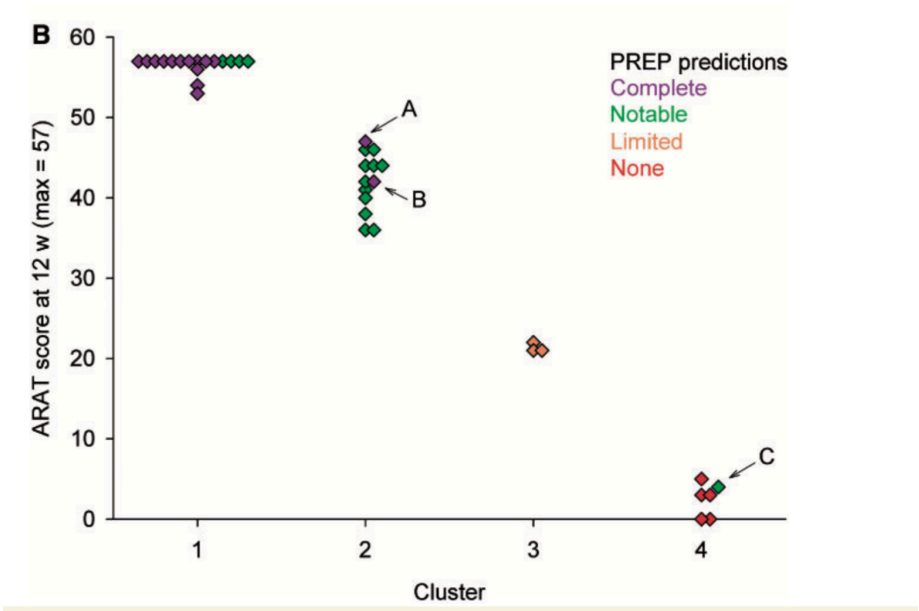


Figure 3 Recovery of upper limb function, measured with the ARAT scale. (**A**) Mean ARAT score (error bars = SD). As a group, patients exhibited a significant improvement in upper limb function ($P < 0.0001$). The ARAT score at 6, 12 and 26 weeks was higher than at 2 weeks (all $P < 0.001$). However, there is marked interindividual variability. (**B**) ARAT score for each patient, stratified according to the PREP algorithm. The algorithm predicts four distinct levels of potential for recovery 12 weeks after stroke, depending on a combination of baseline measures. Note that patients with 'notable', 'limited' and 'none' predicted recovery can initially have similar, minimal levels of upper limb function 2 weeks after stroke.

Brain 2012: 135; 2527–2535

L'analyse en 4 clusters décrit le mieux la population en s'assurant que la médiane de l'ARAT de chaque groupe à S12 ≥ 12 (MCID)

Brain 2012: 135; 2527–2535



Pour une récupération complète la prédiction positive est de 88% (14 /16) et la prédiction négative est de 83% (20/24)

Vérification

Predicting Recovery Potential for Individual Stroke Patients Increases Rehabilitation Efficiency

Cathy M. Stinear, PhD; Winston D. Byblow, PhD; Suzanne J. Ackerley, PhD;
P. Alan Barber, PhD; Marie-Claire Smith, BHSc

(*Stroke*. 2017;48:1011-1019. DOI: 10.1161/STROKEAHA.116.015790.)

- Prédiction de l'ARAT à 3 mois correcte pour 80%
- Modification de l'attitude thérapeutique des thérapeutes
- Réduction de la durée d'hospitalisation (7j)

Simultanément

Proportional Motor Recovery After Stroke
Implications for Trial Design

Cathy M. Stinear, PhD; Winston D. Byblow, PhD; Suzanne J. Ackerley, PhD;
Marie-Claire Smith, BHSc; Victor M. Borges, PhD; P. Alan Barber, PhD, FRACP

Stroke. 2017;48:795-798. DOI: 10.1161/STROKEAHA.116.016020.)

- Sur 157 AVC suivis à 3 mois
- Pour les sujets qui ont un MEP+: 63% de récupération proportionnel à leur déficit moteur à J3
- Pour les sujets MEP- pas de récupération proportionnelle
- Pour les sujets MEP+: pas de dépendance de la dose de rééducation

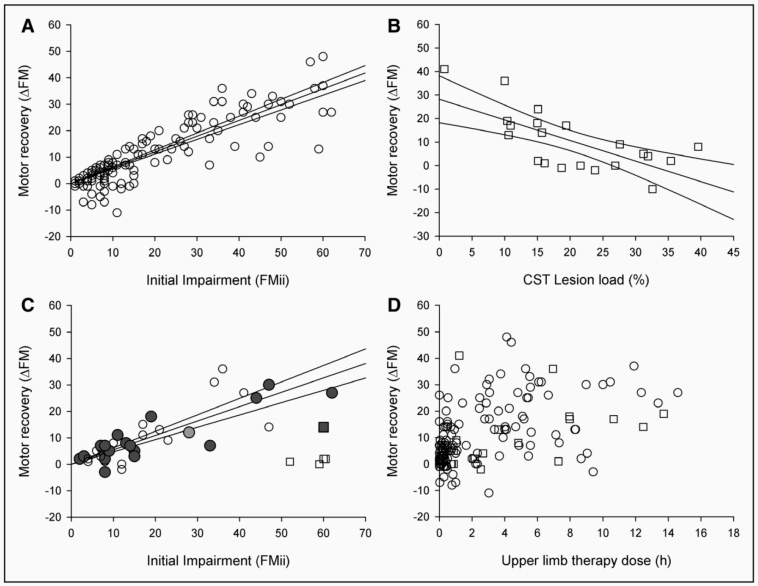


Figure. A, Motor evoked potential positive (MEP+) patients exhibit recovery from motor impairment (Δ Fugl–Meyer [FM]) that is proportional to initial impairment (FMii). **B**, MEP- patients exhibit poor recovery that is not proportional to initial impairment and instead related to corticospinal tract (CST) lesion load. **C**, In patients with hemorrhagic and/or previous stroke, recovery from motor impairment is proportional to initial impairment in MEP+ patients (● and ○), but not MEP– patients (■ and □). Dark gray indicates hemorrhagic stroke; light gray, hemorrhagic and previous stroke; and open symbols, previous stroke. **D**, Recovery from motor impairment is not related to upper-limb therapy dose in patients who are MEP+ (○) or MEP– (□). Regression lines are provided with 95% confidence intervals.

Mais

Accuracy of the Upper Limb Prediction Algorithm PREP2 Applied 2 Weeks Poststroke: A Prospective Longitudinal Study

Neurorehabilitation and Neural Repair
2021, Vol. 35(1) 68–78

DOI: 10.1177/1545968320971763
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Camilla Biering Lundquist, MSc, PT[1], Jørgen Feldbæk Nielsen, MDsc, MD[1], Federico Gabriel Arguissain, PhD[1,2], and Iris Charlotte Brunner, PhD, PT[1,3]

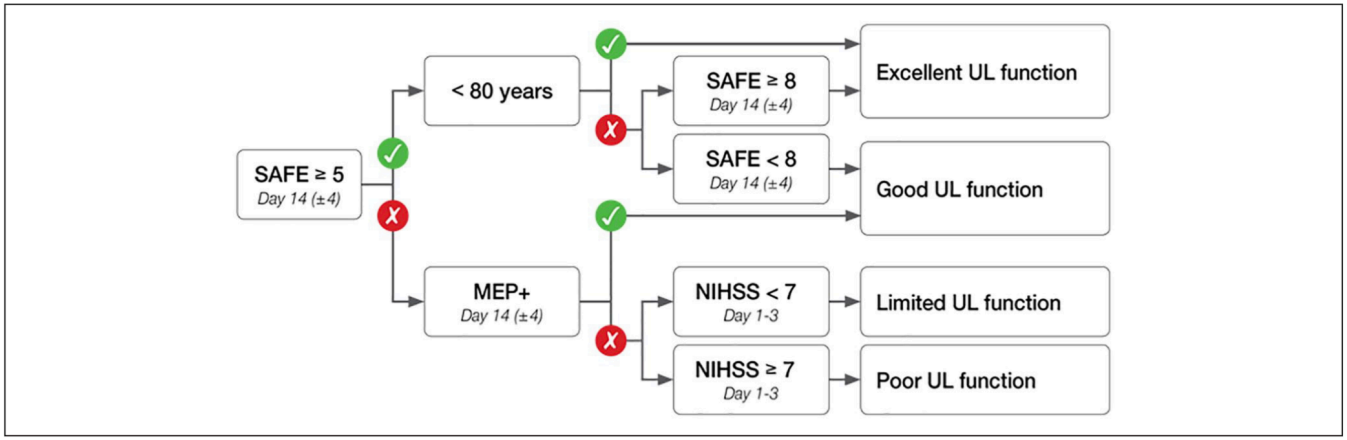

Figure 1. The Predict Recovery Potential algorithm performed 2 weeks poststroke: SAFE, Shoulder Abduction and Finger Extension; <80 y, less than 80 years old; MEP+, motor-evoked potentials present; NIHSS, National Institutes of Health Stroke Scale. Excellent: Potential to make a complete or near complete recovery of hand and arm function within 3 months. Good: Potential to use their affected hand and arm for most activities of daily living within 3 months. Limited: Potential to regain some movement in their hand and arm within 3 months. Poor: Unlikely to regain useful movement in their hand and arm within 3 months.

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Cofemer

Accuracy of the Upper Limb Prediction Algorithm PREP2 Applied 2 Weeks Poststroke: A Prospective Longitudinal Study

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Camilla Biering Lundquist, MSc, PT[1], Jørgen Feldbæk Nielsen, MDsc, MD[1], Federico Gabriel Arguissain, PhD[1,2], and Iris Charlotte Brunner, PhD, PT[1,3]

- PREP2 appliqué à 13,4 j post AVC
- 95 sujets
- MEP pour 38 dont 12 MEP-
- Augmentation moyenne de l'ARAT 17 points
- La classification correcte n'est que de 60%
- Pour les 28 mal classés, ils sont finalement dans un des groupes adjacents
- La meilleure prédiction (78%) est pour le groupe 4 (récupération mauvaise)

Au total

- Des prédictions possibles et « assez » bonnes
- Mais
  - Pas de disponibilité des MEPs partout (examen non coté en France)
  - Ne semble pas disponible avec la même précision à toutes les périodes de prise en charge
  - Pas d'idée pour prise en charge plus tardive
  - Structurer l'évaluation des AVC assez tôt semble un enjeu futur important pour informer les équipes de prise en charge.

ET POUR LA MARCHE?

43

Is Accurate Prediction of Gait in Nonambulatory Stroke Patients Possible Within 72 Hours Poststroke? The EPOS Study

Neurorehabilitation and Neural Repair
25(3) 268–274

DOI: 10.1177/1545968310384271
http://nnr.sagepub.com
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J. M. Veerbeek, MSc[1], E. E. H. Van Wegen, PhD[1], B. C. Harmeling–Van der Wel, PT[2], and G. Kwakkel, PhD[1], for the EPOS Investigators

Position assise tenue>30s et motricity index du membre inférieur ≥ 25 à J3 prédit une récupération de la marche FAC≥4 à 98%

Table 3. Probabilities of Achieving Independent Gait Six Months Post Stroke (N = 154)

			FAC ≥4 at 6 Months				
Determinants	TCT-s	MI leg	True Negatives, n	False Negatives, n	False Positives, n	True Positives, n	*p*
Cutoff	25	≥25					
Model <72 hours			$P = 1/(1 + (\exp^{(-0.982 + 2.691 * \text{TCT-s} + 2.083 * \text{MI leg})}))$				
	+	+	24	9	8	112	.98
	+	−					.85
	−	+					.75
	−	−					.27
Model day 5			$P = 1/(1 + (\exp^{(-1.236 + 2.815 * \text{TCT-s} + 1.609 * *\text{MI leg})}))$				
	+	+	20	7	12	115	.96
	+	−					.83
	−	+					.59
	−	−					.23
Model day 9			$P = 1/(1 + (\exp^{(-2.226 + 3.629 * \text{TCT-s} + 1.854 * \text{MI leg})}))$				
	+	+	24	5	8	117	.96
	+	−					.80
	−	+					.40
	−	−					.10

Abbreviations: FAC, Functional Ambulation Categories; TCT-s, Trunk Control Test sitting balance; MI leg, Motricity Index, lower extremity.

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Step Number and Aerobic Minute Exercise Prescription and Progression in Stroke: A Roadmap

Neurorehabilitation and Neural Repair
2022, Vol. 36(2) 97–102


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Mais aussi

Sue Peters, PhD[1], Tara Klassen, PhD[2,3], Amy Schneeberg, PhD[2], Sean Dukelow, MD, PhD[4], Mark Bayley, MD[5], Michael Hill, MD[4], Sepideh Pooyania, MD[6], Jennifer Yao, MD[7], and Janice Eng, PhD[2,3]

Table 3. Targets for future studies to cross-validate.

*Baseline walking speed (m/s)**	*Session 1 Steps**	*Session 5 Steps**	*Session 10 Steps**	*Session 15 Steps**	*Session 20 Steps**
A: Baseline walking speed (m/s)					
0.2	701	994	1359	1725	2091
0.4	1305	1598	1964	2330	2696
0.6	1910	2203	2569	2935	3301
0.8	2515	2808	3174	3539	3905
1.0	3120	3412	3778	4144	4510
1.2	3724	4017	4383	4749	5115
B. Age (years)					
40	27	29	32	34	37
45	25	27	30	32	35
50	23	25	28	30	33
55	21	23	26	28	31
60	19	21	24	27	29
65	17	19	22	25	27
70	15	17	20	23	25

*Based on equation in Table 1A.
† Based on equation in Table 1B.

Conclusion

- Les modèles prédictifs sont encore partiels et ne permettent pas de répondre à tous les besoins.
- Ils commencent à permettre de prévoir tant l'issue de la récupération que la dose de travail à réaliser.
- La constitution de grosses bases de données internationales est un enjeu important pour rendre compte de la diversité des situations tant des patients que du moment de leur prise en charge ou des moyens attribuables.