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UCLouvain

Thierry Lejeune

EBM dans la rééducation de la locomotion
Accident Vasculaire Cérébral

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Article de synthèse

Acta Neurologica Belgica
https://doi.org/10.1007/s13760-020-01320-7

REVIEW ARTICLE

Gait rehabilitation after stroke: review of the evidence of predictors, clinical outcomes and timing for interventions

Clara Selves[1,2] · Gaëtan Stoquart[1,2] · Thierry Lejeune[1,2]

Stroke 2022

TOPICAL REVIEW

Section Editors: Julie Bernhardt, PhD, and Pam Duncan, PhD

Walk the Talk: Current Evidence for Walking Recovery After Stroke, Future Pathways and a Mission for Research and Clinical Practice

Sarah A. Moore, PhD; Pierce Boyne, PhD; George Fulk, PhD; Geert Verheyden, PhD; Natalie A. Fini, PhD

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Plan

- Introduction
- Recommandations de bonne pratique
- Pronostic
- Rééducation de la marche: principes généraux
- Rééducation de la marche: méthodes spécifiques
- Conclusion

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Introduction: Définition

Locomotion

« Fonction des êtres vivants, et principalement des animaux, par laquelle ils assurent activement le déplacement de leur organisme tout entier »

Larousse

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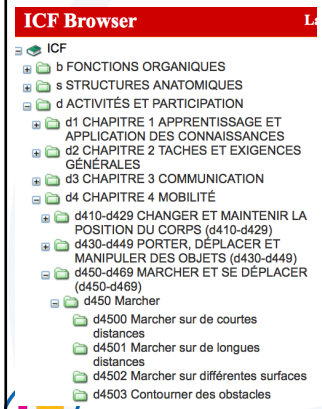
Introduction: Définition



Locomotion

http://apps.who.int/classifications/icfbrowser/

D4500
Avancer à pied, sur une distance de moins d'un kilomètre, comme marcher dans sa chambre ou dans le couloir, dans un bâtiment ou sur de courtes distances à l'extérieur.

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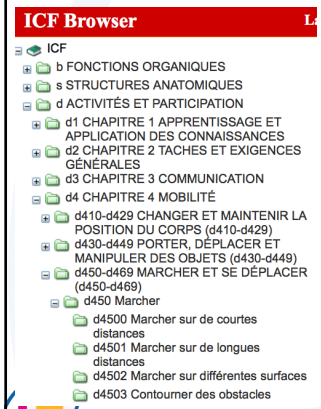
Introduction: Définition



Locomotion

Capacité = réaliser une tâche à un moment donné dans un contexte standardisé (clinique)

Performance = réaliser une tâche dans les conditions de vie réelle « écologique »

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Introduction: Contexte

Locomotion & AVC

80% des patients présentent des déficiences motrices

80% des patients présentent une incapacité de marche

30% des patients sont incapables de marcher > 3 mois

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Introduction: Contexte

Locomotion & AVC

= déterminant des limitations d'activité à long terme

= déterminant de la dépendance et des coûts soins de santé

= objectif principal en réadaptation

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Introduction: Contexte

Locomotion & AVC

TOPICS IN STROKE REHABILITATION
2021, VOL. 28, NO. 2, 153–158
https://doi.org/10.1080/10749357.2020.1789829

Taylor & Francis
Taylor & Francis Group

ARTICLE

OPEN ACCESS Check for updates

Stroke survivors' priorities for research related to life after stroke

Ann-Sofie Rudberg[a,b], Eivind Berge[c,d†], Ann-Charlotte Laska[e], Stina Jutterström[e], Per Näsman[f], Katharina S Sunnerhagen[g], and Erik Lundström[h]

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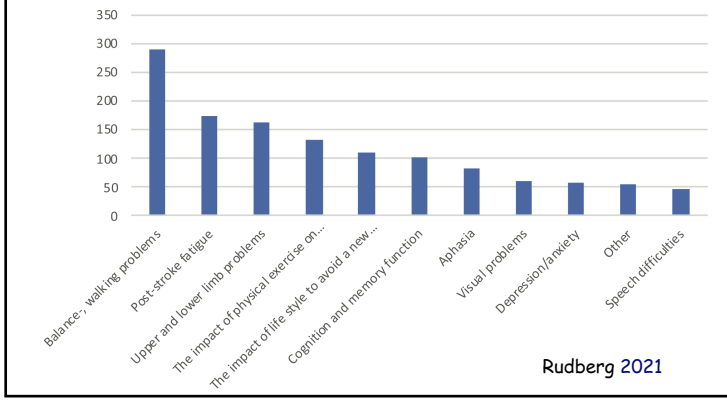
Introduction: Contexte

Locomotion & AVC



Rudberg 2021

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Introduction: EBM

AVC: délai, bilan fonctionnel

P atients
I ntervention
C omparaison
O utcome
T ime

Méthodes de rééducation

Que fait le groupe contrôle ?
Temps et intensité de thérapie

Quel résultat est évalué ?
- Indépendance à la marche
- Vitesse de marche
- Périmètre de marche
- Capacité vs Performance

Moment des interventions et évaluations

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Introduction: EBM

RCT

www.pedro.org.au
rehabilitation.cochrane.org

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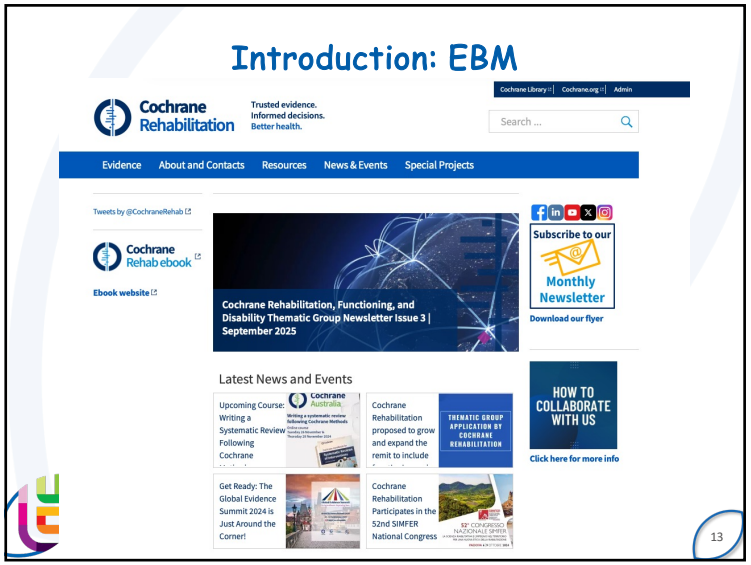
Introduction: EBM



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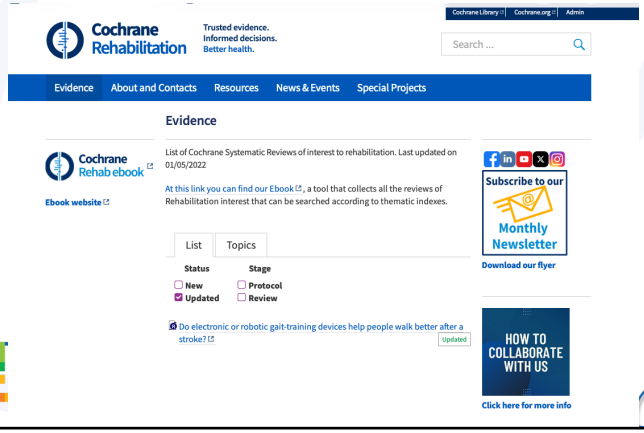
Introduction: EBM

https://rehabilitation.cochrane.org/evidence



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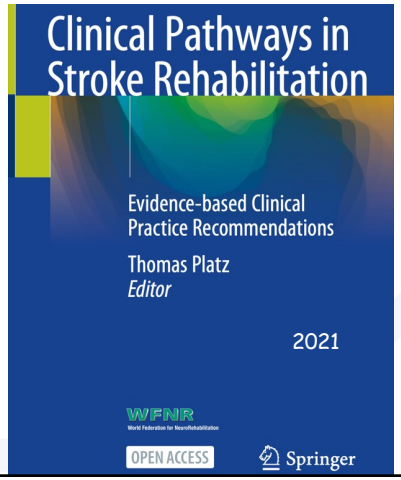
Introduction: EBM



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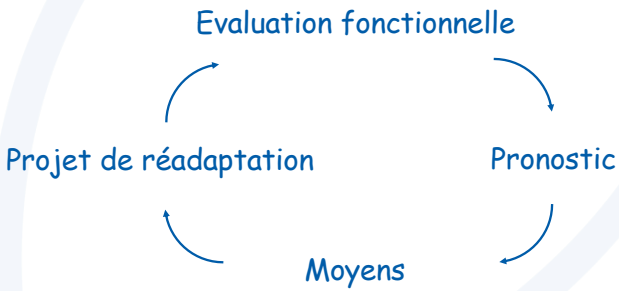
Introduction: Démarche



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Evaluation des capacités de marche

Domain ICF level		(H)AR	VR	LR	RC
Walking and walking-related functions and activities					
Functions:					
MI for lower extremity	muscle strength	●	●	●	●
10MWT comfortable (FAC ≥ 3)	walking speed	●	●	●	●
FMA for lower extremity	selective movements	●	●	●	●
10MWT maximum (FAC ≥ 3)	walking speed	●	●	●	●
6MWT (whether or not combined with Borg RPE) (FAC ≥ 3)	walking distance, functional endurance	●	●	●	●
Activities:					
TCT	trunk activity	●	●	●	●
BBS	sitting and standing balance	●	●	●	●
FAC	walking ability	●	●	●	●
TIS	sitting balance	●	●	●	●
TUG (FAC ≥ 3)	walking ability	●	●	●	●

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Evaluation des capacités de marche

RÉCUPÉRATION MOTRICE ET FONCTIONNELLE APRÈS UN AVC: MESURER, C'EST SAVOIR, CAR DEVINER, C'EST SE TROMPER

Geert Verheyden
PhD
Professeur de revalidation neurologique, KU Leuven

2021

L'applicabilité et la pertinence des instruments pour la pratique clinique sont abordées plus en détail sur la base de modèles prédictifs, dans lesquels les informations recueillies au cours des deux premières semaines ou lors de l'admission au centre de revalidation donnent des indications claires quant à la récupération de la fonction du membre supérieur touché et à la capacité/l'incapacité à marcher ou à exécuter des tâches simples du quotidien de manière autonome 3 ou 6 mois après l'AVC ou à la sortie du centre de revalidation. Bien que les modèles prédictifs ne soient qu'indicatifs et n'aient généralement pas fait l'objet d'une validation croisée dans un nouveau cadre international, cela démontre l'exploitabilité de différents instruments de mesure et la pertinence de leur utilisation à des moments convenus. De cette manière, la revalidation motrice et fonctionnelle peut être adaptée au patient, des indications relatives à la récupération peuvent être données à un stade précoce au patient et à sa famille, et les perspectives d'avenir du patient peuvent être évoquées de manière raisonnable dans le cadre d'une concertation interdisciplinaire.

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Evaluation des capacités de marche

frontiers in Neurology

ORIGINAL RESEARCH
published: 02 September 2020
doi: 10.3389/fneur.2020.00875

Consensus-Based Core Set of Outcome Measures for Clinical Motor Rehabilitation After Stroke—A Delphi Study

Johannes Pohl[1,2], Jeremia Philipp Oskar Held[1], Geert Verheyden[2], Margit Alt Murphy[3], Stefan Engelter[4,5], Agnes Flöel[6,7], Thierry Keller[8], Gert Kwakkel[9,10], Tobias Nef[11,12], Nick Ward[13,14], Andreas Rüdiger Luft[1,15] and Janne Marieke Veerbeek[1]**

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Evaluation des capacités de marche

TABLE 2 | Core set of outcome measures for clinical motor rehabilitation after stroke.

	Body functions	Activities	Participation
Upper extremity	FMA	ARAT	SIS
Lower extremity	FMMA & 10MWT	TUG & BBS	SIS
ADL/ stroke-specific	NIHSS	BI/ FIM	SIS

**Measure only required for patients with a Functional Ambulation Categories score of ≥3/5.*

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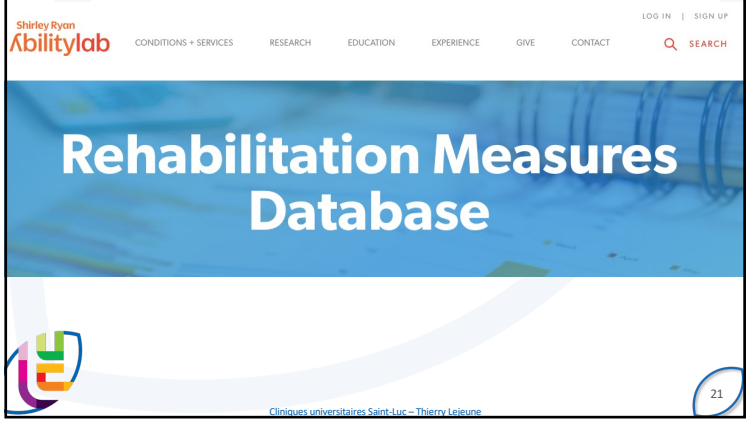
Evaluation des capacités de marche

www.sralab.org/rehabilitation-measures



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Sources Principales: AHA/ASA

AHA/ASA Guideline

Guidelines for Adult Stroke Rehabilitation and Recovery
A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association

Endorsed by the American Academy of Physical Medicine and Rehabilitation and the American Society of Neurorehabilitation

Carolee J. Winstein and coll. ***Stroke*** **June 2016**

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Sources Principales: AHA/ASA

	CLASS I *Benefit >>> Risk* Procedure/Treatment **SHOULD** be performed/ administered	CLASS IIa *Benefit >> Risk* *Additional studies with focused objectives needed* **IT IS REASONABLE** to perform procedure/administer treatment	CLASS IIb *Benefit ≥ Risk* *Additional studies with broad objectives needed; additional registry data would be helpful* Procedure/Treatment **MAY BE CONSIDERED**
LEVEL A Multiple populations evaluated* Data derived from multiple randomized clinical trials or meta-analyses	■ Recommendation that procedure or treatment is useful/effective ■ Sufficient evidence from multiple randomized trials or meta-analyses	■ Recommendation in favor of treatment or procedure being useful/effective ■ Some conflicting evidence from multiple randomized trials or meta-analyses	■ Recommendation's usefulness/efficacy less well established ■ Greater conflicting evidence from multiple randomized trials or meta-analyses

Carolee J. Winstein and coll. ***Stroke*** **June 2016**

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Sources Principales: AHA/ASA

Table 2. Definition of Classes and Levels of Evidence Used in AHA/ASA Recommendations

Class I	Conditions for which there is evidence for and/or general agreement that the procedure or treatment is useful and effective
Class II	Conditions for which there is conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of a procedure or treatment
Class IIa	The weight of evidence or opinion is in favor of the procedure or treatment
Class IIb	Usefulness/efficacy is less well established by evidence or opinion

Carolee J. Winstein and coll. *Stroke* June 2016

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Sources Principales: KNGF

de Fysiotherapeut
Royal Dutch Society for Physical Therapy

KNGF Guideline

Stroke

Veerbeek and coll.

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Sources Principales: KNGF

Figure 1. Timeline (non-linear) showing the various phases after a stroke.

Veerbeek and coll.

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Sources Principales: KNGF

- outcome measure(s) at the body function level and at the activities and participation levels of the ICF;
- outcome measure(s) at the body function level of the ICF;
- outcome measure(s) at the activities and participation levels of the ICF;

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Sources Principales: KNGF

✓ phase for which the intervention was studied (with favorable effect);

× phase for which the intervention was studied (with adverse effect);

= phase for which the intervention was studied (no added value / added value unclear).

Tabel 2. Categorization of research findings according to level of evidence for interventional studies.

A1	Systematic reviews based on at least a few RCTs of A2 level, with consistent findings across individual studies.
A2	RCTs of sound methodological quality and sufficient size and consistency (PEDRO scores of 4 points or more).
B	RCTs of lower methodological quality and quasi-experimental studies (PEDRO scores of 3 points or less).
C	Non-comparative studies; pre-experimental studies.
D	Not supported by research studies. Expert opinion.

Veerbeek and coll.

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Sources plus récentes

Cochrane Library

Cochrane Database of Systematic Reviews

Cochrane Database of Systematic Reviews 2025

Physical rehabilitation approaches for the recovery of function and mobility following stroke (Review)

Todhunter-Brown A, Sellers CE, Baer GD, Choo PL, Cowie J, Cheyne JD, Langhorne P, Brown J, Morris J, Campbell P

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Plan

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Pronostic capacité de marche

Predicting activities after stroke: what is clinically relevant?

G. Kwakkel[1,2,3]* and B. J. Kollen[4]

International Journal of Stroke © 2012

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Pronostic capacité de marche

Predicting activities after stroke: what is clinically relevant?

G. Kwakkel[1,2,3]* and B. J. Kollen[4]

International Journal of Stroke © 2012

« …many evidence-based therapies are heavily dependent on an appropriate selection of stroke patients that may benefit most from a particular intervention. »
e.g. CIMT

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Pronostic capacité de marche

Predicting activities after stroke: what is clinically relevant?

G. Kwakkel[1,2,3]* and B. J. Kollen[4]

International Journal of Stroke © 2012

« Hence, the establishment of an adequate prognosis by a stroke rehabilitation team will increase the efficiency of stroke services and reduce costs. »

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Pronostic capacité de marche

Predicting activities after stroke: what is clinically relevant?

G. Kwakkel[1,2,3]* and B. J. Kollen[4]

International Journal of Stroke © 2012

« From a patient's perspective, effective prognostics enable health care professionals to provide correct information to patients and their families. »

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Pronostic capacité de marche

Importance de:

- déficiences neurologiques initiales
- l'évolution au cours des premiers jours
- l'âge

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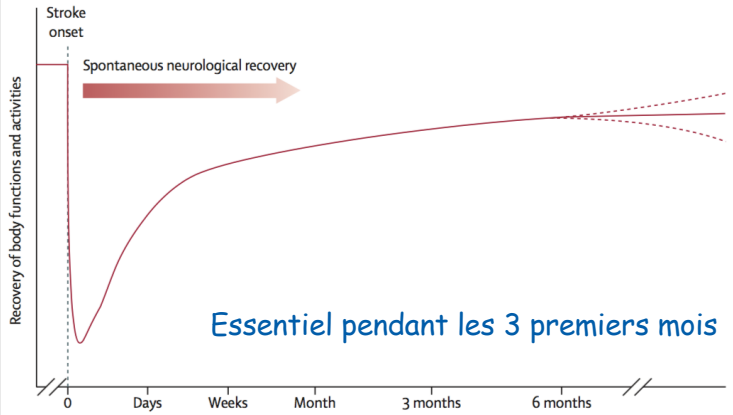
Pronostic capacité de marche



Essentiel pendant les 3 premiers mois

Langhorne, Lancet, 2011

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Pronostic capacité de marche

Domain	Determinants
walking ability	sitting balance
	motor function of leg
	initial ADL skills
	age
	homonymous hemianopia
	urinary incontinence
	premorbid walking ability
	premorbid ADL skills

Veerbeek and coll.

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Pronostic capacité de marche

Prognosis for walking ability 6 months after the stroke *16, 17*

It has been demonstrated that establishing an estimated prognosis for the patient's walking ability 6 months after the stroke requires their sitting balance (assessed with the sitting balance item of the Trunk Control Test) and the motor function of the leg (assessed with the Motricity Index) to be recorded as soon as possible, but preferably on day 2 after the stroke. (Level 1)

Veerbeek and coll.

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Pronostic capacité de marche

Trunk Control Test

TRUNK CONTROL ASSESSMENT		
TESTS (On bed)		SCORING
1 Rolling to weak side		0 – Unable to
2 Rolling to strong side		12 – Able to do with non-muscular help
3 Balance in sitting position		25 – Normal
4 Sitting up from lying down		

TRUNK SCORE [1 + 2 + 3 + 4] =

Collin & Wade *Journal of Neurology, Neurosurgery, and Psychiatry* 1990;

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Pronostic capacité de marche

Motricity Index

Leg	Muscle Grading[a]
Ankle dorsiflexion From plantar-flexed position	0 = No movement 9 = Palpable contraction in muscle but no movement
Knee extension From 90° flexion of knee	14 = Movement seen but not full range against gravity 19 = Full range against gravity, not against resistance
Hip flexion From 90° flexion at hip	25 = Movement against resistance but weaker than other side 33 = Normal power

The scores for each limb have a maximum value of 99 + 1 = 100 points. The index is scored with patient in sitting position.

Collin & Wade *Journal of Neurology, Neurosurgery, and Psychiatry* 1990;

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Pronostic capacité de marche

80% de patients remarche > 3 mois

Evaluation précoce

- Équilibre assis
  Trunk Control Test - Sitting balance ≥ 25/100
- Parésie membre inférieur
  Motricity Index ≥ 25/100
  Fugl-Meyer Moteur Membre inférieur ≥ 19/34

Veerbeek and coll.

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Pronostic capacité de marche

The TWIST Algorithm Predicts Time to Walking Independently After Stroke

Marie-Claire Smith, BHSc[1], P. Alan Barber, Phd[1,2], and Cathy M. Stinear, PhD[1*]

Neurorehabilitation and Neural Repair 2017

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Pronostic capacité de marche

Table 1. Demographic and Clinical Characteristics.

Demographic Characteristics (n = 41)	n (%)
Age (years)	
Median age (range)	72 (43-96)
Stroke severity (NIHSS)	
NIHSS median (range)	8 (1-21)
Mild (NIHSS <5)	7 (17)
Moderate-Severe (NIHSS ≥5)	34 (83)
Stroke type	
Motor (M)	13 (32)
Motor-sensory (MS)	19 (46)
Motor-sensory-hemianopia (MSH)	9 (22)
Baseline FAC score (0-5)	
FAC median (range)	0 (0-2)
Nonambulatory (FAC = 0)	33 (80)
Dependent ambulation FAC (1, 2, 3)	8 (20)

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Pronostic capacité de marche

Evaluation à J3, Semaine 6, Semaine 12

Prédiction:
- Indépendance à la marche (FAC ≥ 4)
- Quand cette indépendance est acquise

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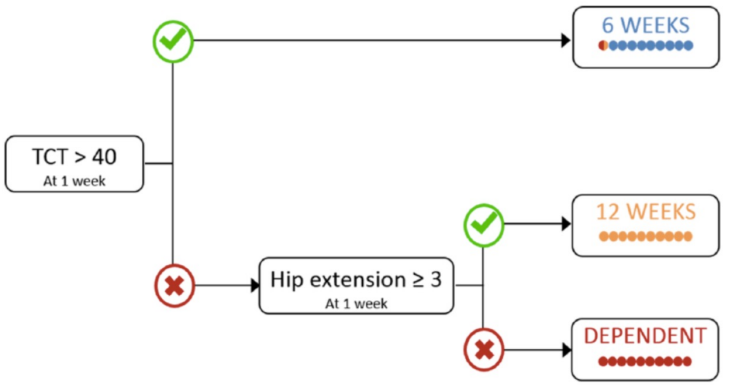
Pronostic capacité de marche



Neurorehabilitation and Neural Repair 2017

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Pronostic capacité de marche

Table 3. Sensitivity and Specificity of Time to Walk Independently after Stroke (TWIST) Algorithm.

	Independent by 6 Weeks	Independent by 12 Weeks	Dependent at 12 Weeks
Sensitivity, % (95% CI)	100 (84-100)	80 (28-99)	93 (68-100)
Specificity, % (95% CI)	90 (68-99)	100 (90-100)	100 (87-100)
PPV,[a] % (95% CI)	91 (73-98)	100 (40-100)	100 (77-100)
NPV,[b] % (95% CI)	100 (100-100)	97 (86-100)	96 (81-100)
Overall accuracy 95%	91% (21/23)	100% (4/4)	100% (14/14)

Neurorehabilitation and Neural Repair 2017

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Pronostic capacité de marche

TWIST score	4 weeks	6 weeks	9 weeks	16 weeks	26 weeks
0	1 (1-1)	1 (1-1)	3 (3-3)	11 (11-11)	20 (20-20)
1	3 (2-9)	7 (4-17)	21 (12-60)	49 (31-100)	62 (42-100)
2	13 (5-63)	35 (18-81)	68 (37-99)	88 (62-100)	92 (68-100)
3	43 (14-97)	81 (51-99)	95 (72-100)	98 (85-100)	99 (86-100)
4	79 (33-100)	97 (83-100)	99 (92-100)	100 (95-100)	100 (95-100)

Neurorehabilitation and Neural Repair 2017

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Pronostic capacité de marche

Accuracy of Physiotherapist Predictions for Independent Walking After Stroke

Marie-Claire Smith, PhD[1,2,3], Benjamin J. Scrivener, MHlthLd[1,4], Luke Skinner, BHSc[5], and Cathy M. Stinear, PhD[1,3]

Neurorehabilitation and Neural Repair
2024, Vol. 38(10) 742–751
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DOI: 10.1177/15459683241270055
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Pronostic capacité de marche

TWIST est plus précis que les kinés pour prédire si un patient sera capable de marcher de manière autonome 4, 6 ou 9 semaines après un AVC, mais pas 16 ou 26 semaines après.
TWIST peut être utile pour orienter la rééducation précoce et planifier la sortie de l'hôpital.

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Pronostic capacité de marche

Cerebrovascular disease

Original research *J Neurol Neurosurg Psychiatry* 2021

Factors associated with time to independent walking recovery post-stroke

Caitlin Kennedy [1], Julie Bernhardt [2,3], Leonid Churilov [1], Janice M Collier [2], Fiona Ellery [2], Venesha Rethnam [2], Lilian B Carvalho [2,3], Geoffrey A Donnan [4,5], Kathryn S Hayward [2,3,6]

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Pronostic capacité de marche

Etude AVERT
2104 patients

Délai pour être capable de marcher 50 m sans aide
Suivi 3 mois

Kennedy, 2021

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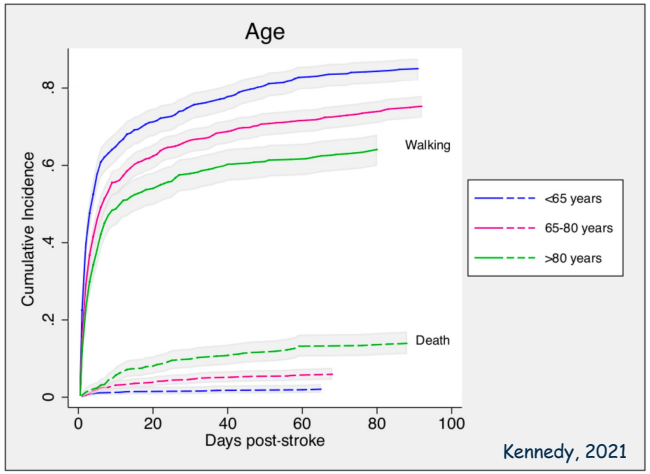
Pronostic capacité de marche



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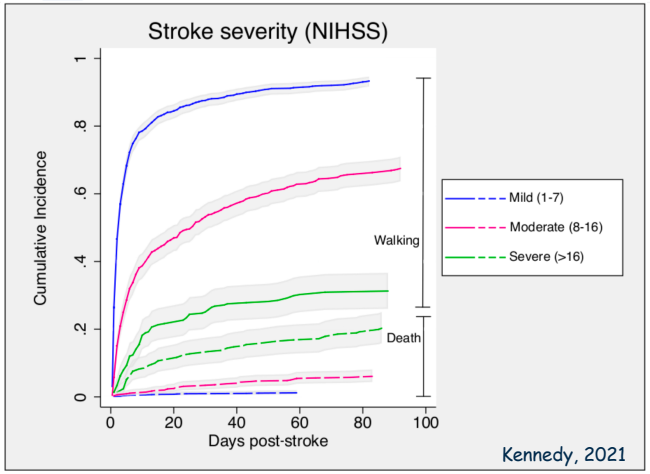
Pronostic capacité de marche



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Guidelines: principes généraux

Intensity of exercise training *5*

It has been demonstrated that increasing the intensity of therapy (in terms of more hours of exercise) for patients with a stroke, compared to less intensive exercising, results in more rapid recovery of *selective movements*, *comfortable walking speed*, *maximum walking speed*, *walking distance*, *muscle tone*, *sitting and standing balance*, performance of *basic activities of daily living*, and *severity of depression and anxiety*. (Level 1)

Studied for ER (✓), LR (✓), RC (✓).

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Guidelines: principes généraux

Task specificity of training effects *6*

It has been demonstrated that training specific skills, such as exercising balance while standing and reaching to grasp objects, has a favorable effect on the specific skill being trained by stroke patients, in all phases of rehabilitation. Transfer to other skills, which were not specifically trained during the therapy, has however hardly been demonstrated. (Level 1)

Veerbeek and coll.

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Guidelines: principes généraux

Context specificity of training effects *7*

It has been demonstrated that training stroke patients in a functional context has a favorable effect on learning specific movements or skills, regardless of the patient's rehabilitation phase. If possible, patients with a stroke should preferably be rehabilitated in their own domestic and community environment. (Level 1)

Veerbeek and coll.

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Guidelines: principes généraux

Neurological exercise methods or treatment concepts (NDT/Bobath) *8*

◐ It has been demonstrated that neurological exercise methods or treatment concepts (NDT/Bobath) are no more effective for patients with a stroke at the body functions and activities levels than other treatment methods. (Level 1)
Studied for ER (=), LR (=), RC (=).

Veerbeek and coll.

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Guidelines: principes généraux

Bobath – Brunnström - PNF

None of these so-called neurofacilitation approaches has been able to show better effect on motor performance after stroke than any other treatment method, and permanent improvements in walking performance are lacking.

Meyer and coll. ***Stroke*** **June 2015**

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Guidelines: principes généraux

Recommendations: Mobility	Class	Level of Evidence
Intensive, repetitive, mobility- task training is recommended for all individuals with gait limitations after stroke.	I	A

- Difficulté adaptée
- Variabilité
- Feedback
- Orientée vers la tâche
- Contexte fonctionnel

Carolee J. Winstein and coll. *Stroke* June 2016

61

Plan

- Introduction
- Recommandations de bonne pratique
- Pronostic
- Rééducation de la marche: principes généraux
- Rééducation de la marche: méthodes spécifiques
- Conclusion

62

Guidelines: Tapis roulant +/- décharge

63

Guidelines: Tapis roulant avec décharge

Intensité (# pas)
Mise en charge
Séance 20-30 min, par période de 5 min

Décharge < 40%
Vitesse 0.1-0.3 m s^{-1}
Adaptation progressive

FAC ≤ 3

Pénible pour les rééducateurs

Veerbeek and coll.

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Guidelines: Tapis roulant avec décharge

Body-weight supported treadmill training *49, 50*

- It has been demonstrated that body-weight supported treadmill training improves the *comfortable walking speed* and *walking distance* of patients with a stroke. (Level 1)
Studied for ER (✓) and RC (✓).

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65

Guidelines: Tapis roulant sans décharge

Intensité (# pas)
Mise en charge
Séance 20-30 min, par période de 5 min

Adaptation progressive

FAC ≥ 3

Aisé pour les rééducateurs

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66

Guidelines: Tapis roulant sans décharge

Treadmill training without body-weight support *53*

- It has been demonstrated that treadmill training without body-weight support is more effective in increasing *maximum walking speed* and *width of gait* than conventional gait training for patients with a stroke. (Level 1)
Studied for ER (✓), LR (✓) and RC (✓).

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Guidelines: Tapis roulant +/- décharge

Recommendations: Mobility	Class	Level of Evidence
Practice walking with either a treadmill (with or without body-weight support) or overground walking exercise training combined with conventional rehabilitation may be reasonable for recovery of walking function.	IIb	A

Carolee J. Winstein and coll. *Stroke* **June 2016** 68
Cliniques universitaires Saint-Luc – Thierry Lejeune

68

Guidelines: Tapis roulant +/- décharge

International Journal of Nursing Practice

WILEY

INTERNATIONAL JOURNAL of NURSING PRACTICE

META-ANALYSIS OPEN ACCESS

Effectiveness of Treadmill Training Intervention for the Management of Patients With Stroke: A Systematic Review and Meta-Analysis

Chenyi Shi[1] | Yuxi Xiao[2] | Dawei Zang[1] | Hongjun Ren[2]

[1]Department of Rehabilitation, Beijing Tiantan Hospital, Capital Medical University, Beijing, China | [2]Department of Trauma, Beijing Water Conservancy Hospital, Beijing, China

Correspondence: Yuxi Xiao (xiaoyuxi0111@sina.com)

Received: 1 August 2024 | **Revised:** 27 March 2025 | **Accepted:** 25 April 2025

69

Guidelines: Tapis roulant +/- décharge

59 études – 3000 sujets

Augmentation de la vitesse et de l'endurance de marche surtout chez les sujets marchant de manière indépendante (SMD 0.355 et 0.374)

Shi 2025

70

Guidelines: Robot

71

Guidelines: Robot

Confortable pour les rééducateurs

Intensité

Coût

FAC ≤ 3

Veerbeek and coll.

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72

Guidelines: Robot

Robot-assisted gait training *51, 52*

It has been demonstrated that robot-assisted gait training for stroke patients who are unable to walk independently improves their *comfortable walking speed, maximum walking speed, walking distance, heart rate, sitting and standing balance, walking ability* and performance of *basic activities of daily living*, compared to conventional therapy (including overground walking). (Level 1)

Veerbeek and coll.

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Guidelines: Robot

Recommendations: Mobility	Class	Level of Evidence
Robot-assisted movement training to improve motor function and mobility after stroke in combination with conventional therapy may be considered.	IIb	A

Carolee J. Winstein and coll. *Stroke* **June 2016**

74

Guidelines: Robot

Hu *et al.*
Journal of NeuroEngineering and Rehabilitation (2024) 21:165
https://doi.org/10.1186/s12984-024-01463-1

Journal of NeuroEngineering and Rehabilitation

REVIEW Open Access

Efficacy of robot-assisted gait training on lower extremity function in subacute stroke patients: a systematic review and meta-analysis

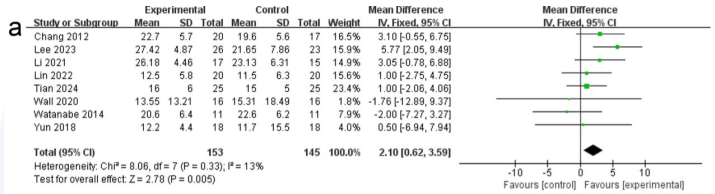
Miao-miao Hu[1†], Shan Wang[1†], Cai-qin Wu[1], Kun-peng Li[2], Zhao-hui Geng[1], Guo-hui Xu[3*] and Lu Dong[1*]

Phase subaiguë (< 6 mois)

75

Guidelines: Robot Fugl-Meyer

a



Hu and coll. 2024

76

Guidelines: Robot
FAC

b

Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
Bergmann 2018	0.36	0.82	15	0.36	0.82	15	6.4%	0.00 [-0.59, 0.59]
Castelli 2023	2.36	1.89	12	1.87	1.68	12	1.9%	0.49 [-0.94, 1.92]
Chang 2012	1.3	0.7	20	1.4	0.8	17	7.6%	-0.10 [-0.59, 0.39]
Chua 2016	2.28	1.15	53	2.23	1.3	53	7.9%	0.05 [-0.42, 0.52]
Hu 2024	3.61	0.79	28	3.21	0.63	28	9.1%	0.40 [0.03, 0.77]
Lee 2023	3.35	1.23	26	2.48	1.12	23	5.7%	0.87 [0.21, 1.53]
Li 2021	3.76	0.9	17	3.67	0.72	15	6.7%	0.09 [-0.47, 0.65]
Meng 2022	4.1	0.91	62	3.58	0.81	61	10.1%	0.52 [0.22, 0.82]
Morone 2011	2.6	0.9	12	1.2	0.8	12	5.5%	1.40 [0.72, 2.08]
Morone 2011	2.2	0.8	12	2.5	1	12	5.1%	-0.30 [-1.02, 0.42]
Morone 2018	3.6	1.1	50	2.7	1.4	50	7.5%	0.90 [0.41, 1.39]
Ng 2008	3.2	0.8	17	2.5	1.2	21	5.9%	0.70 [0.06, 1.34]
Park 2020	4.43	0.98	7	3.29	0.76	7	3.8%	1.14 [0.22, 2.06]
Pournajaf 2023	3.4	0.9	61	2.9	1.2	28	7.5%	0.50 [0.00, 1.00]
Tong 2006	3	1	15	2	2	20	3.3%	1.00 [-0.01, 2.01]
Wall 2020	2.09	1.42	16	2.23	1.42	16	3.4%	-0.14 [-1.12, 0.84]
Watanabe 2014	3.1	1.4	11	2.6	1.4	11	2.6%	0.50 [-0.67, 1.67]
Total (95% CI)			**434**			**401**	**100.0%**	**0.44 [0.23, 0.65]**

Heterogeneity: Tau² = 0.09; Chi² = 33.36, df = 16 (P = 0.007); I² = 52%
Test for overall effect: Z = 4.08 (P < 0.0001)

Mean Difference IV, Random, 95% CI
-2 -1 0 1 2
Favours [control] Favours [experimental]

Hu and coll. 2024

77

Guidelines: Robot
BBS

c

Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Castelli 2023	45.07	8.39	12	39.57	17.61	12	2.0%	5.50 [-5.54, 16.54]
Kóra 2024	27.1	3.7	15	23.5	2.88	15	42.7%	3.60 [1.23, 5.97]
Lee 2023	47.58	21.33	26	38.87	22.56	23	1.6%	8.71 [-3.63, 21.05]
Lin 2022	22.8	16.7	20	22.4	17.8	20	2.1%	0.40 [-10.30, 11.10]
Ng 2008	37.1	9.6	17	28.5	15.9	21	3.6%	8.60 [0.41, 16.79]
Park 2020	42.86	7.38	7	34.71	9.86	7	2.9%	8.15 [-0.97, 17.27]
Tian 2024	26	10	25	21	10	25	7.8%	5.00 [-0.54, 10.54]
Tong 2006	40	12	15	30	27	20	1.4%	10.00 [-3.30, 23.30]
Wall 2020	24.35	24.38	16	23.04	19.91	16	1.0%	1.31 [-14.11, 16.73]
Yun 2018	11.1	5.1	18	6.3	2.5	18	34.9%	4.80 [2.18, 7.42]
Total (95% CI)			**171**			**177**	**100.0%**	**4.55 [3.00, 6.11]**

Heterogeneity: Chi² = 4.07, df = 9 (P = 0.91); I² = 0%
Test for overall effect: Z = 5.76 (P < 0.00001)

Mean Difference IV, Fixed, 95% CI
-20 -10 0 10 20
Favours [control] Favours [experimental]

Hu and coll. 2024

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Guidelines: Robot
Time Up & Go

a

Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Castelli 2023	20	8.39	12	24.8	8.39	12	2.6%	-4.80 [-11.51, 1.91]
Hu 2024	15.61	2.37	28	19.35	2.06	28	85.1%	-3.74 [-4.90, -2.58]
Lee 2023	54.67	40.48	17	50.6	20.32	21	0.3%	4.07 [-17.04, 25.18]
Lin 2022	48.7	32.6	8	39.4	19.3	8	0.2%	9.30 [-16.95, 35.55]
Pournajaf 2023	10.2	5.2	61	16.2	7.9	28	11.2%	-6.00 [-9.20, -2.80]
Watanabe 2014	16.8	7	8	29.9	18.4	10	0.7%	-13.10 [-25.49, -0.71]
Total (95% CI)			**134**			**107**	**100.0%**	**-4.05 [-5.12, -2.98]**

Heterogeneity: Chi² = 5.35, df = 5 (P = 0.37); I² = 7%
Test for overall effect: Z = 7.40 (P < 0.00001)

Mean Difference IV, Fixed, 95% CI
-20 -10 0 10 20
Favours [experimental] Favours [control]

Hu and coll. 2024

79

Guidelines: Robot
Test de Marche 6 min.

b

Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Chua 2016	145.1	121	53	156.9	144	53	2.7%	-11.80 [-62.44, 38.84]
Kóra 2024	224.3	29.57	15	185.7	22.75	15	19.4%	38.60 [19.72, 57.48]
Lee 2023	41.13	25.46	17	9.72	3.18	21	46.5%	31.41 [19.23, 43.59]
Li 2021	197.24	86.78	17	179.8	80.86	15	2.0%	17.44 [-40.66, 75.54]
Meng 2022	199.11	60.72	62	173.69	40.58	62	20.9%	25.42 [7.24, 43.60]
Morone 2011	156	78	12	91	35	12	2.9%	65.00 [16.63, 113.37]
Morone 2011	161	89	12	151	89	12	1.4%	10.00 [-61.21, 81.21]
Pournajaf 2023	194	110	61	172	163	28	1.6%	22.00 [-44.39, 88.39]
Taveggia 2016	191.6	178.4	13	272.8	155.6	15	0.4%	-81.20 [-206.12, 43.72]
Thimabut 2022	120.08	115.5	13	55.14	27.54	13	1.7%	64.94 [0.39, 129.49]
Watanabe 2014	156.7	137.9	11	134.5	132.1	11	0.5%	22.20 [-90.65, 135.05]
Total (95% CI)			**286**			**257**	**100.0%**	**30.66 [22.36, 38.97]**

Heterogeneity: Chi² = 10.42, df = 10 (P = 0.40); I² = 4%
Test for overall effect: Z = 7.24 (P < 0.00001)

Mean Difference IV, Fixed, 95% CI
-200 -100 0 100 200
Favours [control] Favours [experimental]

Hu and coll. 2024

80

Guidelines: Robot
Test de Marche 10 m

c

Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Chua 2016	0.56	0.45	53	0.63	0.6	53	12.5%	-0.07 [-0.27, 0.13]
Kóra 2024	1.61	0.28	15	1.34	0.23	15	15.1%	0.27 [0.09, 0.45]
Lee 2023	0.6	0.36	26	0.43	0.29	23	15.3%	0.17 [-0.01, 0.35]
Morone 2011	0.49	0.21	12	0.52	0.3	12	11.8%	-0.03 [-0.24, 0.18]
Morone 2011	0.36	0.11	12	0.37	0.27	12	18.7%	-0.01 [-0.17, 0.15]
Pournajaf 2023	0.72	0.44	61	0.57	0.55	28	9.5%	0.15 [-0.08, 0.38]
Tanaka 2023	0.27	0.37	12	0.28	0.26	8	6.7%	-0.01 [-0.29, 0.27]
Taveggia 2016	0.56	0.44	13	0.66	0.19	15	7.7%	-0.10 [-0.36, 0.16]
Watanabe 2014	0.85	0.43	8	0.63	0.5	10	2.8%	0.22 [-0.21, 0.65]
Total (95% CI)			**212**			**176**	**100.0%**	**0.06 [-0.01, 0.14]**

Heterogeneity: Chi² = 12.27, df = 8 (P = 0.14); I² = 35%
Test for overall effect: Z = 1.78 (P = 0.08)

Mean Difference IV, Fixed, 95% CI
-0.5 -0.25 0 0.25 0.5
Favours [control] Favours [experimental]

Hu and coll. 2024

81

Guidelines: Robot
Effet durée – Fugl Meyer

a

Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
1.9.1 two weeks								
Chang 2012	22.7	5.7	20	19.6	5.6	17	16.5%	3.10 [-0.55, 6.75]
Tian 2024	16	6	25	15	5	25	23.4%	1.00 [-2.06, 4.06]
Subtotal (95% CI)			**45**			**42**	**39.9%**	**1.87 [-0.48, 4.21]**
Heterogeneity: Chi² = 0.75, df = 1 (P = 0.39); I² = 0%								
Test for overall effect: Z = 1.56 (P = 0.12)								
1.9.2 three weeks								
Yun 2018	12.2	4.4	18	11.7	15.5	18	4.0%	0.50 [-6.94, 7.94]
Subtotal (95% CI)			**18**			**18**	**4.0%**	**0.50 [-6.94, 7.94]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.13 (P = 0.90)								
1.9.3 four weeks								
Lee 2023	27.42	4.87	26	21.65	7.86	23	15.9%	5.77 [2.05, 9.49]
Li 2021	26.19	4.46	17	23.13	6.31	15	14.9%	3.05 [-0.78, 6.88]
Lin 2022	12.5	5.8	20	11.5	6.3	20	15.6%	1.00 [-2.75, 4.75]
Wall 2020	13.55	13.21	16	15.31	18.49	16	1.8%	-1.76 [-12.89, 9.37]
Watanabe 2014	20.6	6.4	11	22.6	6.2	11	7.9%	-2.00 [-7.27, 3.27]
Subtotal (95% CI)			**90**			**85**	**56.1%**	**2.39 [0.41, 4.36]**
Heterogeneity: Chi² = 7.02, df = 4 (P = 0.13); I² = 43%								
Test for overall effect: Z = 2.36 (P = 0.02)								
Total (95% CI)			**153**			**145**	**100.0%**	**2.10 [0.62, 3.59]**
Heterogeneity: Chi² = 8.06, df = 7 (P = 0.33); I² = 13%								
Test for overall effect: Z = 2.78 (P = 0.005)								
Test for subgroup differences: Chi² = 0.30, df = 2 (P = 0.86), I² = 0%								

Mean Difference IV, Fixed, 95% CI
-20 -10 0 10 20
Favours [control] Favours [experimental]

Hu and coll. 2024

82

Guidelines: Robot
Effet durée – FAC

b

Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
1.8.1 two weeks								
Bergmann 2018	0.36	0.82	15	0.36	0.82	15	6.9%	0.00 [-0.59, 0.59]
Chang 2012	1.3	0.7	20	1.4	0.8	17	8.0%	-0.10 [-0.59, 0.39]
Park 2020	4.43	0.98	7	3.29	0.76	7	4.2%	1.14 [0.22, 2.06]
Subtotal (95% CI)			**42**			**39**	**19.2%**	**0.24 [-0.38, 0.86]**
Heterogeneity: Tau² = 0.19; Chi² = 5.67, df = 2 (P = 0.06); I² = 65%								
Test for overall effect: Z = 0.75 (P = 0.45)								
1.8.2 four weeks								
Castelli 2023	2.36	1.89	12	1.87	1.68	12	2.2%	0.49 [-0.94, 1.92]
Hu 2024	3.61	0.79	28	3.21	0.63	28	9.4%	0.40 [0.03, 0.77]
Lee 2023	3.35	1.23	26	2.48	1.12	23	6.2%	0.87 [0.21, 1.53]
Li 2021	3.76	0.9	17	3.67	0.72	15	7.2%	0.09 [-0.47, 0.65]
Meng 2022	4.1	0.91	62	3.58	0.81	61	10.3%	0.52 [0.22, 0.82]
Morone 2011	2.6	0.9	12	1.2	0.8	12	6.0%	1.40 [0.72, 2.08]
Morone 2011	2.2	0.8	12	2.5	1	12	5.6%	-0.30 [-1.02, 0.42]
Morone 2018	3.6	1.1	50	2.7	1.4	50	8.0%	0.90 [0.41, 1.39]
Ng 2008	3.2	0.8	17	2.5	1.2	21	6.4%	0.70 [0.06, 1.34]
Tong 2006	3	1	15	2	2	20	3.7%	1.00 [-0.01, 2.01]
Wall 2020	2.09	1.42	16	2.23	1.42	16	3.8%	-0.14 [-1.12, 0.84]
Watanabe 2014	3	1	15	2	2	20	3.7%	1.00 [-0.01, 2.01]
Subtotal (95% CI)			**282**			**290**	**72.5%**	**0.57 [0.32, 0.82]**
Heterogeneity: Tau² = 0.08; Chi² = 20.96, df = 11 (P = 0.03); I² = 48%								
Test for overall effect: Z = 4.46 (P < 0.00001)								
1.8.3 eight weeks								
Chua 2016	2.28	1.15	53	2.23	1.3	53	8.3%	0.05 [-0.42, 0.52]
Subtotal (95% CI)			**53**			**53**	**8.3%**	**0.05 [-0.42, 0.52]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.21 (P = 0.83)								
Total (95% CI)			**377**			**382**	**100.0%**	**0.46 [0.23, 0.69]**
Heterogeneity: Tau² = 0.11; Chi² = 34.49, df = 15 (P = 0.003); I² = 57%								
Test for overall effect: Z = 3.88 (P = 0.0001)								
Test for subgroup differences: Chi² = 4.10, df = 2 (P = 0.13), I² = 51.2%								

Mean Difference IV, Random, 95% CI
-2 -1 0 1 2
Favours [control] Favours [experimental]

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Guidelines: Robot

Cochrane Library

Cochrane Database of Systematic Reviews

Electromechanical-assisted training for walking after stroke (Review)

Mehrholz J, Kugler J, Pohl M, Elsner B

Cochrane Database of Systematic Reviews 2025

84

Guidelines: Robot

2017: 36 RCT – 1472 sujets
2020: 62 RCT – 2440 sujets
2025: 101 RCT – 4224 sujets

Bien toléré

85

Guidelines: Robot

Robot + rééducation conventionnelle

Probablement

Augmente l'indépendance à la marche en phase subaiguë
NNT = 9

N'augmenterait pas la vitesse de marche ?

86

Guidelines: Robot

Quid du groupe contrôle?
Effet similaire si intensité équivalente?

Type de robot ?
Pas d'argument en faveur d'un dispositif

87

Guidelines: Réalité virtuelle

88

Guidelines: Réalité virtuelle

Mobility training in virtual reality *58*

It remains unclear whether virtual reality mobility training is more effective than other interventions for patients with a stroke in terms of *comfortable and maximum walking speed*, *spatiotemporal gait parameters* and *walking ability*. (Level 1)
Studied for RC (=).

Veerbeek and coll.

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Guidelines: Réalité virtuelle

Cochrane Library

Cochrane Database of Systematic Reviews

Virtual reality for stroke rehabilitation (Review)

Laver KE, Lange B, George S, Deutsch JE, Saposnik G, Chapman M, Crotty M

Cochrane Database of Systematic Reviews 2025

90

Guidelines: Réalité virtuelle

Immersive ou non
Jeu
Répétition
Tâche spécifique
Motivation
Challenge
Adaptation

Adhérence

91

Guidelines: Réalité virtuelle

Ratio # patients / # rééducateurs

Feedback: intrinsèque et extrinsèque

Feedback augmenté:
concurrent pendant l'exercice
sur la performance à la fin de l'exercice

92

Guidelines: Réalité virtuelle

Réalité virtuelle et jeu vidéo interactif

190 RCT - 7188 sujets

Critère de jugement principal : membre supérieur

Peu de données, de faible qualité

Laver 2025

93

Guidelines: Réalité virtuelle

Effet favorable sur l'équilibre

Pas d'effet sur la vitesse de marche

Laver 2025

94

Guidelines: entraînement en circuit & atelier

95

Guidelines: entraînement en circuit & atelier

5 min par station

1 rééducateur / 3 patients

Effet groupe – interaction

FAC ≥ 3

Veerbeek and coll.

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Guidelines: entraînement en circuit & atelier

Circuit class training for walking and other mobility-related functions and activities *59*

It has been demonstrated that circuit class training (CCT) for walking and other mobility-related functions and activities improves walking *distance/speed*, *sitting and standing balance* and *walking ability*, and *reduces inactivity* in patients with a stroke. (Level 1)
Walking distance/speed studied for ER (✓), LR (✓) and RC (✓), sitting and standing balance for ER (✓), LR (✓) and RC (✓), walking ability for ER (✓), LR (✓), and RC (✓), and inactivity for LR (✓) and RC (✓).

97

Guidelines: entraînement en circuit & atelier

Recommendations: Mobility	Class	Level of Evidence
Group therapy with circuit training is a reasonable approach to improve walking.	IIa	A

Carolee J. Winstein and coll. *Stroke* **June 2016**

98

Guidelines: entraînement en circuit & atelier

Cochrane Library
Cochrane Database of Systematic Reviews

Circuit class therapy for improving mobility after stroke (Review)

English C, Hillier SL, Lynch EA **2017 The Cochrane Collaboration**

99

Guidelines: entraînement en circuit & atelier

17 RCT – 1297 sujets

Bien toléré
Pas de risque de chute supérieur
(RD 0.03, 95% CI -0.02 to 0.08, GRADE: very low).

100

Guidelines: entraînement en circuit & atelier

Intensité – répétitif
Niveau de difficulté adapté progressivement
Orienté vers la tâche

Ratio # patients / # rééducateurs

Effet groupe – relation sociale

101

Guidelines: entraînement en circuit & atelier

Comparison 1. Circuit class therapy versus other

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 6mWT early and late	10	835	Mean Difference (IV, Fixed, 95% CI)	60.86 [44.55, 77.17]
1.1 Early	4	487	Mean Difference (IV, Fixed, 95% CI)	46.56 [21.35, 71.77]
1.2 Late	6	348	Mean Difference (IV, Fixed, 95% CI)	71.15 [49.76, 92.54]
2 Gait speed early and late	8	744	Mean Difference (IV, Fixed, 95% CI)	0.15 [0.10, 0.19]
2.1 Early	2	437	Mean Difference (IV, Fixed, 95% CI)	0.17 [0.10, 0.25]
2.2 Late	6	307	Mean Difference (IV, Fixed, 95% CI)	0.13 [0.07, 0.19]
3 Cadence	2	50	Mean Difference (IV, Random, 95% CI)	13.57 [7.52, 19.62]
4 Timed Up and Go	5	488	Mean Difference (IV, Fixed, 95% CI)	-3.62 [-6.09, -1.16]
5 Rivermead Mobility Index	2	296	Mean Difference (IV, Fixed, 95% CI)	0.56 [0.17, 0.95]
6 Functional Ambulation Classification	3	469	Odds Ratio (M-H, Random, 95% CI)	1.91 [1.01, 3.60]

Augmente le périmètre, la vitesse et la capacité de marche.
Phase chronique

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Guidelines: entraînement en circuit & atelier

Comparison 1. Circuit class therapy versus other

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
11 VO2 peak	2	103	Mean Difference (IV, Fixed, 95% CI)	2.81 [0.90, 4.72]
12 Steps per day	2	206	Mean Difference (IV, Fixed, 95% CI)	1325.66 [411.09, 2240.22]

Augmente l'activité physique et la condition physique.

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Guidelines: autorééducation

Walking and other mobility-related functions and activities exercised under the supervision of an informal caregiver *60*

- It has been demonstrated that exercising walking and other mobility-related functions and activities under the supervision of an informal caregiver improves the performance of *basic activities of daily living* for the patient with a stroke, and reduces the *perceived burden of care for the informal caregiver.* (Level 1)

Studied for ER (✓).

Veerbeek and coll.

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Guidelines: autorééducation

Review Article

ASNR AMERICAN SOCIETY OF NEUROREHABILITATION

Self-Rehabilitation for Post-Stroke Motor Function and Activity–A Systematic Review and Meta-Analysis

Neurorehabilitation and Neural Repair
2021, Vol. 35(12) 1043–1058
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Gauthier Everard, MSc[1,2], Alexandre Luc, MSc[1], Ioannis Doumas, MD[1,2,3], Khawla Ajana, MSc[4], Gaëtan Stoquart, PhD[1,2,3], Martin Gareth Edwards, PhD[2,4], and Thierry Lejeune, PhD[1,2,3]

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Guidelines: autorééducation

In this review, we define self-rehabilitation as a tailored therapy program where for most of the time, the patient performs rehabilitation exercises independently to the presence of a clinician.

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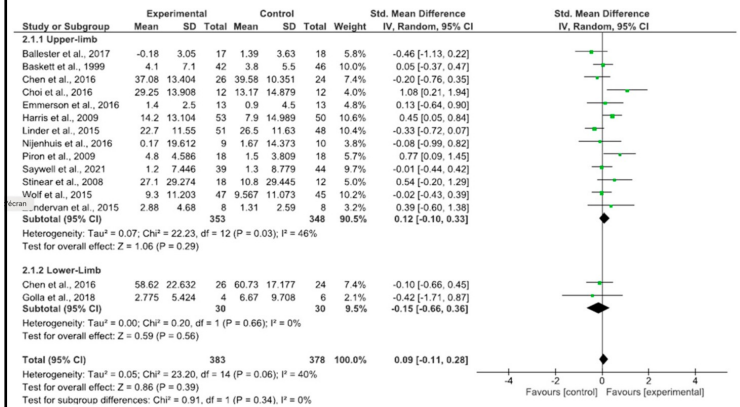
Guidelines: autorééducation



Motor function

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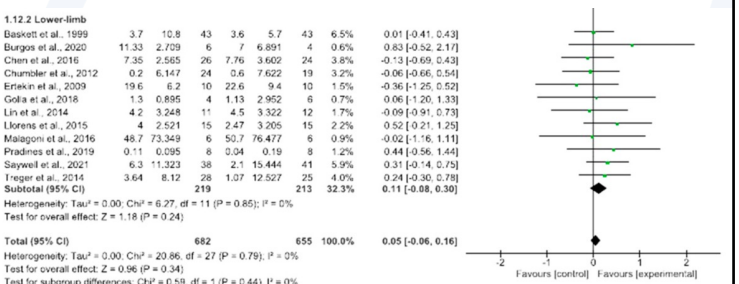
Guidelines: autorééducation



Activity

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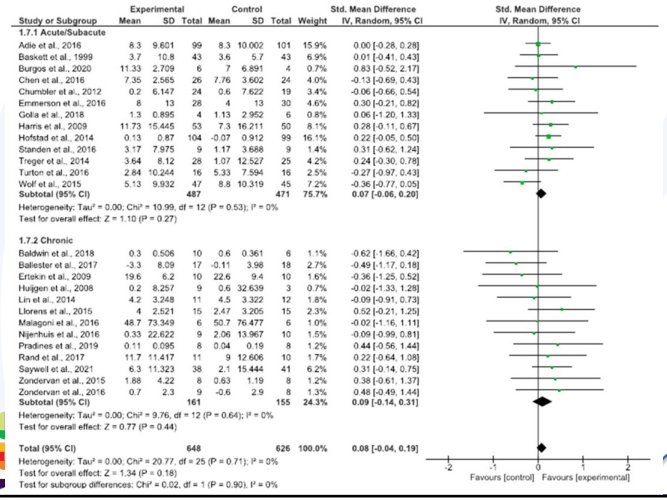

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Guidelines: autorééducation

Review Article

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This meta-analysis showed low to moderate evidence that self-rehabilitation and conventional therapy efficacy was equally valuable for post-stroke motor function and activity.

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Plan

- Introduction
- Recommandations de bonne pratique
- Pronostic
- Rééducation de la marche: principes généraux
- Rééducation de la marche: méthodes spécifiques
- Conclusion

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Conclusion

Non exhaustif

Nombre de RCT augmente
Qualité des RCT augmente ⟶ RS & Meta-Analyses

Possibilité de prédire la récupération

Efficacité de la rééducation à la marche après un AVC

Approche fonctionnelle, intensive, variabilité, feedback
Nouvelles technologies (Robot, RV)
Nouvelles approches (Groupes & Atelier)

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Conclusion

Stroke 2022

TOPICAL REVIEW

Section Editors: Julie Bernhardt, PhD, and Pam Duncan, PhD

Walk the Talk: Current Evidence for Walking Recovery After Stroke, Future Pathways and a Mission for Research and Clinical Practice

Sarah A. Moore, PhD; Pierce Boyne, PhD; George Fulk, PhD; Geert Verheyden, PhD; Natalie A. Fini, PhD

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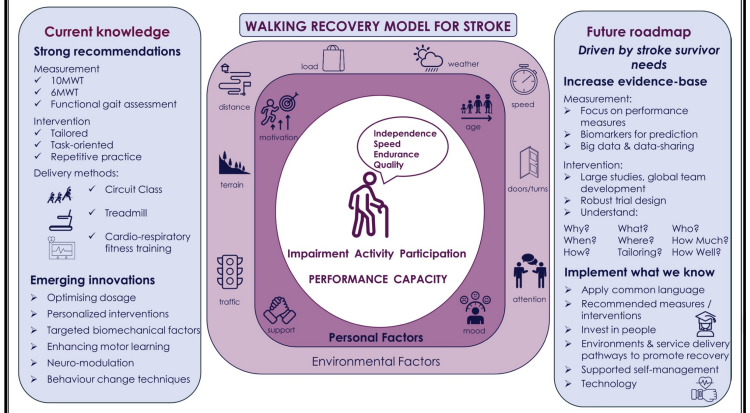
Conclusion



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Cliniques universitaires SAINT-LUC UCL BRUXELLES

UCL Université catholique de Louvain

Thierry Lejeune

EBM dans la rééducation de la locomotion Accident Vasculaire Cérébral

Questions ?

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