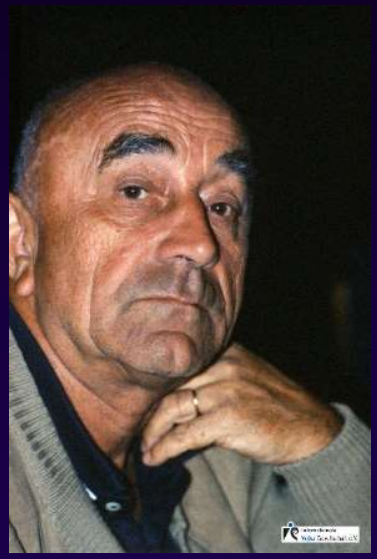
Guided Self-rehabilitation Contracts in Spastic Paresis



Jean-Michel Gracies
Henri Mondor University Hospitals, Créteil, France

Disclosure

JMG received research grants and consultancy fees from Ipsen, Fastox, Abbvie and Merz.

Patient videos shown after specific patient consent

Vidéos réalisées avec le consentement du patient

L'approche éducative du thérapeute dans l'application des Contrats d'Autorééducation Guidée (CAG)

Kinésithér Scient 2018,0602:31-43

RÉSUMÉ | *SUMMARY*

Le thérapeute tient une place centrale dans le Contrats d'Autorééducation Guidée (CAG), jouant les rôles de prescripteur, éducateur et entraîneur. Grâce à ces trois fonctions assumées au sein des CAG, celui-ci amène le patient à améliorer progressivement la compréhension de son problème, puis, en conséquence, son degré de responsabilité quant à sa propre rééducation, lui permettant à terme d'augmenter l'intensité nécessaire de son travail rééducatif.

Cet article propose quatre fiches éducatives. Les deux premières présentent la survenue des différents phénomènes physiopathologiques de la parésie spastique. La troisième explique leurs intrications progressives et l'approche technique du CAG qui en découle, ciblant spécifiquement les muscles antagonistes. La dernière fiche illustre l'approche psychologique du CAG avec la place centrale occupée par le registre, outil fondamental de responsabilisation et de motivation.

The therapist plays a central part in the Guided Self-rehabilitation Contract (GSC), with the threefold mission of prescriber, teacher and coach. Successful fulfillment of this triple role will enable to increase the patients levels of knowledge and understanding of their problem, therefore their level of responsibility regarding their own rehabilitation, ultimately allowing to enhance the intensity level of the physical work that they will perform.

This article proposes four educational sheets for use by the therapist. The first two present the pathophysiological mechanisms at work in spastic paresis. The third sheet explains the progressive entanglements between them, and the technical approach of the GSC as a result, targeting specifically antagonist muscles. The final sheet illustrates the psychological approach of the GSC, the central component being the diary, fundamental tool of empowerment and motivation.

MOTS CLÉS | *KEYWORDS*

▸ Kinésithérapeute prescripteur ▸ Motivation
▸ Myopathie spastique ▸ Parésie spastique ▸ Registre

▸ *Therapist prescriber* ▸ *Motivation*
▸ *Spastic myopathy* ▸ *Spastic paresis* ▸ *Diary*

Thara SANTIAGO*
Maud PRADINES*
Mouna GHÉDIRA*
Catherine HENNEGRAVE*
Caroline GAULT-COLAS*
Nicolas BAYLE*
Pr Jean-Michel GRACIES*

* Service de rééducation neurolocomotrice
Unité de neurorééducation, AP-HP

Hôpitaux universitaires Henri Mondor
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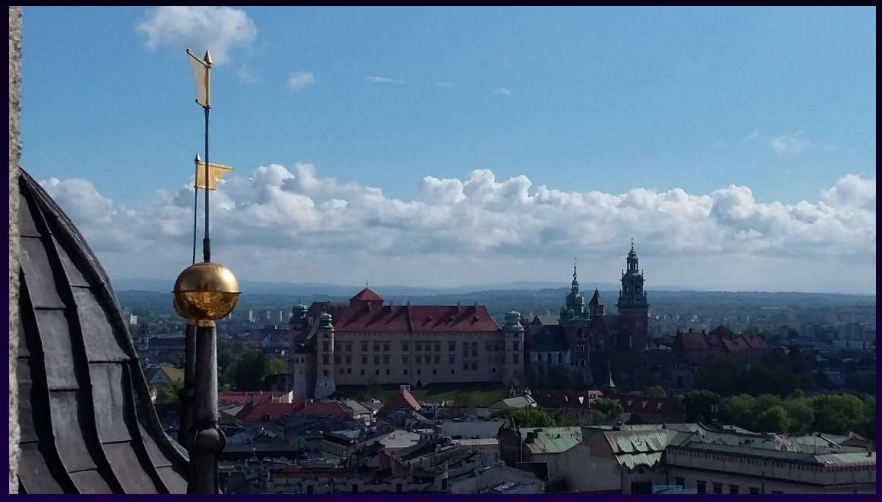

DIU Neuroréeducation du Mouvement Université Paris-Est Créteil Université de Corte mai-juillet 2025

Neuroréeducation du Mouvement

15 journées d'enseignement théorique
et 5 jours d'immersion pratique sur 1 semaine

Jean-Michel Gracies, Professeur

Lieu des cours : en alternance, **Faculté de Médecine de Créteil,** 8 rue du Général Sarrail, 94000 Créteil - Métro Créteil l'Echat - Hôpital Henri Mondor et **Université de Corte,** avec transmissions en visio simultanées sur l'autre site.

Module 1 – *Iatrogénie – Plasticité cérébrale* (Corte)

Jour 1 - Iatrogénie
9H Iatrogénie physique - Horizontalité - Restrictions sensorimotrices
14H Iatrogénie chimique

Jour 2 – Plasticité cérébrale
9H Plasticité cérébrale non guidée
14H Plasticité cérébrale guidée

Module 2 – *Plasticité musculaire – Parésie spastique* (Corte)

Jour 3 – Plasticité musculaire
9H Plasticité musculaire - myopathie spastique
14H Etirement musculaire – *Maud Pradines, kinésithérapeute, MCF UPEC*

Jour 4 – Parésie Spastique Déformante : définition d'un syndrome
9H Physiopathologie
14H Taxonomie

Module 3 – *Parésie spastique : évaluations et traitements* (Corte)

Jour 5 - Parésie Spastique Déformante : évaluations
9H Evaluations fonctionnelles
14H Evaluations analytiques

Jour 6 - Parésie Spastique Déformante : traitements
9H Techniques neuro-rééducatives validées dans la parésie
14H Contrats d'Autoréeducation Guidée

DIU Neuroréeducation du Mouvement
Université Paris-Est Créteil
Université de Corte
mai-juillet 2025

Module 4 – *Parkinsonisme et tremblements* (Créteil)

Jour 7 - Syndromes parkinsoniens : définition
9H Histoire, sémiologie, diagnostics
14H Physiopathologie

Jour 8 - Syndromes parkinsoniens : évaluations
9H Evaluations cliniques quantifiées
14H Imagerie cérébrale **-** *Pr P Rémy, Neurologie, UPEC*

Jour 9 - Syndromes parkinsoniens : traitements non physiques
9H Approches moléculaires et chirurgicales
14H Stimulation cérébrale profonde - *Dr T Hälbig, Charité, Berlin*
16H Biothérapies - *Pr S Palfi, Neurochirurgie, UPEC*

Jour 10 - Syndromes parkinsoniens : traitements physiques
9H Traitements physiques (neuroréeducatifs) du parkinsonisme
Indiçage, Renforcement moteur à haute intensité, Traitement aérobie à haute intensité

14H Pratique neuroréeducative en parkinsonisme - *Tharaga Santiago, kinésithérapeute, Service de Rééducation Neurolocomotrice, HU Henri Mondor*
16H Rôle du kinésithérapeute dans les Contrats et les Ateliers d'Autoréeducation Guidée - *Tharaga Santiago*
17h30 Témoignage de patients parétiques ou parkinsoniens ayant suivi des Contrats d'Autoréeducation Guidée

Jour 11 - Tremblements – Cervelet
9H Tremblements : sémiologie, physiopathologie, typologie, évaluations
14H Tremblements : Neuroréeducation et autres traitements

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Université Paris-Est Créteil
Université de Corte
mai-juillet 2025

Module 5 – *Cervelet – Chorée - Sujet âgé* (Corte)

Jour 12 - Ataxies – Apraxies – Chorées – Parésies faciales

9H Ataxies, apraxies, chorées. Sémiologie, Neuroréeducation
14H Evaluation et Rééducation des Parésies faciales - *Dr M Baude, Neuroréeducation, UPEC*

Jour 13 – Sujet âgé neurologique

9H Equilibre et Chutes chez le sujet âgé

Module 6 – *Enfant – Droit et Handicap* (Corte ou Créteil, à définir)

Jour 14 - Enfant neurologique

9H Parésies infantiles – aspects théoriques

14H Evaluation du mouvement chez le très jeune enfant – *Dr C Boulay, MPR, Marseille*
16H Hétéroréeducation parentale guidée 0-2 ans - *Dr C Amelon-Petit, Garches*

Jour 15 - Droit et handicap

9H Droit et handicap - Réparation du dommage neurologique
Inclusion sociale et modifications des droits de l'homme
Maître ME AFONSO, Avocat à la Cour, Paris

15h +++ EXAMEN ECRIT +++

Informations complémentaires - Conditions d'admission

- ***Auprès de la Faculté de Médecine de Créteil*** : Mme Clotilde Boyer, DUFMC, 8 rue du Général Sarrail 94010 Créteil Cedex - Téléphone : 01 49 81 39 03 ou 37 32, mails : inscriptions.dufmc@u-pec.fr / dufmc.fi@u-pec.fr / dufmc.fc@u-pec.fr
- ***Auprès de l'Université de Corte*** **:** Mme Valérie Letreux, Responsable administrative, de l'Institut Universitaire de Santé, Université de Corse Pasquale Paoli, Campus Grimaldi- BP 52, 20250 CORTE - Tél : 04 95 45 06 50 - https://ius.universita.corsica - mail letreux_v@univ-corse.fr

MASTER 2

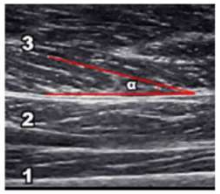
Biologie & Santé - Parcours

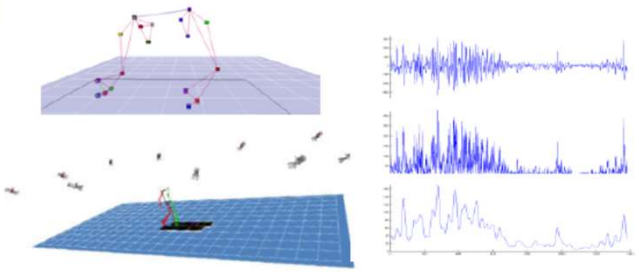
Neurosciences du Mouvement

UPEC – Université Paris-Est Créteil Val de Marne – Connaissance - Action

Hôpitaux Universitaires Henri Mondor – Assistance Publique Hôpitaux de Paris

PROGRAMME





Neurosciences du Mouvement

- De la conception à l'exécution
- Anatomie neurologique et musculaire
- Examen clinique quantifié
- Analyse biomécanique
- Neurophysiologie
- Modifications tissulaires
- Imagerie
- Techniques neurorestauratives
- Biothérapies neurochirurgicales
- Programmation en analyse du signal
- Parésies faciales

Objectifs

Initier à la recherche sur déterminants et thérapeutiques des affections centrales et périphériques du mouvement.

ORGANISATION

• **Semestre 3 – Mi octobre à fin décembre** :
15 ECUE (30 ECTS)
Examen écrit début janvier.

• **Semestre 4 - Janvier à juin** : Stage de recherche en laboratoire, validé par la rédaction d'un mémoire et une soutenance orale fin juin

MASTER 2 NEUROSCIENCES DU MOUVEMENT 2024-2025

SEMESTRE 3 = 30 ECTS	ECTS	Demi-journées
ECUE 1 : Syndromes Moteurs Centraux (SMC - JM Gracies)	3	9
ECUE 2 : Analyse Biomécanique du Mouvement (ABM - O Pila)	3	5
ECUE 3 : Plasticité musculaire (PM - M Pradines)	2	5
ECUE 4 : Pathologies Neurologiques Inflammatoires (PNI - A Créange)	3	6
ECUE 5 : Programmation en Analyse du Signal/Matlab (PAS - M Guihard)	3	7
ECUE 6 : Recueil et Analyse des Signaux Neurophysiologiques (RSN - JP Lefaucheur)	2	5
ECUE 7 : Imagerie du Mouvement (IM - P Rémy)	2	4
ECUE 8 : Maladies du Muscle (MM - FJ Authier)	3	8
ECUE 9 : Outils et Méthodologie pour la Recherche (OMR - O Pila)	3	5
ECUE 10 : Anatomie neurologique et musculaire du Mouvement Humain (ANM - B Parratte)	1	4
ECUE 11 : Chirurgie neuro-orthopédique (CNO - N Sturbois-Nachef)	1	2
ECUE 12 : Bibliographie et LCA (LCA - M Baude)	1	4
ECUE 13 : Parésies Faciales (PF - M Baude)	1	4
ECUE 14 : Neurochirurgie du Mouvement (NCM - S Palfi)	1	3
ECUE 15 : Robotique d'Assistance (RA - S Mohammed)	1	4
	30	**75**

Marjolaine BAUDE
Responsable Pédagogique

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EMPLOI du TEMPS 2021/2022 Master 2 Neurosciences du Mouvement

Sauf indication différente. les cours sont de 9h à 13h et de 14h à 18h . à la Faculté de Médecine de Créteil.

SEPTEMBRE

LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM
30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
																Réunion de rentrée 14h											

OCTOBRE

LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM
27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
								MM1		POR1	OMR1 9h30-13h			Statistiques (F. Mathieu) 9h30-	MM2 8h30	PNI2		RSN3				MM3	OMR3 9h-12h IUT	Statistiques (F. Mathieu) 9h30-	RSN4		
							PNI1		RSN1	RPA1	OMR2					RSN2	RPA2				PNI3	PNI4	ABM1		RPA3		

OCTOBRE / NOVEMBRE

LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM
25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
OMR4 9h30-12h30	OMR6 9h30-12h30	MM4	ABM2	NCM1 Senova				MM5	ABM3 10h30-12h30	RA2	POR2			RSN5	MM6	POR3					RA3	MM7	ABM4	SMC1	SMC2		
OMR5 14h-17h	OMR7 14h-17h	PNI5	RPA4	RA1				PNI7	OMR8 14h-17h	RPA5				DFT1 Maktouf	PF1	ANM 13h		DFT2 Martouf			PNI6	PF2	PAS1 IUT GEii Salle L3-	RPA6	SMC3		

NOVEMBRE / DECEMBRE

LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM
22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
RA4	MM8	NCM1 Palfi	SMC5 Chenevier	NCM2 Senova			RA5		PAS4 IUT GEii Salle L3-	DFT5 Portero	POR4	ANM1 Visioconf		RA6				POR5				NCM3		SMC7	SMC9 Chenevier		
DFT3 Portero	PF3	PAS2 IUT GEii Salle L3-	SMC6	DFT4 Pradines			PAS3 IUT GEii Salle L3-	PF4	IM1		PAS5 IUT GEii Salle L3-	ANM2 Visioconf		DFT6 Pradines	OMR9 16h-18h	IM2	IM3	PAS6 IUT GEii Salle L3-			PAS7 IUT GEii Salle L3-	IM4	SMC8	SMC10 Blanchon		

JANVIER / FEVRIER

LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13
	Examens Session 1						Stage							Stage							Rendu Synopsis	Présentation Projet (Session 1)		Stage			

FEVRIER / MARS

LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	1	2	3	4	5	6	7	8	9	10	11	12	13
Stage							Stage							Stage								Examens Session 2					

MARS / AVRIL

LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10
Stage							Rendu Synopsis (Session	Présentation Projet (Session 2) 14h		Stage				Stage							AR1 13h-17h	Stage						

AVRIL / MAI

LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8
AR2 13h-17h	Stage						Stage							Stage							Stage						

MAI / JUIN

LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM
9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5
Stage							Stage							Stage							Stage						

JUIN / JUILLET

LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM	LUN	MAR	MER	JEU	VEN	SAM	DIM
6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3
	Stage							AR3 13h-17h	Stage					Stage			Dépôt Mémoire				AR4 13h-17h	Soutenance Mémoire				

PHRC Neurorestore

JM Gracies (HU Mondor)

OBJECTIF PRINCIPAL

Evaluer au-delà d'un an après l'AVC, la **récupération motrice** fonctionnelle au bout d'un an, dans les conditions d'un **Contrat d'Autoréeducation Guidée (CAG)** versus les conditions de la prise en charge classique.

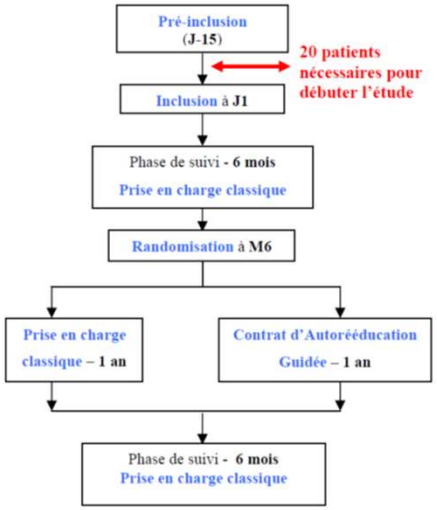
CRITERES D'INCLUSION

- Patient **hémiparétique spastique**, à la suite d'un 1er AVC survenu **1 an au moins avant la date de recrutement dans l'étude**
- Age ≥ 18 ans
- Déambulation pieds nus possible sans aide technique sur 10m
- Vitesse de déambulation maximale pieds nus entre 0,1m/sec et 1,3m/sec
- Score sur l'échelle modifiée de Frenchay entre 20 et 80/100
- Patient ayant accepté de signer un consentement éclairé à participer à l'étude

CRITERES DE NON INCLUSION

- Patient ayant fait **une ou plusieurs récidives d'AVC**, clinique ou visible à l'imagerie
- **Pas d'imagerie** cérébrale disponible (scanner ou IRM) datant **de moins de 3 mois** avant l'inclusion malgré un **doute clinique** sur une récidive depuis l'AVC initial
- Maladie intercurrente évolutive sévère grevant le pronostic fonctionnel ou vital, ou la capacité à participer aux séances de rééducation
- Dysfonction cognitive, phasique, comportementale ou physique rendant impossible une communication verbale efficace, la participation active à un programme de rééducation ou d'auto-rééducation ou à une étude de recherche, selon le jugement de l'investigateur
- Personne bénéficiant d'une mesure de protection juridique à l'exception de la curatelle
- Personne non affiliée à la sécurité sociale

DEROULEMENT DE L'ETUDE



TRAITEMENTS EVALUES

1. Contrat d'Auto-rééducation Guidée (CAG)
Prescription d'une séance précise de postures d'auto-étirement et d'exercices moteurs actifs, enseignés au patient et à réaliser quotidiennement (cf. manuel d'auto-rééducation). Une séance de kinésithérapie est prévue tous les 15 jours pour un travail de sélection et d'explication des exercices, de motivation et de vérification de la compliance et de la documentation des exercices effectués sur le carnet de bord du patient.

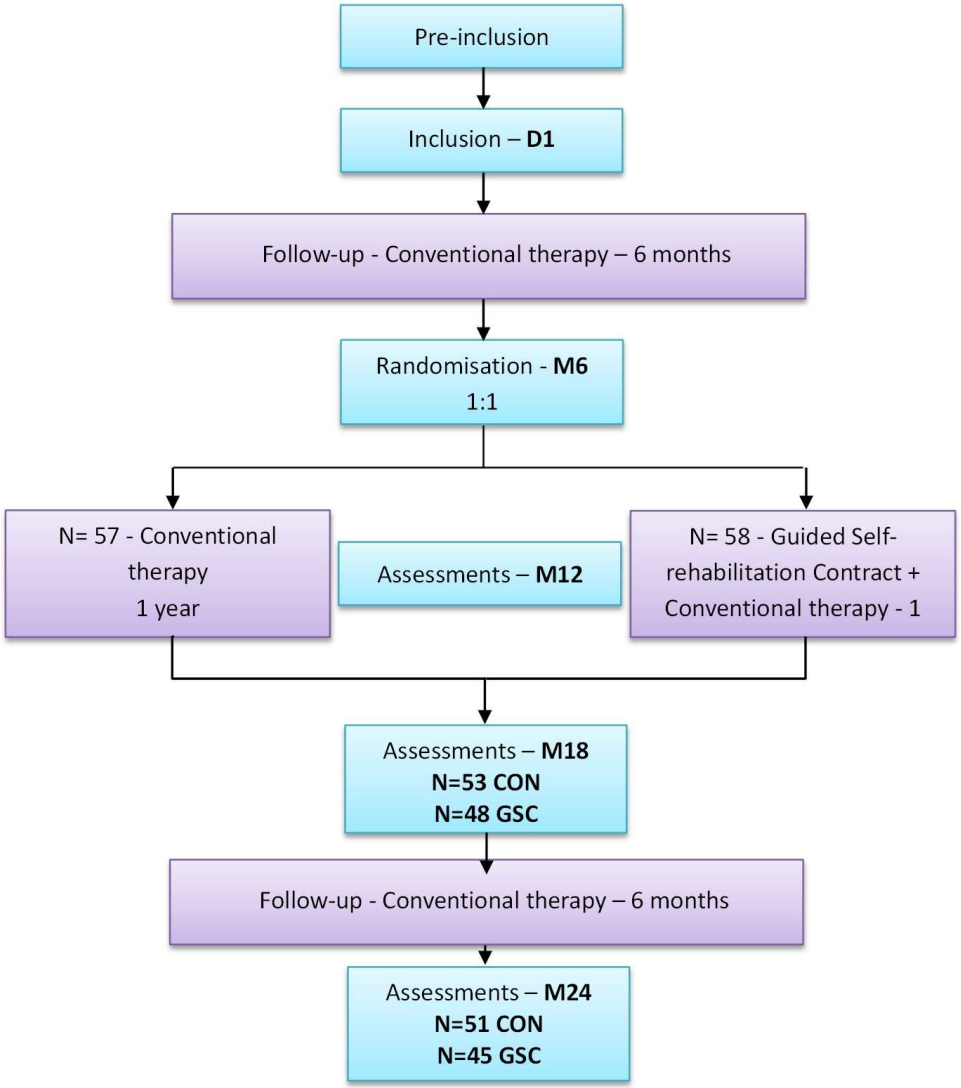
2. Prise en charge classique
Kinésithérapie prescrite ou non à la demande par le médecin traitant comme en pratique courante.

ORGANIGRAMME DES EVALUATIONS

	J1	M6	M12	M18	M24
Vérification des critères d'inclusion et de non inclusion et invitation du patient à participer à l'étude	X				
Examen neurologique	X	X	X	X	X
Signature du consentement éclairé	X				
Randomisation		X			
Bilan des traitements (médicamenteux systémiques, chirurgicaux neuro-orthopédiques, locaux et physiques)	X	X	X	X	X
Bilan des aides humaines, sociales et financières	X	X	X	X	X
Bilan des conditions de vie	X	X	X	X	X
Vitesse de déambulation confortable et maximale sur 10 mètres *	X	X	X	X	X
Test d'endurance et PCI sur 2 min (chaussé)	X	X	X	X	X
Echelle Modifiée de Frenchay **	X	X	X	X	X
Disability Assessment Scale (DAS)	X	X	X	X	X
Indice de Barthel	X	X	X	X	X
Echelle de Qualité de Vie (EQ-5D)	X	X	X	X	X
Echelle de Dépression Gériatrique (GDS15)	X	X	X	X	X
Questionnaire sur la prise en charge rééducative		X	X	X	X
Evaluation en ergothérapie		X***	X	X***	X
Evaluation du psychologue clinicien	X****	X****		X****	

* Critère d'évaluation principal pour le membre inférieur
** Critère d'évaluation principal pour le membre supérieur
*** Seulement pour les centres H. Mondor et F. Widal

Neurorestore Study flow chart (from 71)



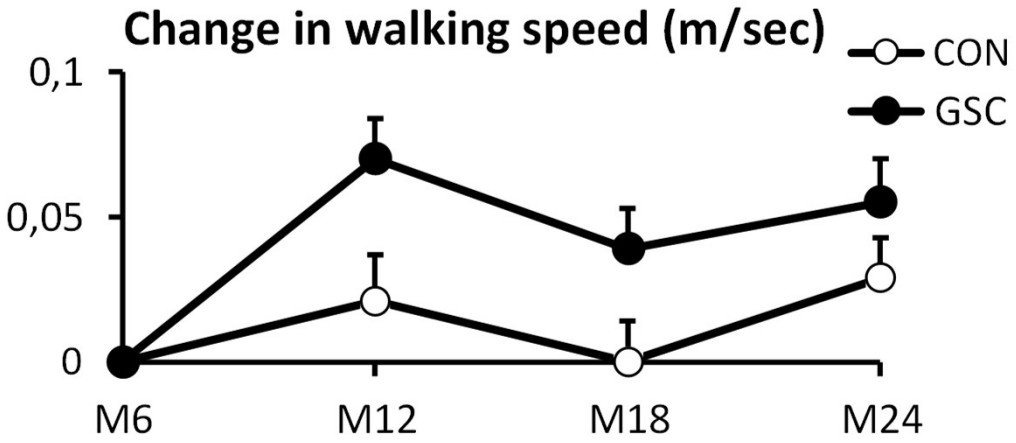
Gracies et al, unpublished

Neurorestore Study – participant characteristics

Characteristic	**J1, N = 115[1]**	**M6, N = 115[1]**
Age	54 (13); 55 (47, 62)	54 (13); 55 (47, 62)
Sex		
Male	72 (63%)	72 (63%)
Female	43 (37%)	43 (37%)
Causes of stroke		
Atheroma	36 (31%)	0 (0%)
Dissection	15 (13%)	0 (0%)
Undetermined	18 (16%)	0 (0%)
Emboligenic heart disease	13 (11%)	0 (0%)
Aneurysm, MAV	15 (13%)	0 (0%)
Other	17 (15%)	0 (0%)
(Missing)	1 (0.9%)	115 (100%)
Hemi-hypoesthesia		
No	73 (63%)	68 (59%)
Moderate	33 (29%)	42 (37%)
Major	9 (7.8%)	4 (3.5%)
(Missing)	0 (0%) 1 (0.9%)	
Phasic disorders		
No	75 (65%)	74 (64%)
Moderate	33 (29%)	34 (30%)
Major	7 (6.1%)	6 (5.2%)
(Missing)	0 (0%) 1 (0.9%)	
Frenchay score	4.6 (1.8); 4.2 (3.1, 5.9)	4.6 (1.8); 4.3 (3.1, 5.8)
Max speed barefoot over 10 m (m/sec)	0.66 (0.31); 0.67 (0.44, 0.90)	0.69 (0.34); 0.64 (0.43, 0.92)
Barthel Index: total score	91 (9); 95 (88, 95)	93 (8); 95 (90, 100)
Geriatric Depression Scale: score	5 (3); 4 (2, 6)	5 (3); 4 (2, 7)
Frequency of PT visits in past 6 months	2 (1); 2 (1, 3)	2 (1); 2 (2, 3)
PT sessions duration in past 6 months (min)	50 (29); 45 (30, 60)	50 (28); 45 (30, 60)

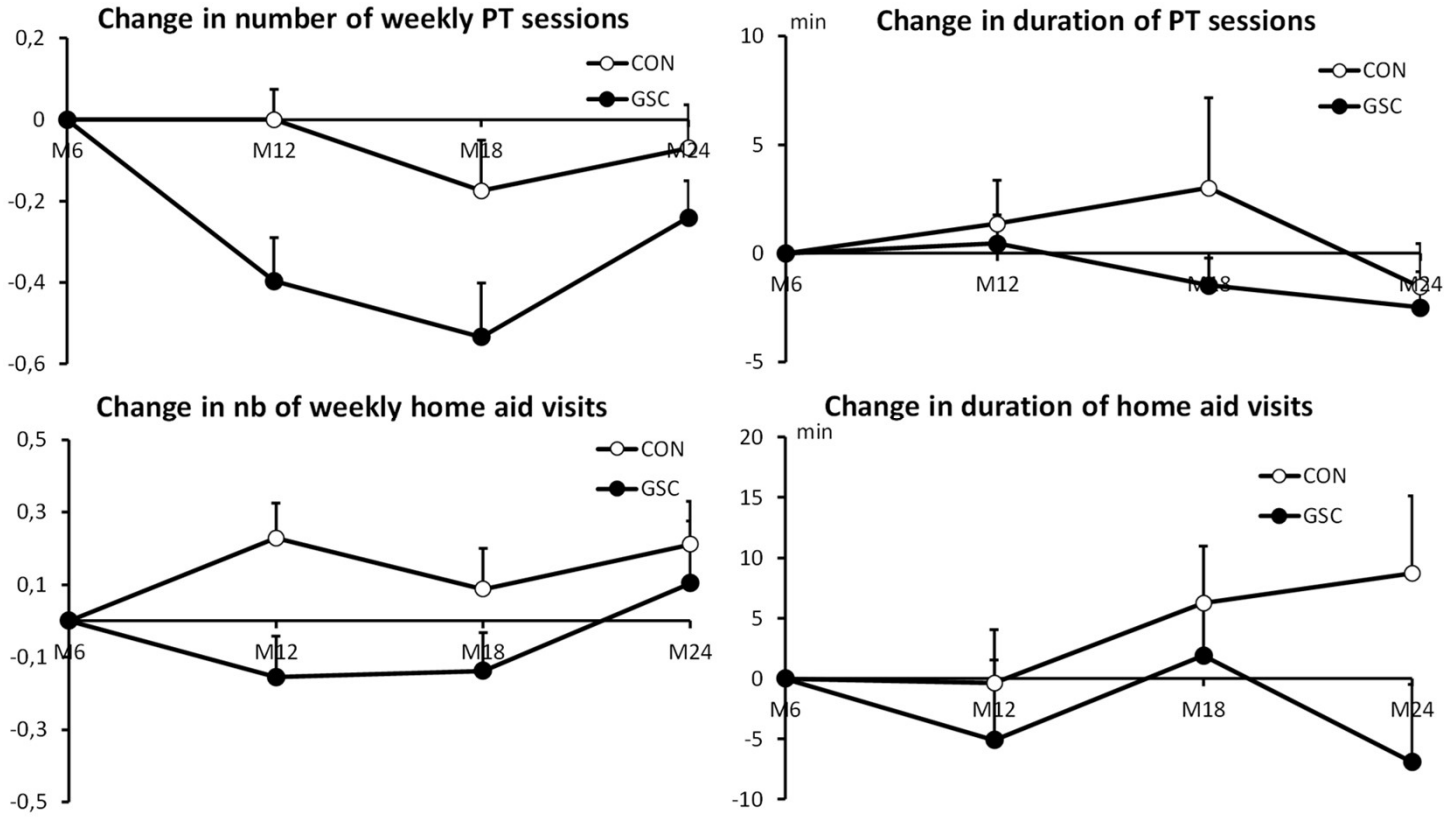
Gracies et al, unpublished

Primary outcome measures



Gracies et al, unpublished

Secondary endpoints: changes in number of PT sessions/week, in human aid from Day 1 to M24



Gracies et al, unpublished


CAG-unlimited !
©T. Santiago

Parésie Spastique Déformante
Contrats d'Autorééducation Guidée

A1 post AVC – nov 2013

A4 post AVC – fév 2017

Parésie Spastique Déformante
Contrats d'Autorééducation Guidée
Professionalisation – Culte de la difficulté

A1 post AVC – nov 2013

A4 post AVC – fév 2017

68a - Tétraparésie contusion médullaire C3-C4
Juil 2016 – accident triathlon chute vélo AV

27 août 2019

Travail contre les droits antérieurs - 05 oct 2020

68a - Tétraparésie contusion médullaire C3-C4
Juil 2016 – accident triathlon chute vélo AV

15 mars 2021
Pré exo
Début Fin avril

26 mai 2021
J30 post exo

Plan

1. Role of the physician/therapist
2. Role of the patient
3. Psychological tool
4. Technical tool
5. Literature - and practice -
   on Guided Self-rehabilitation Contracts

MASTER 2

Biologie & Santé - Parcours

Neurosciences du Mouvement

UPEC Connaissance - Action — Université Paris-Est Créteil Val de Marne — Hôpitaux Universitaires Henri Mondor — Assistance Publique Hôpitaux de Paris

PROGRAMME


Marjolaine BAUDE

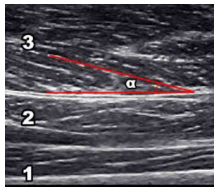

François Jérôme AUTHIER

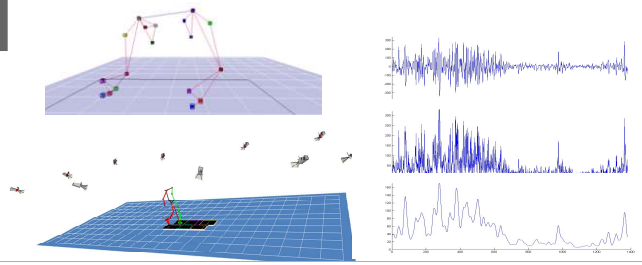
Responsables Pédagogiques


Jean-Michel GRACIES

Neurosciences du Mouvement

- De la conception à l'exécution
- Anatomie neurologique et musculaire
- Examen clinique quantifié
- Analyse biomécanique
- Neurophysiologie
- Modifications tissulaires
- Imagerie
- Techniques neurorestauratives
- Biothérapies neurochirurgicales
- Programmation en analyse du signal
- Parésies faciales





Objectifs

Initier à la recherche sur déterminants et thérapeutiques des affections centrales et périphériques du mouvement.

ORGANISATION

• **Semestre 3 – Fin octobre à fin décembre** :
15 ECUE (30 ECTS)
Examen écrit début janvier.

• **Semestre 4 - Janvier à juin** : Stage de recherche en laboratoire, validé par la rédaction d'un mémoire et une soutenance orale fin juin

MASTER 2 NEUROSCIENCES DU MOUVEMENT 2022-2023

SEMESTRE 3 = 30 ECTS	ECTS	Demi-journées envisagées
ECUE 1 : Syndromes Moteurs Centraux (SMC - JM Gracies)	3	8
ECUE 2 : Analyse Biomécanique du Mouvement (ABM - E Hutin)	3	6
ECUE 3 : Demandes Fonctionnelles et Adaptations Tissulaires (DFT - M Pradines)	2	4
ECUE 4 : Pathologies Neurologiques Inflammatoires (PNI - A Créange)	3	6
ECUE 5 : Programmation en Analyse du Signal/Matlab (PAS - Guihard, Garric)	3	7
ECUE 6 : Recueil et Analyse des Signaux Neurophysiologiques (RSN - JP Lefaucheur)	2	5
ECUE 7 : Imagerie du Mouvement (IM - P Rémy)	2	4
ECUE 8 : Maladies du Muscle (MM - FJ Authier)	3	7
ECUE 9 : Outils et Méthodologie pour la Recherche (OMR - E Hutin)	3	5
ECUE 10 : Anatomie Neuro-Musculaire du Mouvement humain (ANM - Parratte, Tatu)	1	4
ECUE 11 : Chirurgie neuro-orthopédique (CNO - Nachef)	1	3
ECUE 12 : Bibliographie et LCA (Biblio - M Baude / Pradines / Gracies)	1	3
ECUE 13 : Parésies Faciales (PF - M Baude)	1	4
ECUE 14 : Neurochirurgie du Mouvement (NCM - S Palfi)	1	3
ECUE 15 : Robotique d'Assistance (RA - S Mohammed)	1	4
Total	**30**	**73**


Maud PRADINES


Emilie HUTIN


Nadine STURBOIS-NACHEF


Jean-Pascal LEFAUCHEUR


Philippe REMY


Stéphane PALFI


Alain CREANGE


Marina GUIHARD


Bernard PARRATTE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DIRECTEURS D'ECUE

http://www.u-pec.fr - courriel : master.biologie.sante@u-pec.fr - Tél : +33-1-4981-3553/3500/4399

INVITED REVIEW

ABSTRACT: Spastic paresis follows chronic disruption of the central execution of volitional command. Motor function in patients with spastic paresis is subjected over time to three fundamental insults, of which the last two are avoidable: (1) the neural insult itself, which causes paresis, i.e., reduced voluntary motor unit recruitment; (2) the relative immobilization of the paretic body part, commonly imposed by the current care environment, which causes adaptive shortening of the muscles left in a shortened position and joint contracture; and (3) the chronic disuse of the paretic body part, which is typically self-imposed in most patients. Chronic disuse causes plastic rearrangements in the higher centers that further reduce the ability to voluntarily recruit motor units, i.e., that aggravate baseline paresis. Part I of this review focuses on the pathophysiology of the first two factors causing motor impairment in spastic paresis: the vicious cycle of paresis–disuse–paresis and the contracture in soft tissues.

Muscle Nerve **31:** 535–551, 2005

PATHOPHYSIOLOGY OF SPASTIC PARESIS. I: PARESIS AND SOFT TISSUE CHANGES

JEAN-MICHEL GRACIES, MD, PhD

Department of Neurology, Mount Sinai Medical Center, One Gustave L Levy Place, Annenberg 2/Box 1052, New York, New York 10029-6574, USA

Accepted 19 November 2004

INVITED REVIEW

ABSTRACT: In the subacute and chronic stages of spastic paresis, stretch-sensitive (spastic) muscle overactivity emerges as a third fundamental mechanism of motor impairment, along with paresis and soft tissue contracture. Part II of this review primarily addresses the pathophysiology of the various forms of spastic overactivity. It is argued that muscle contracture is one of the factors that cause excessive responsiveness to stretch, which in turn aggravates contracture. Excessive responsiveness to stretch also impedes voluntary motor neuron recruitment, a concept termed stretch-sensitive paresis. None of the three mechanisms of impairment (paresis, contracture, and spastic overactivity) is symmetrically distributed between agonists and antagonists, which generates torque imbalance around joints and limb deformities. Thus, each may be best treated focally on an individual muscle-by-muscle basis. Intensive motor training of the less overactive muscles should disrupt the cycle of paresis–disuse–paresis, and concomitant use of aggressive stretch and focal weakening agents in their more overactive and shortened antagonists should break the cycle of overactivity–contracture–overactivity.

Muscle Nerve **31:** 552–571, 2005

PATHOPHYSIOLOGY OF SPASTIC PARESIS. II: EMERGENCE OF MUSCLE OVERACTIVITY

JEAN-MICHEL GRACIES, MD, PhD

Department of Neurology, Mount Sinai Medical Center, One Gustave L Levy Place, Annenberg 2/Box 1052, New York, New York 10029-6574, USA

Accepted 19 November 2004

Annals of Physical and Rehabilitation Medicine 58 (2015) 173–178

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Update article

Coefficients of impairment in deforming spastic paresis

J.-M. Gracies

Service de rééducation neurolocomotrice, laboratoire analyse et restauration du mouvement, université Paris-Est, hôpitaux universitaires Henri-Mondor, AP–HP, 51, avenue du Maréchal-de-Lattre-de-Tassigny, 94010 Créteil, France

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Spastic cocontraction
Spastic dystonia
Spasticity
Stepwise quantified assessment
Tardieu Scale
Fatigability
Weakness
Coefficients of impairment

ABSTRACT

This position paper introduces an assessment method using staged calculation of coefficients of impairment in spastic paresis, with its rationale and proposed use. The syndrome of deforming spastic paresis superimposes two disorders around each joint: a neural disorder comprising stretch-sensitive paresis in agonists and antagonist muscle overactivity, and a muscle disorder ("spastic myopathy") combining shortening and loss of extensibility in antagonists. Antagonist muscle overactivity includes spastic cocontraction (misdirected descending command), spastic dystonia (tonic involuntary muscle activation, at rest) and spasticity (increased velocity-dependent reflexes to phasic stretch, at rest). This understanding of various types of antagonist resistance as the key limiting factors in paretic movements prompts a stepwise, quantified, clinical assessment of antagonist resistances, elaborating on the previously developed Tardieu Scale. Step 1 quantifies limb function (e.g. ambulation speed in lower limb, Modified Frenchay Scale in upper limb). The following four steps evaluate various angles X of antagonist resistance, in degrees all measured from 0°, position of minimal stretch of the tested antagonist. Step 2 rates the functional muscle length, termed X_{V1} (V1, slowest stretch velocity possible), evaluated as the angle of arrest upon slow and strong passive muscle stretch. X_{V1} is appreciated with respect to the expected normal passive amplitude, X_N, and reflects combined muscle contracture and residual spastic dystonia. Step 3 determines the angle of catch upon fast stretch, termed X_{V3} (V3, fastest stretch velocity possible), reflecting spasticity. Step 4 measures the maximal active range of motion against the antagonist, termed X_A, reflecting agonist capacity to overcome passive (stiffness) and active (spastic cocontraction) antagonist resistances over a single movement. Finally, Step 5 rates the residual active amplitude after 15 seconds of maximal amplitude rapid alternating movements, X_{A15}. Amplitude decrement from X_A to X_{A15} reflects fatigability. Coefficients of shortening $(X_N - X_{V1})/X_N$, spasticity $(X_{V1} - X_{V3})/X_{V1}$, weakness $(X_{V1} - X_A)/X_{V1}$ and fatigability $(X_A - X_{A15})/X_A$ are derived. A high (e.g., >10%) coefficient of shortening prompts aggressive treatment of the muscle disorder – e.g. by stretch programs, such as prolonged stretch postures –, while high coefficients of weakness or fatigability prompt addressing the neural motor command disorder, e.g. using training programs such as repeated alternating movements of maximal amplitude.

frontiers in Neurology

ORIGINAL RESEARCH
published: 14 March 2022
doi: 10.3389/fneur.20[illegible]817229

Do Muscle Changes Contribute to the Neurological Disorder in Spastic Paresis?

Maud Pradines[1,2], Mouna Ghédira[1,2], Blaise Bignami[2], Jordan Vielotte[2], Nicolas Bayle[1,2], Christina Marciniak[3,4], David Burke[5], Emilie Hutin[1,2] and Jean-Michel Gracies[1,2]*

[1] UR 7377 BIOTN, Laboratoire Analyse et Restauration du Mouvement, Université Paris Est Créteil (UPEC), Créteil, France, [2] AP-HP, Service de Rééducation Neurolocomotrice, Unité de Neurorééducation, Hôpitaux Universitaires Henri Mondor, Créteil, France, [3] Department of Physical Medicine and Rehabilitation, Northwestern University and the Shirley Ryan AbilityLab, Chicago, IL, United States, [4] Department of Neurology, Northwestern University and the Shirley Ryan AbilityLab, Chicago, IL, United States, [5] Department of Neurology, Royal Prince Alfred Hospital and the University of Sydney, Sydney, NSW, Australia

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TYPE Opinion
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EDITED BY
Nicola Smania,
University of Verona, Italy

REVIEWED BY
Yusuke Sekiguchi,
Tohoku University Hospital, Japan
Carlo Trompetto,
University of Genoa, Italy

*CORRESPONDENCE
Maud Pradines
maud.pradines@u-pec.fr

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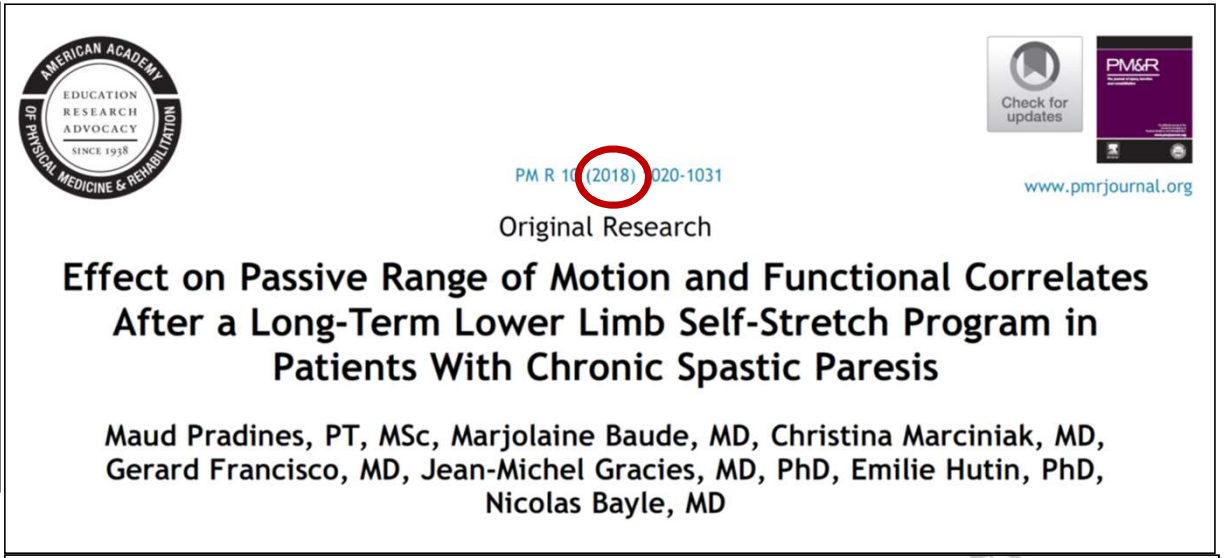
Where is the zero of Tardieu for proximal trans-joint lower limb muscles? The relevance for the estimation of muscle shortening and weakness

Maud Pradines[1,2]*, Tymothée Poitou[2], Ota Gál[3], Martina Hoskovcová[3], Nicolas Bayle[1,2], Marjolaine Baude[1,2] and Jean-Michel Gracies[1,2]

[1]UR 7377 BIOingénierie Tissus Neuroplasticité (BIOTN), Faculté de Santé, Université Paris-Est Créteil, Créteil, France, [2]Service de Rééducation Neurolocomotrice, Hôpitaux Universitaires Henri Mondor, Créteil, France, [3]Department of Neurology, Charles University, Prague, Czechia

KEYWORDS

modified Tardieu scale, five step assessment, coefficient of shortening, hemiparesis, zero of Tardieu, quantified assessment



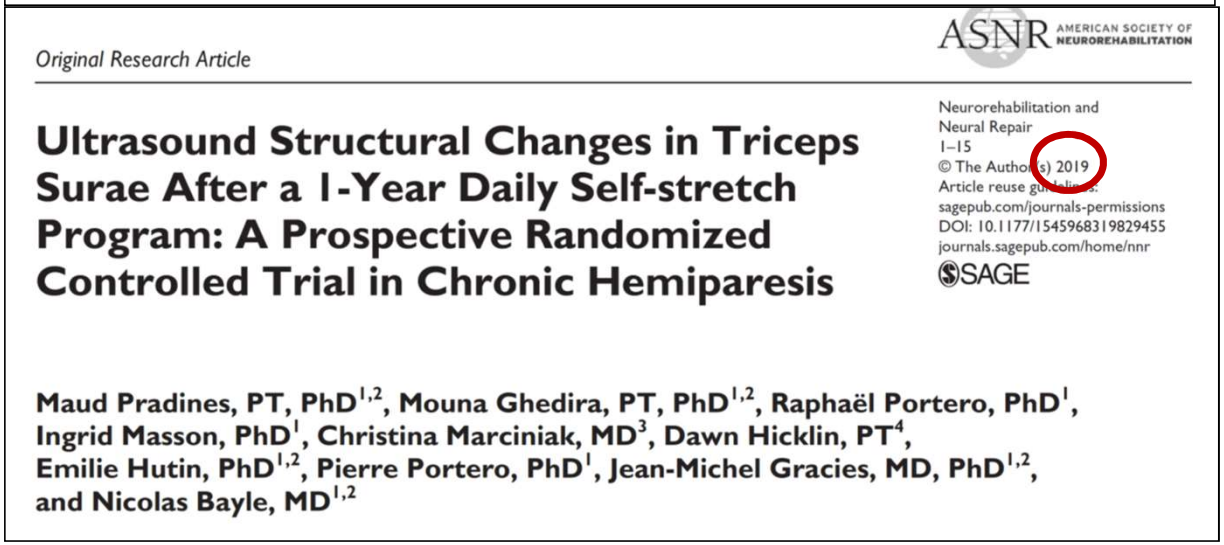
PM R 10 (2018) 1020-1031

www.pmrjournal.org

Original Research

Effect on Passive Range of Motion and Functional Correlates After a Long-Term Lower Limb Self-Stretch Program in Patients With Chronic Spastic Paresis

Maud Pradines, PT, MSc, Marjolaine Baude, MD, Christina Marciniak, MD, Gerard Francisco, MD, Jean-Michel Gracies, MD, PhD, Emilie Hutin, PhD, Nicolas Bayle, MD



Original Research Article

ASNR AMERICAN SOCIETY OF NEUROREHABILITATION

Neurorehabilitation and Neural Repair
1–15

DOI: 10.1177/1545968319829455
journals.sagepub.com/home/nnr
SAGE

Ultrasound Structural Changes in Triceps Surae After a 1-Year Daily Self-stretch Program: A Prospective Randomized Controlled Trial in Chronic Hemiparesis

Maud Pradines, PT, PhD[1,2], Mouna Ghedira, PT, PhD[1,2], Raphaël Portero, PhD[1], Ingrid Masson, PhD[1], Christina Marciniak, MD[3], Dawn Hicklin, PT[4], Emilie Hutin, PhD[1,2], Pierre Portero, PhD[1], Jean-Michel Gracies, MD, PhD[1,2], and Nicolas Bayle, MD[1,2]

Rôle of the physician

= Passion of the Patient !

A woman had fallen into lethargy. Her son called doctors.

The doctors all said: please choose one of us to treat her.

One of the doctors said: I will treat her according to Brown's method. However, the others responded: this is a wrong method; she may rather stay in lethargy and die, than being treated according to Brown.

The second said: I will treat her according to Hanneman's method. The others responded: that method is wrong; may she die rather than being treated according to Hanneman's method.

Then the son said: please treat her one way or another as long as you heal her. However, the doctors would not come into an agreement, they would not concede anything to one another.

Then the son, full of distress and despair, cried out : ***O Mother!*** ***And the mother, at the voice of her son, woke up and was cured.*** *One sent the doctors away.*

Adam Mickiewicz* – The book of the Polish Pilgrims, *1832

Rôle of the physician

= Give Hope to the Patient !

Qu'attend le patient du docteur / kinésithérapeute?

= un peu de travail/espoir?

- Wiles et al, 2004 : Information donnée/kinés à propos d'exercices à pratiquer après sortie maintient sentiment d'espoir sur récupération.
- Becker and Kaufman, 1995 : Entretiens 36 patients AVC + 20 médecins. *« Patients supposaient que leur trajectoire de récupération était modifiable s'ils travailleraient suffisamment »*
- Pound et al, 1994 : Programmes d'exercices pour maison prisés pour la structuration qu'ils donnent à chaque jour.
- → *« Cependant, les professionnels de santé doivent rester attentifs à ne pas promouvoir de faux espoirs quant à la récupération. »*

Gracies, 2009

Quel message adresse le docteur / kiné au patient ?

= “modérez votre enthusiasme” ?

Anderson and Marlett, 2004:

“Le discours professionnel tente d’assurer des espoirs réalistes de récupération…”

→ “..patients AVC et familles se plaignent des discours négatifs, de la façon dont les possibilités de vie après l’AVC sont présentées, et du désespoir engendré”

Gracies, 2009

Quel message adresser au patient ?

« Cependant, les professionnels de santé doivent faire attention à ne pas promouvoir de faux espoirs concernant la récupération. »

Faux espoirs?

ou

Vrais objectifs????

Bach-y-Rita P, Bach-y-Rita E. Hope and active patient participation in the rehabilitation environment. Arch Phys Med Rehabil. 1990;71(13):1084-5

Espoir

Socrate à Antiphon : « Tu sais que, sans l'espoir du succès, on ne goûte aucune jouissance, tandis que, si on pense réussir en agriculture, dans la navigation, ou dans toute autre profession que ce soit, on s'y livre avec autant de joie que si on réussissait déjà. Crois-tu, cependant, que ce [la réussite] soit un bonheur égal à celui que donne l'espoir de se rendre meilleur soi-même et ses amis ? »

Cité par Ph Simon (1905) dans Xénophon, L'Economique, p. 47

Bach-y-Rita P, Bach-y-Rita E. Hope and active patient participation in the rehabilitation environment. Arch Phys Med Rehabil. 1990;71(13):1084-5

Espérance en situation d'incertitude

La rééducation d'une hémiparésie est comme <u>jouer</u> au casino

Tel homme passe sa vie sans ennui en jouant tous les jours peu de choses. Donnez-lui tous les matins l'argent qu'il peut gagner chaque jour, à la charge qu'il ne joue point, vous le rendez malheureux.

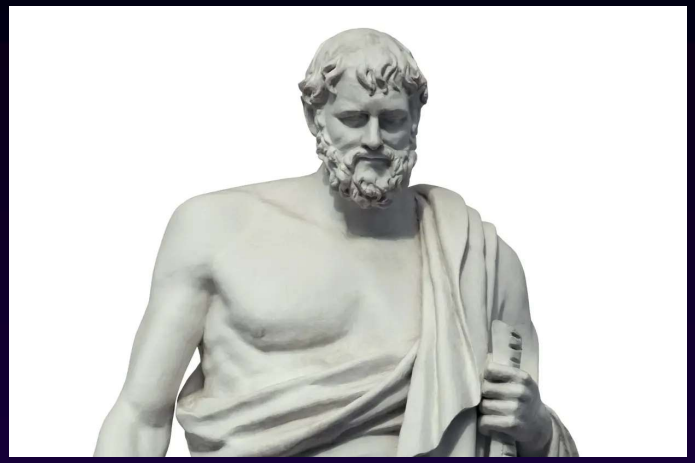
Blaise Pascal

Il y a des gens pour qui l'espérance elle-même est un plaisir plus grand que ce qu' ils pourraient se procurer par la jouissance de leur mise.

Buffon *(cité dans le* Buffon *de Jasques Roger)*

Role of the Patient

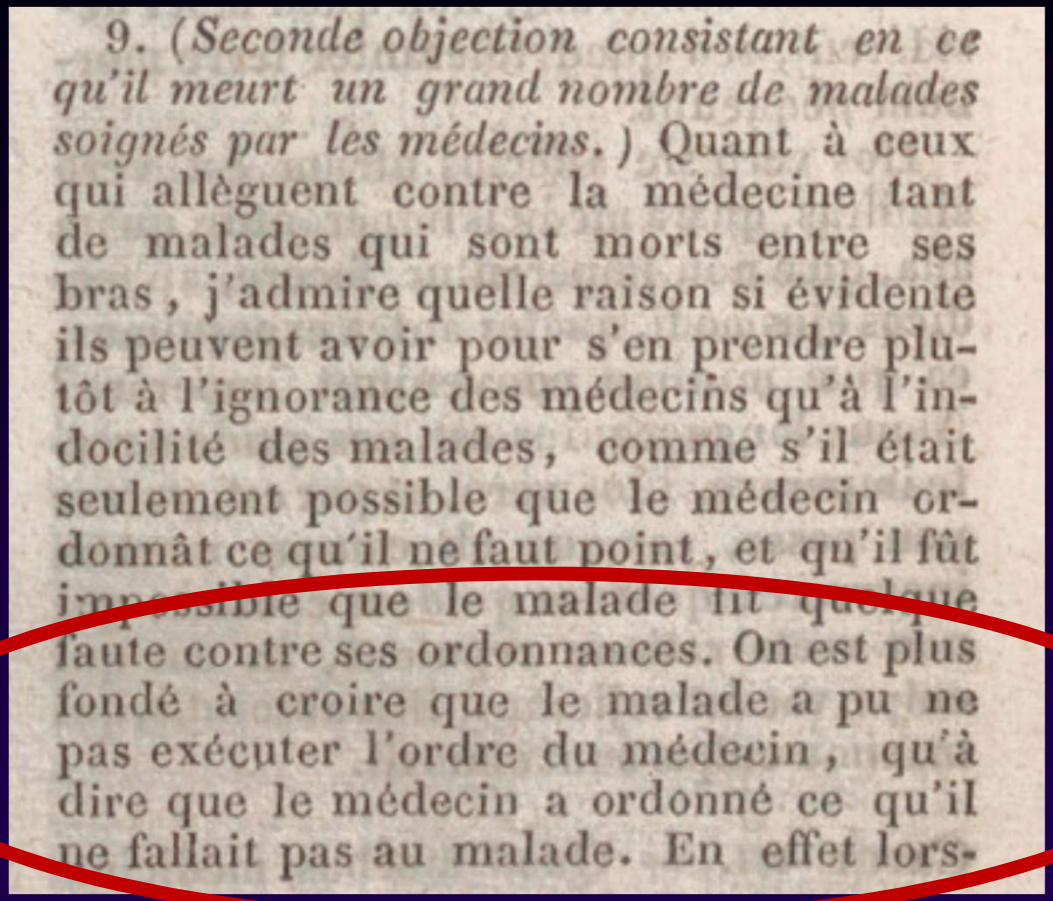
Ars longa vita brevis - The Oracle from Cos



« The patient must fight the disease, with the help of the doctor. »

Hippocrates (-460;-377) - Epidemics I - La consultation
Hermann, 1986 (ISBN 2-7056-5996-X), p. 4 et 13.
Selected texts by par Armelle Debru.

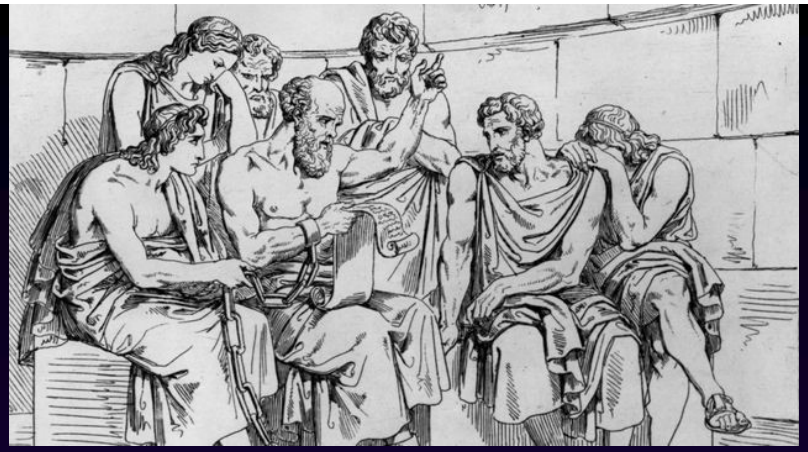
Hippocrates (*de l'Art* - Foës) – actions or <u>non-actions</u> on the part of the patient

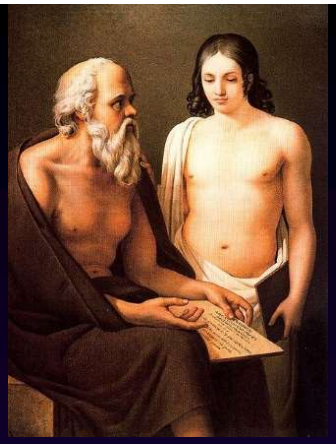


9. (*Seconde objection consistant en ce qu'il meurt un grand nombre de malades soignés par les médecins.*) Quant à ceux qui allèguent contre la médecine tant de malades qui sont morts entre ses bras, j'admire quelle raison si évidente ils peuvent avoir pour s'en prendre plutôt à l'ignorance des médecins qu'à l'indocilité des malades, comme s'il était seulement possible que le médecin ordonnât ce qu'il ne faut point, et qu'il fût impossible que le malade fît quelque faute contre ses ordonnances. On est plus fondé à croire que le malade a pu ne pas exécuter l'ordre du médecin, qu'à dire que le médecin a ordonné ce qu'il ne fallait pas au malade. En effet lors-

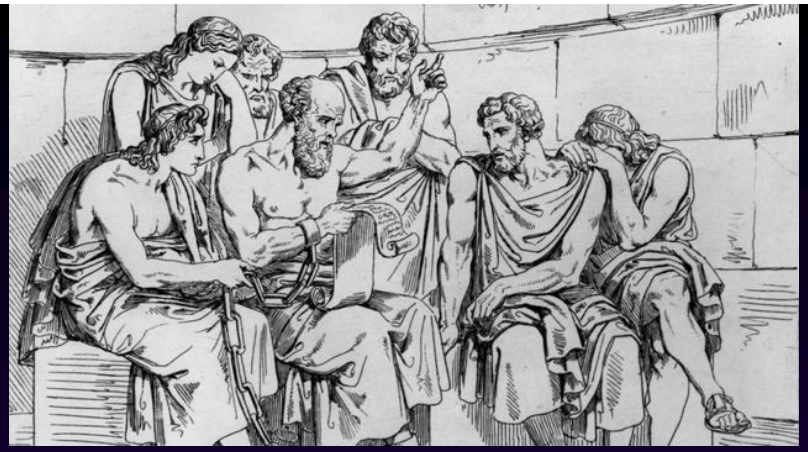
When things go wrong, it is more plausible that there are instances when the patient <u>does not execute</u> the doctor's orders, rather than to say that the doctor gave wrong orders to the patient.

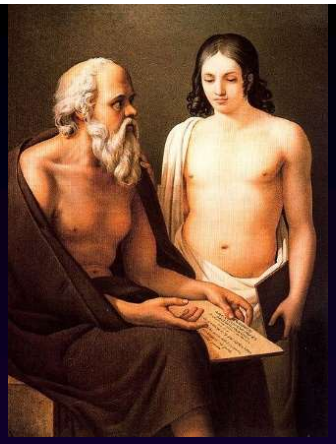
***Hippocrate** (460-377 av. J.-C.) - Foës, Anuce (1528-1595). Traducteur*
***Gardeil, Jean-Baptiste (1726-1808).** 1836-1837. <u>http://gallica.bnf.fr/ark:/12148/bpt6k9659638z</u> - p.415*



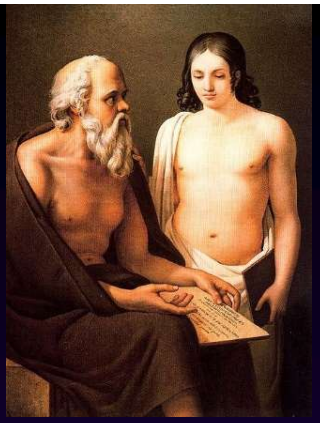


How to bring the patient to fight - harder - the disease ?





How to enhance patient motivation ?



Psychological tool

The Diary

Guided Self-rehabilitation Contract

Psychological aspect

=

diary-based rehabilitation

Guided Self-rehab = Contract

Self-monitoring!

Psychiatry: Continuous, daily holding of a diary provides positive reinforcement.
It may have antidepressant properties *per se*.

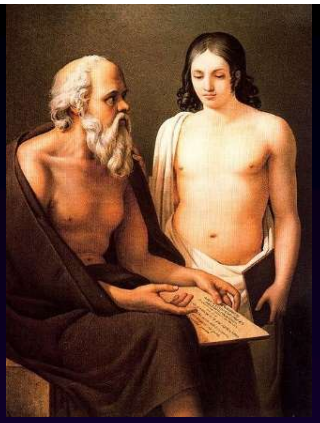
Hanel F & Martin G. Int J Rehabil Res. 1980;3(4):505–517;
Ackerman AM & Shapiro ES. J Appl Behav Anal. 1984;17(3):403–407;
Lenderking WR et al. Contemp Clin Trials. 2008;29(6):867–877.

Guided Self-rehab = Contract

Self-monitoring!

Addictology: Self-monitoring diary + moral contract between patient and therapist = components of a *physical inactivity-cessation programme* (akin to smoking cessation programmes)

Burkhart PV et al. J Nurs Scholarsh. 2007;39(2):133-40;
Kilmann PR et al. J Clin Psychol. 1977;33(3):912–914;
Strecher VJ. Public Health Rep. 1983;98(5):497–502.



Psychological tool

The Quantified Diary

International Randomized Clinical Trial, Stroke Inpatient Rehabilitation With Reinforcement of Walking Speed (SIRROWS), Improves Outcomes

Bruce H. Dobkin, MD[1], **Prudence Plummer-D'Amato, PhD**[2], **Robert Elashoff, PhD**[1], **Jihey Lee, PhD**[1], and **the SIRROWS Group**

[1]Geffen School of Medicine, University of California Los Angeles, Los Angeles, California, USA

[2]Northeastern University, Boston, Massachusetts, USA

Abstract

Background—Feedback about performance may optimize motor relearning after stroke.

Objectives—Develop an international collaboration to rapidly test the potential efficacy of daily verbal feedback about walking speed during inpatient rehabilitation after stroke, using a protocol that requires no research funds.

Methods—This phase 2, single-blinded, multicenter trial randomized inpatients to either feedback about self-selected fast walking speed (daily reinforcement of speed, DRS) immediately after a single, daily 10-m walk or to no reinforcement of speed (NRS) after the walk, performed within the context of routine physical therapy. The primary outcome was velocity for a 15.2-m (50-foot) timed walk at discharge. Secondary outcomes were walking distance in 3 minutes, length of stay (LOS), and level of independence (Functional Ambulation Classification, FAC).

International Randomized Clinical Trial, Stroke Inpatient Rehabilitation With Reinforcement of Walking Speed (SIRROWS), Improves Outcomes

Bruce H. Dobkin, MD[1], **Prudence Plummer-D'Amato, PhD**[2], **Robert Elashoff, PhD**[1], **Jihey Lee, PhD**[1], and **the SIRROWS Group**

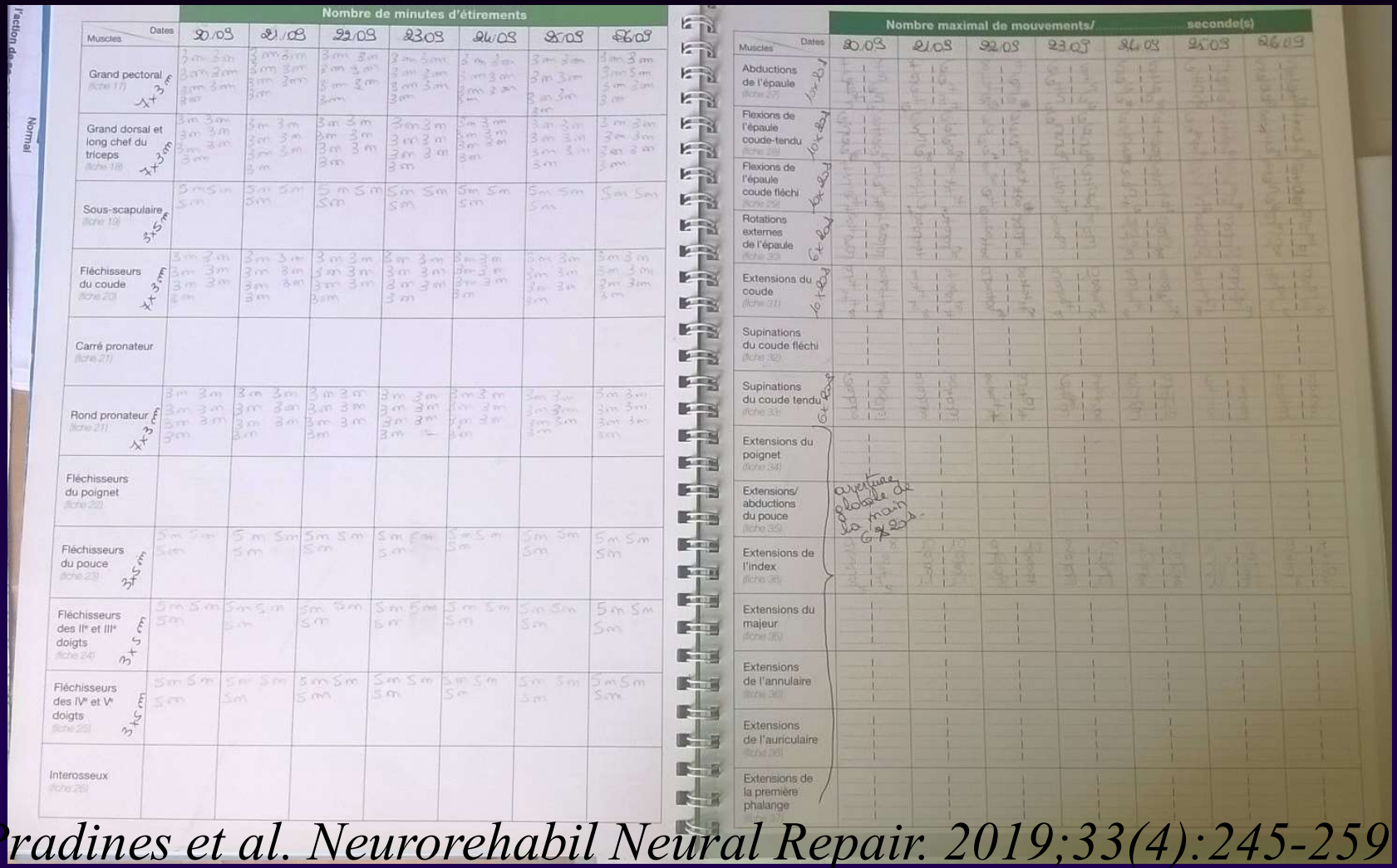
[1]Geffen School of Medicine, University of California Los Angeles, Los Angeles, California, USA

[2]Northeastern University, Boston, Massachusetts, USA

age, gender, time from onset of stroke to entry, initial velocity, and level of walking-related disability. The walking speed at discharge for DRS (0.91 m/s) was greater ($P = .01$) than that for NRS (0.72 m/s). No difference was found for LOS. LOS for both DRS and NRS was significantly shorter, however, for those who had mean walking speeds >0.4 m/s at entry. The DRS group did not have a higher proportion of FAC independent walkers ($P = .1$) and did not walk longer distances ($P = .09$).

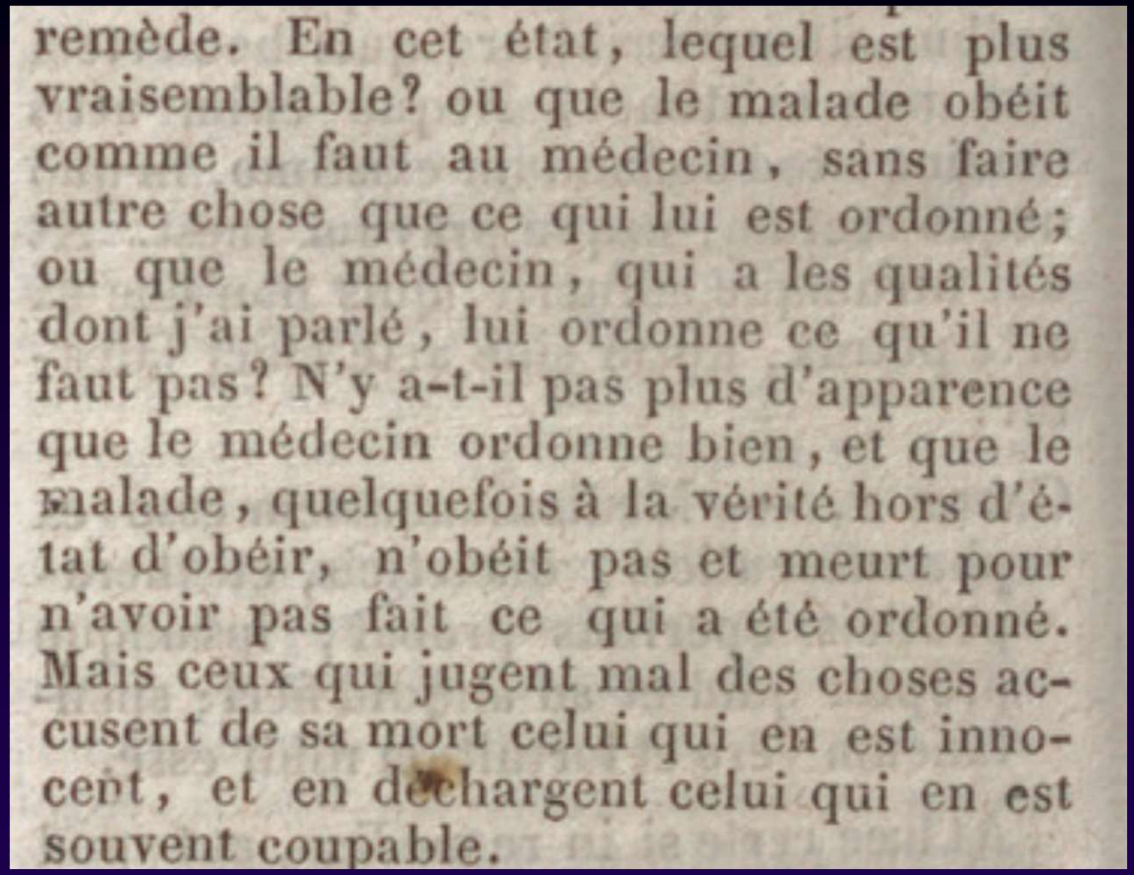
Conclusions—An Internet-based collaboration of 18 centers found that feedback about performance once a day produced gains in walking speed large enough to permit unlimited, slow community ambulation at discharge from inpatient rehabilitation.

Quantified Diary+++++



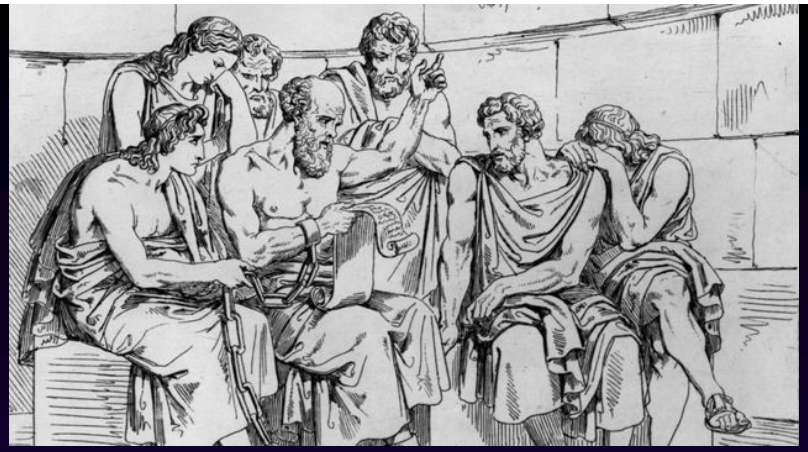
Pradines et al. Neurorehabil Neural Repair. 2019;33(4):245-259

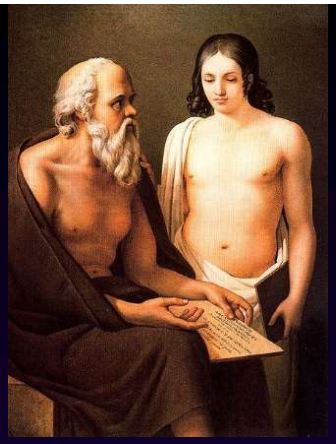
Hippocrate (de l'Art- Foës) – actions ou non du malade



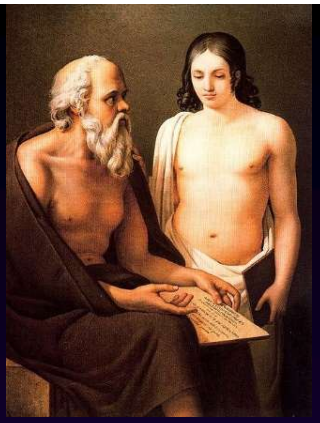
remède. En cet état, lequel est plus vraisemblable? ou que le malade obéit comme il faut au médecin, sans faire autre chose que ce qui lui est ordonné; ou que le médecin, qui a les qualités dont j'ai parlé, lui ordonne ce qu'il ne faut pas? N'y a-t-il pas plus d'apparence que le médecin ordonne bien, et que le malade, quelquefois à la vérité hors d'état d'obéir, n'obéit pas et meurt pour n'avoir pas fait ce qui a été ordonné. Mais ceux qui jugent mal des choses accusent de sa mort celui qui en est innocent, et en déchargent celui qui en est souvent coupable.

Hippocrate (0460-0377 av. J.-C.). Auteur du texte - Foës, Anuce (1528-1595). Éditeur scientifique Bayle, Antoine-Laurent-Jessé (1799-1858). Éditeur scientifique Coray, Adamantios (1748-1833). Traducteur ***Gardeil, Jean-Baptiste (1726-1808). Traducteur -*** *Pierer, Johann Fridrich. Éditeur scientifique. Encyclopédie des sciences médicales ; t. 1-2. Hippocrate. I-II. T. 1 / . [Opera, ex interpretatione latina Anutii Foesii, curante Jo. Frid. Pierer. Oeuvres d'Hippocrate traduites... par J.-B. Gardeil.] (Paris), 1836-1837.*
Cote : Bibliothèque nationale de France. Comprend : De Aere, aquis et locis Contient une table des matières Avec mode texte domaine public public domain Adresse permanente : http://gallica.bnf.fr/ark:/12148/bpt6k9659638z - p.416



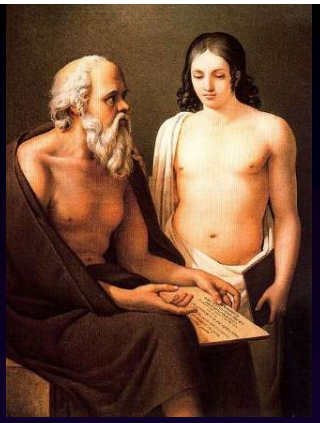


How to bring the patient to fight - better - the disease ?



“ But in truth Sophistics prevail in beauty on Rhetorics as much as does legislation over jurisprudence and Gymnastics over Medicine »

Socrate (-470;-399) – Gorgias Dialog - Platon



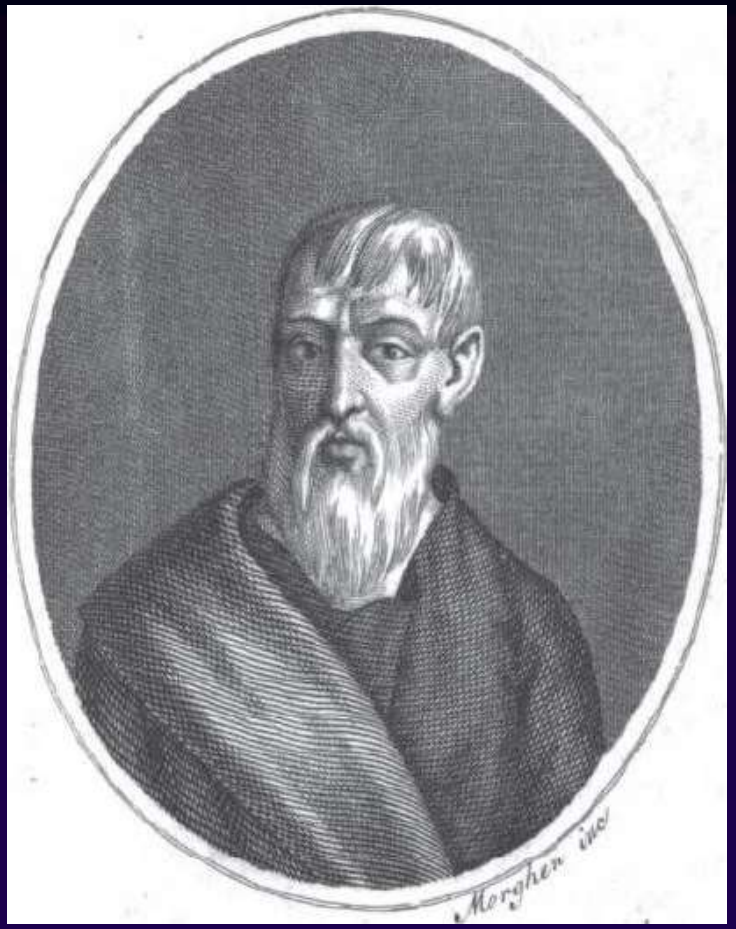
Technical tool?

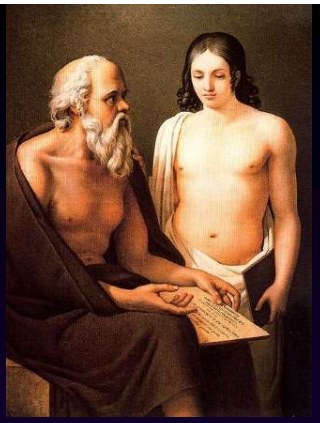
The *Physical* treatment

Hérodicus, athenians and physical exercise

Herodicus de Selymbria appliqua la gymnastique au traitement des maladies.
Jusque-là cet art n'avait été cultivé que pour former des militaires ou des athlètes. Hérodicus, qui était lui-même maître de gymnastique et d'une constitution maladive, entreprit de se fortifier par l'application régulière des exercices. Il faisait faire de très longues courses à ses malades ; par exemple, il les faisait aller d'Athènes à Mégare et revenir sans se reposer. C'était surtout au traitement des maladies chroniques qu'il se consacra… C'est du moins ce que dit Platon ; et en reprochant à Hérodicus de prolonger la vie des gens valétudinaires et de leur faire ainsi une longue maladie. …

Hippocrate-Littré, Vol 4, Remarques rétrospectives, p. 662





Technical tool?

Which Physical treatment?

Hippocrates (de l'Art- Foës) – Diagnosis of external vs internal disorders

The same science that makes you understand the disease, also teaches you its remedy.

Hippocrate* (460-377 av. J.-C.).** *Foës, Anuce (1528-1595). Éditeur scientifique Bayle, Antoine-Laurent-Jessé (1799-1858). Coray, Adamantios (1748-1833). Traducteur* ***Gardeil*, Jean-Baptiste (1726-1808). Traducteur -** *Pierer, Johann Fridrich.. Encyclopédie des sciences médicales ; t. 1-2. Hippocrate. I-II.* ***Tome 1 */ . [Opera, ex interpretatione latina Anutii Foesii, curante Jo. Frid. Pierer. Oeuvres d'Hippocrate traduites... par J.-B. Gardeil.] (Paris), 1836-1837. http://gallica.bnf.fr/ark:/12148/bpt6k9659638z -* ***p.418***

Deforming Spastic Paresis?

Little WJ. "Deformities of the human frame", 1843

Which factors impede movements?

Gracies, 2021

Deforming spastic paresis is first a problem with the antagonist.

Tardieu, throughout his career

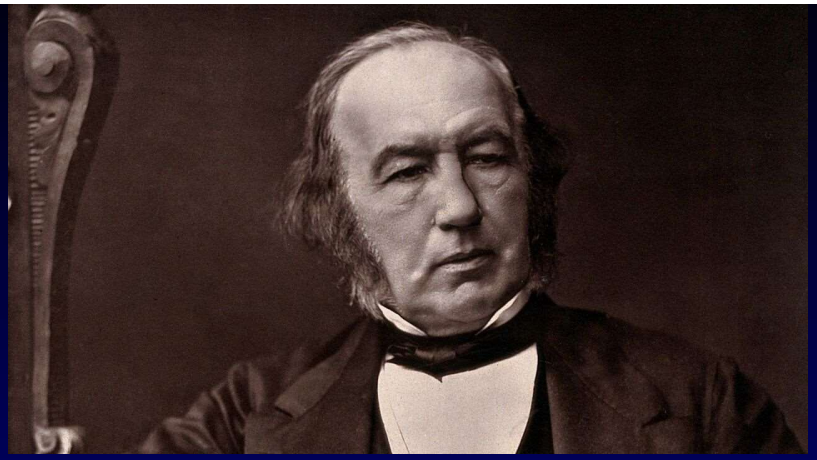
But which problem?

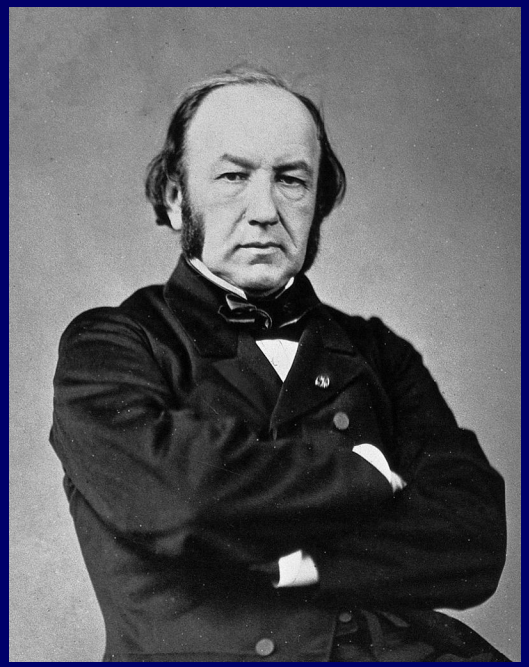
Guided Self-rehabilitation Contracts in Spastic Paresis

Psychologically = diary-based

Technically = antagonist-based

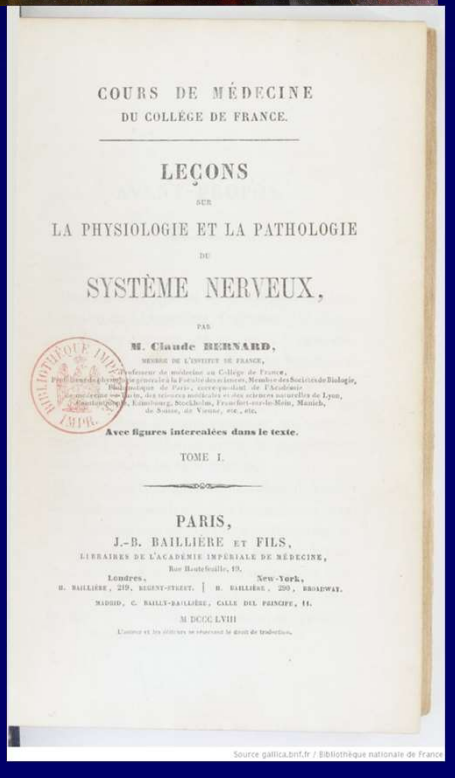
Gracies JM. Guided Self-rehabilitation Contract in Spastic Paresis. Springer Int Publ, Switzerland, 2016; ISBN 978-3-319-29107-9; ISBN 978-3-319-29108-6 (eBook);118p.





Physiology *must be able to explain life's phenomena, provided it remains built upon the knowledge of* ***histology.***

Claude Bernard, c 1845



COURS DE MÉDECINE
DU COLLÈGE DE FRANCE.

LEÇONS
SUR
LA PHYSIOLOGIE ET LA PATHOLOGIE
DU
SYSTÈME NERVEUX,

PAR
M. Claude BERNARD,

Avec figures intercalées dans le texte.

TOME I.

PARIS,
J.-B. BAILLIÈRE ET FILS,
LIBRAIRES DE L'ACADÉMIE IMPÉRIALE DE MÉDECINE,

M DCCC LVIII

The Syndrome of
Deforming Spastic Paresis
=
Spastic Myopathy, a neurological aggressor
+ …

Norvang et al. BMC Neurology (2018) 18:138
https://doi.org/10.1186/s12883-018-1134-0

BMC Neurology

RESE

Access

Tim
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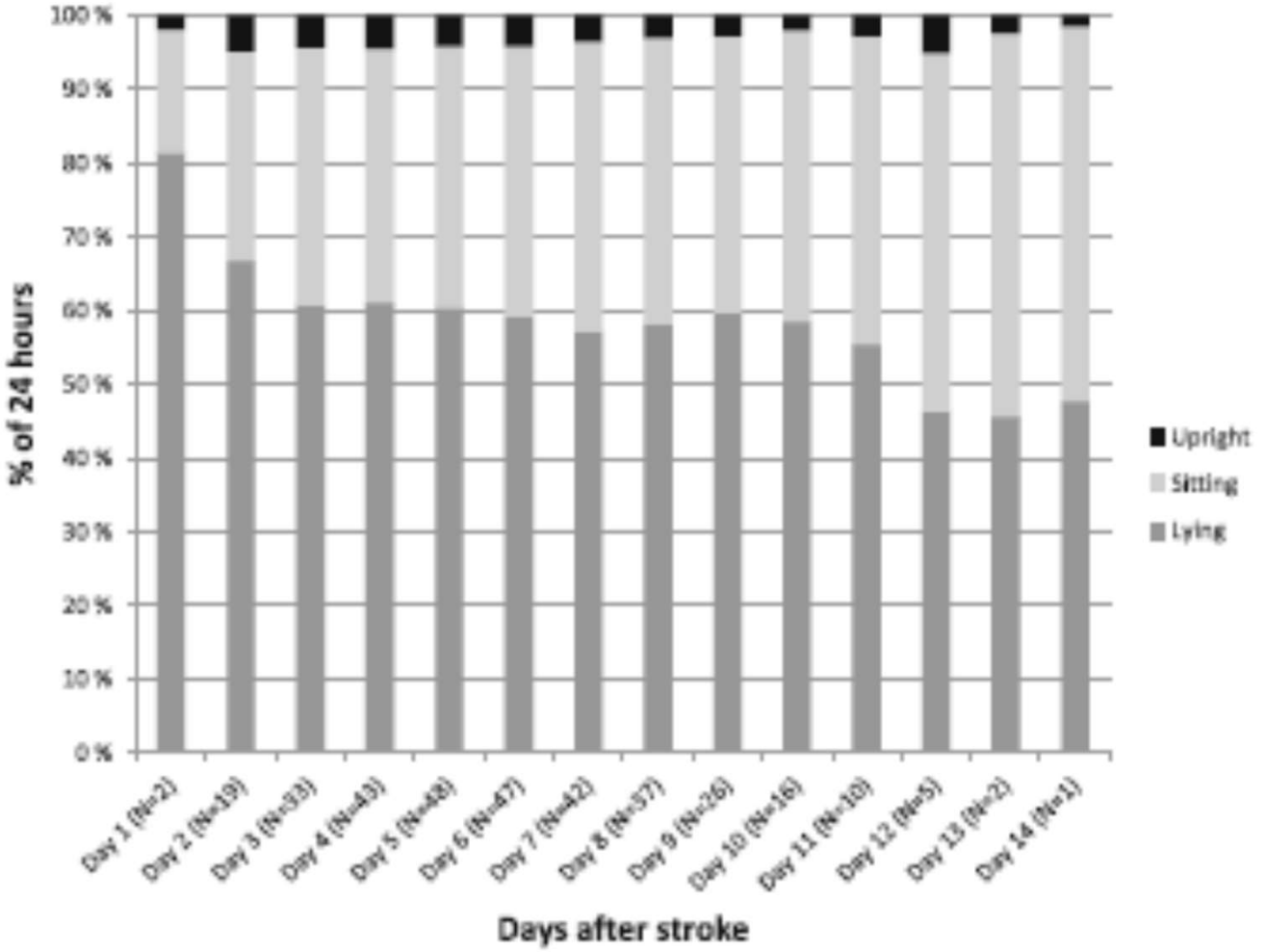


Fig. 2 Percentage of time spent in different positions within every 24 h

Time of arm positions in healthy subjects

- Arm movements observed for >5h/day in homes and local community of 21 older people age 73 (SD 7).
- Duration (min/hr) of arm positions > 90° elevation + purpose (manipulating, holding, reaching, pulling/pushing, or gesturing) recorded.
- Participants' arms spent 0.6 min/hr at > 90° elevation

~ 6-12 min / waking day !

Schurr K, Ada L. Observation of arm behaviour in healthy elderly people: implications for contracture prevention after stroke. Aust J Physiother. 2006;52(2):129-33

Immobilization or hypo-mobilization in short position

=

Muscle aggression worse than stroke

Jalal N, Gracies JM, Zidi M. Biomech Model Mechanobiol. 2020;19(1):61-80

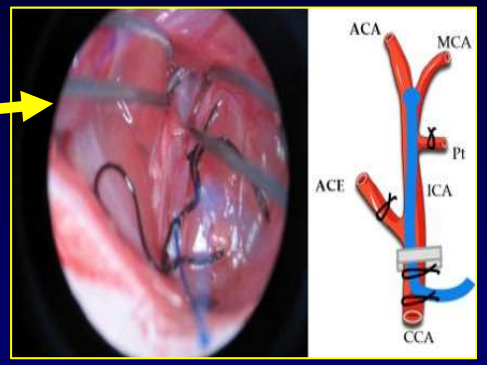
Singer et al, 2002

Muscle structure:
Role of Immobilization *vs* Stroke?

Four groups :

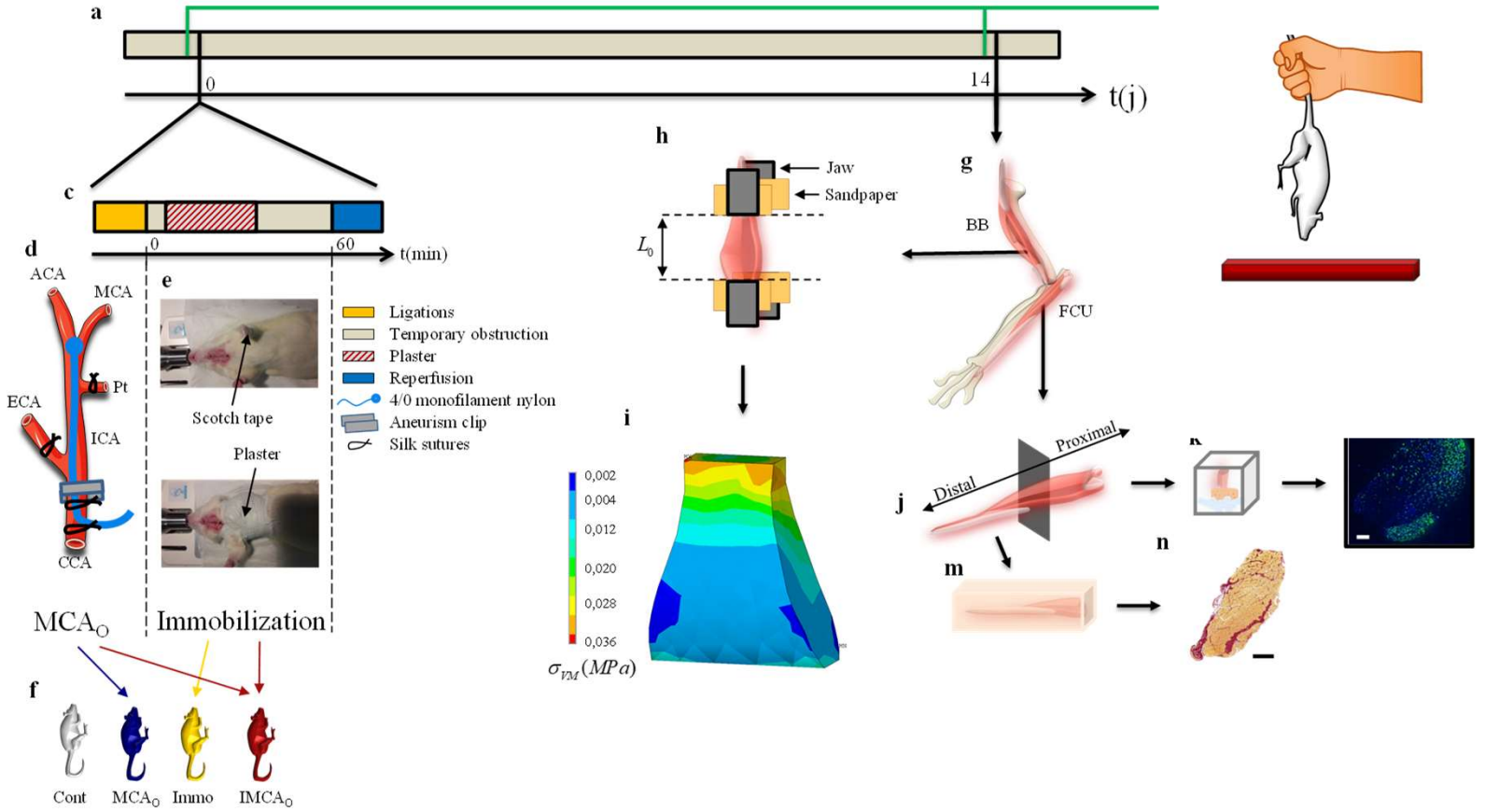
- **S**: “Stroke” without immobilization
- **I**: "Immobilization” without stroke
- **S+I**: “Stroke+Immobilization”
- **C**: “Sham” (failed strokes)

Duration : 14 days



Jalal N, Gracies JM, Zidi M. Mechanical and microstructural changes of skeletal muscle following immobilization and/or stroke. Biomech Model Mechanobiol. 2020;19(1):61-80

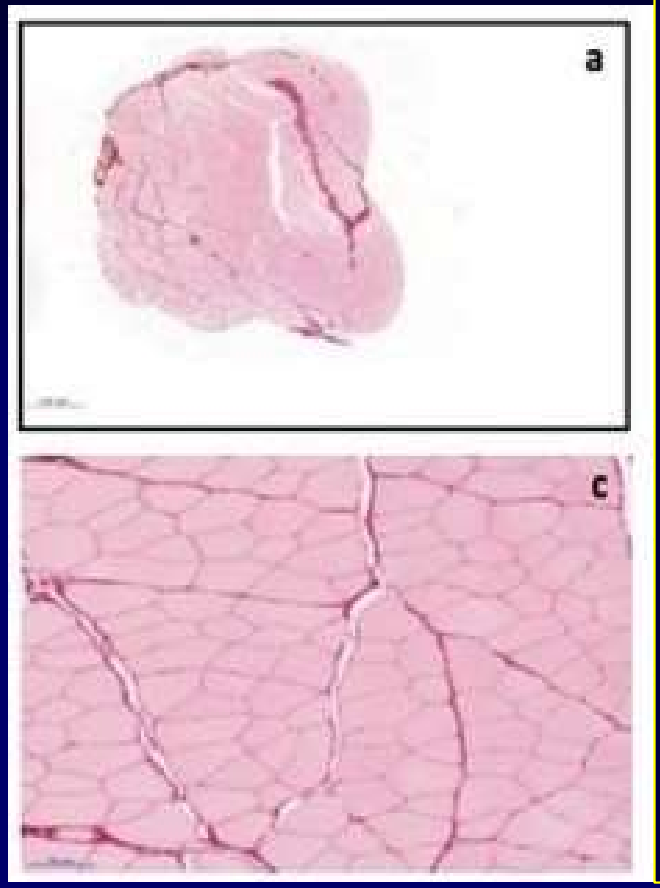
Methods



Jalal N, Gracies JM, Zidi M. *Mechanical and microstructural changes of skeletal muscle following immobilization and/or stroke.*
Biomech Model Mechanobiol. 2020;19(1):61-80

Histology of flexor carpi ulnaris

Red Sirius: quantification of collagen



Stroke w/o Immobilization

Immobilization w/o stroke

Jalal N, Gracies JM, Zidi M. Mechanical and microstructural changes of skeletal muscle following immobilization and/or stroke. ***Biomech Model Mechanobiol. 2020;19(1):61-80***

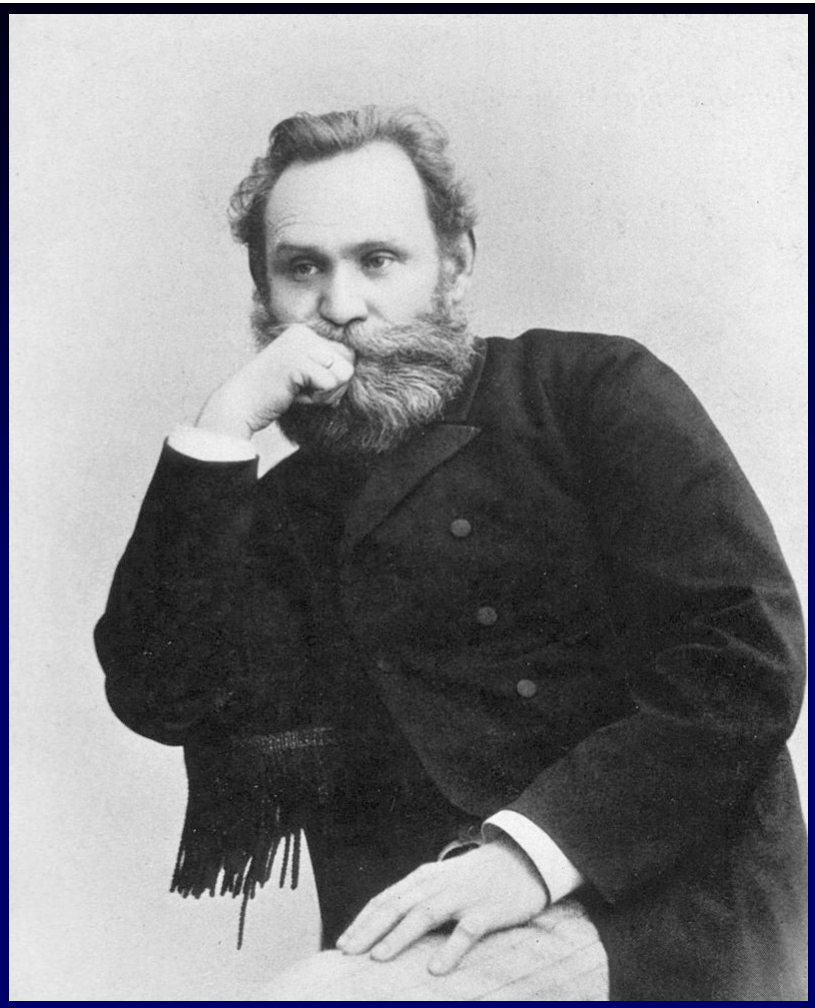
frontiers in Neurology

ORIGINAL RESEARCH
published: xx xx 2022
doi: 10.3389/fneur.2022.817229

Do Muscle Changes Contribute to the Neurological Disorder in Spastic Paresis?

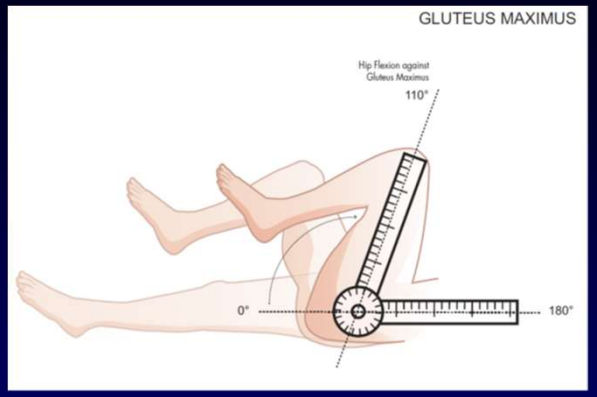
Maud Pradines[1,2*], *Mouna Ghédira*[1,2], *Blaise Bignami*[2], *Jordan Vielotte*[2], *Nicolas Bayle*[1,2], *Christina Marciniak*[3,4], *David Burke*[5], *Emilie Hutin*[1,2] *and Jean-Michel Gracies*[1,2]

[1] *UR 7377 BIOTN, Laboratoire Analyse et Restauration du Mouvement, Université Paris Est Créteil (UPEC), Créteil, France,* [2] *AP-HP, Service de Rééducation Neurolocomotrice, Unité de Neurorééducation, Hôpitaux Universitaires Henri Mondor, Créteil, France,* [3] *Department of Physical Medicine and Rehabilitation, Northwestern University and the Shirley Ryan AbilityLab, Chicago, IL, United States,* [4] *Department of Neurology, Northwestern University and the Shirley Ryan AbilityLab, Chicago, IL, United States,* [5] *Department of Neurology, Royal Prince Alfred Hospital and the University of Sydney, Sydney, NSW, Australia*



"One often says, and rightly so, that science advances in fits, according to successes in the methodological field. ... This is why our most urgent task was to develop a method."

Ivan Petrovitch PAVLOV, 1897
Conferences on the activity of the main digestive glands.
I. Pavlov. Selected works, ed. Kh. Kochtoianz, Moscow, 1954. p.92



Quantification of clinical examination

gluteus maximus – shoulder extensors

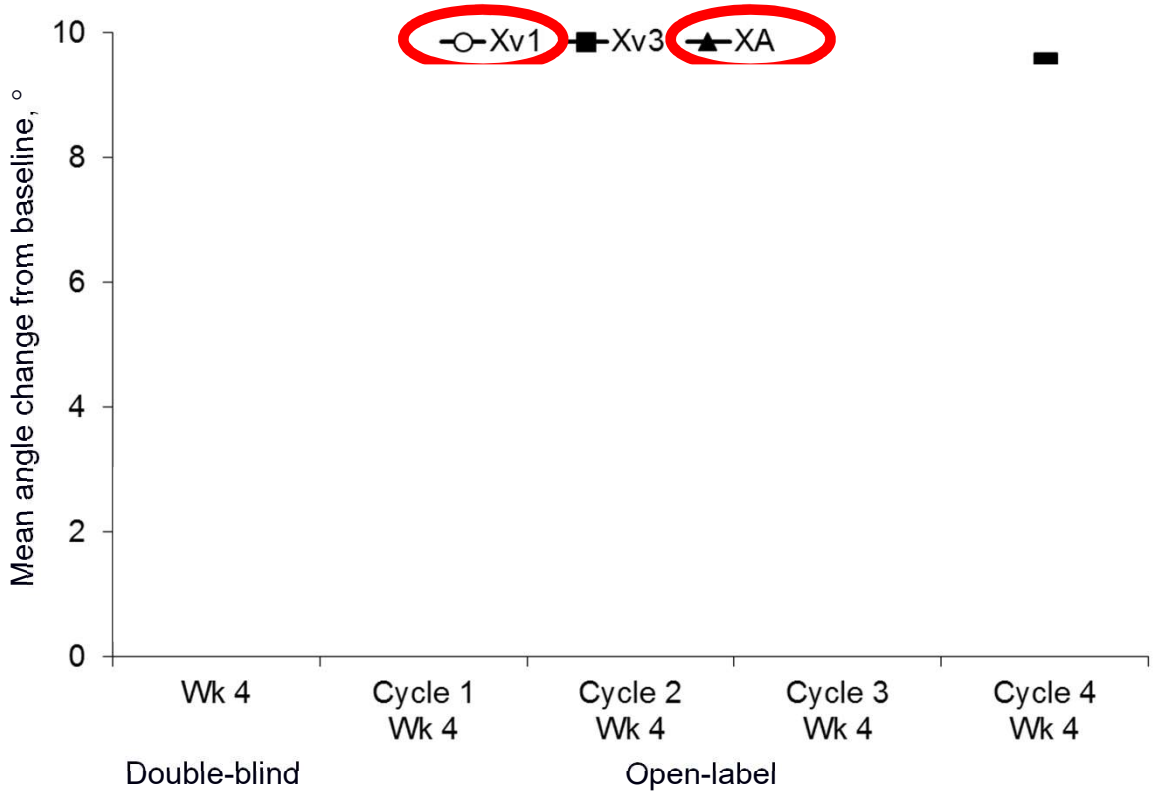
Five Step Assessment to guide treatment

Gracies JM. Coefficients of impairment in deforming spastic paresis. Ann Phys Rehabil Med. 2015;58(3):173-8

Coefficient of Shortening = $(X_N - X_{V1})/X_N$ → **Stretch**

Coefficient of Weakness = $(X_{V1} - X_A)/X_{V1}$ → **Training**

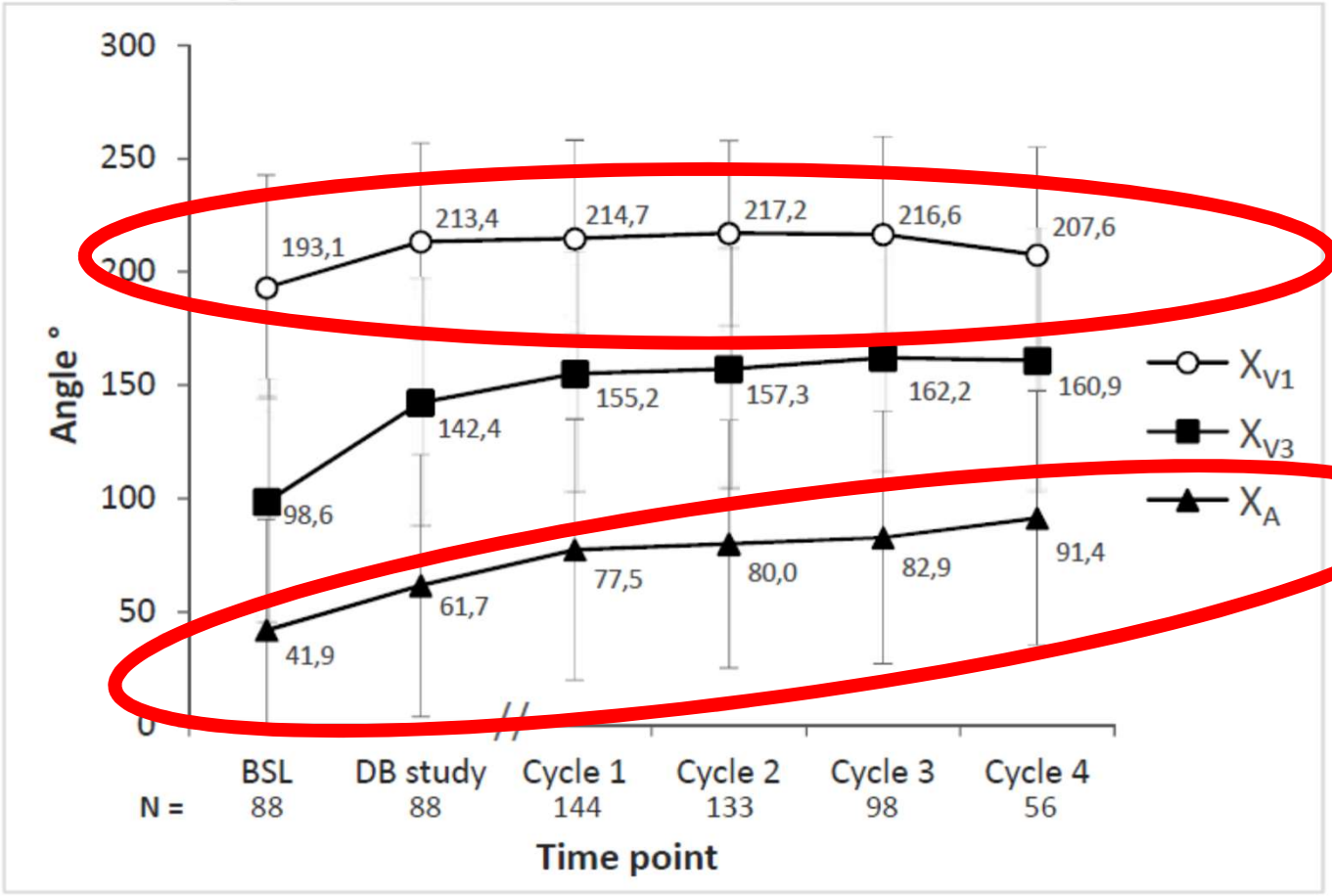
Maximal Clinical Extensibility X_{V1}
Angle of Catch X_{V3}
Angle of Match X_A
vs gastrocnemius resistance after repeated BoNT injections



Gracies et al, Efficacy and safety of abobotulinumtoxinA in spastic lower limb: Randomized trial and extension. ***Neurology 2017;89:1-9***

Upper Limb Open Label phase – Repeated injection cycles

A. Extrinsic finger flexors



Gracies et al, Muscle Nerve 2018;57(2):245-254

Double nature of coefficients 'of shortening' (X_{V1}) and 'of weakness' (X_A)?

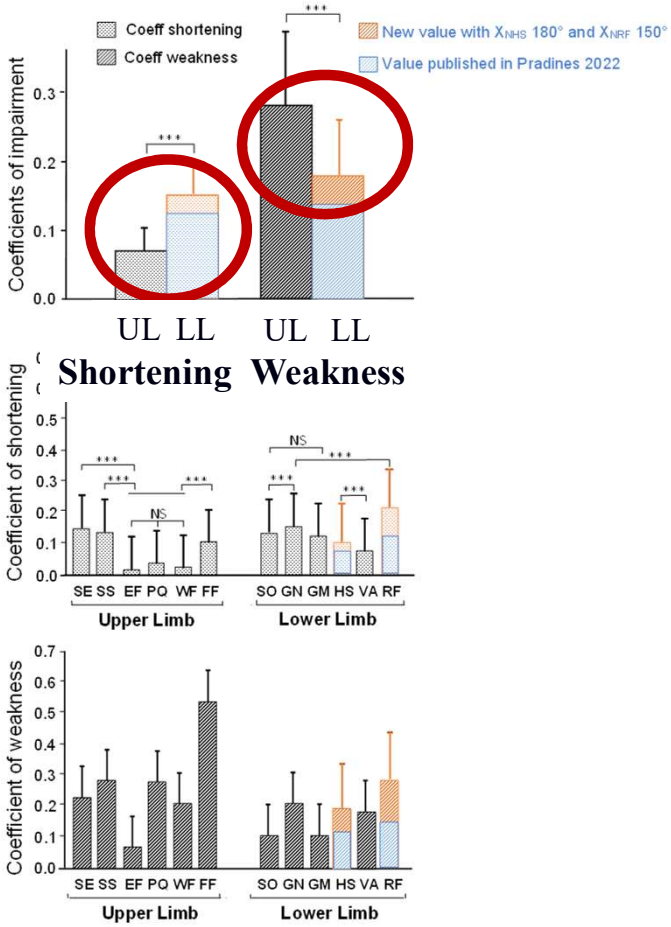
- X_{V1} = mostly histological measure: little change post lidoc block orrepeated BoNT injections *(Gracies et al, 2017, 2018)*; remains far from expected physiological values (X_N) *(Winston et al, 2019)*

- **X_A: markedly ↑** post lidoc block *(Winston et al, 2019)* or repeated BoNT injections (Gracies etal 2017, 2018) - ***adds*** **antagonistic cocontractions** (and agonist paresis) **to X_{V1}**

Winston P, *Mills PB, Reebye R, Vincent D. Cryoneurotomy as a Percutaneous Mini-invasive Therapy for the Treatment of the Spastic Limb: Case Presentation, Review of the Literature, and Proposed Approach for Use.* ***Arch Rehabil Res Clin Transl. 2019****;1(3-4):100030*

Chronic paretic upper and lower limbs are *two different beasts*

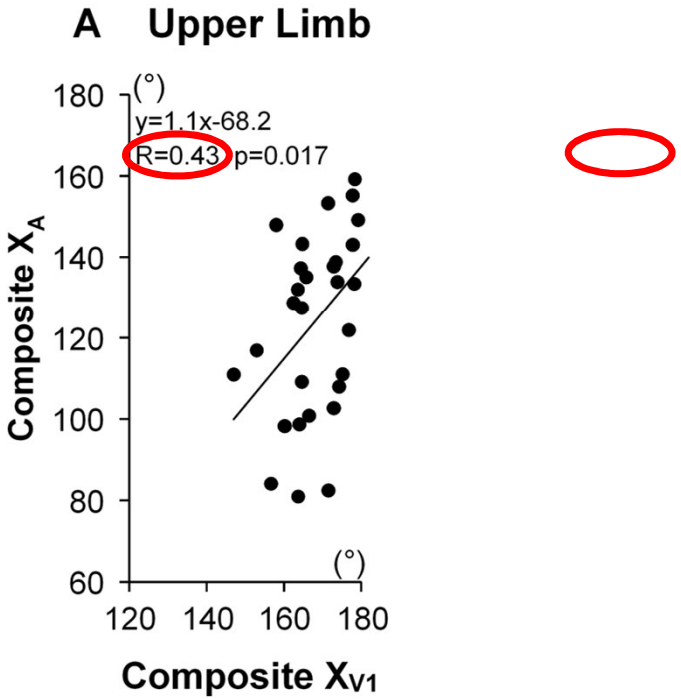
→ More sensitivity to toxin in UL



Pradines et al. *Does the muscle disorder contribute to the neurological disorder in spastic paresis?* ***Front Neurol. 2022 Mar 14;13:817229***

Pradines et al. *Where is the zero of Tardieu for proximal transjoint muscles?* ***Front Neurol 2023***

Role of histological muscle changes in active movements



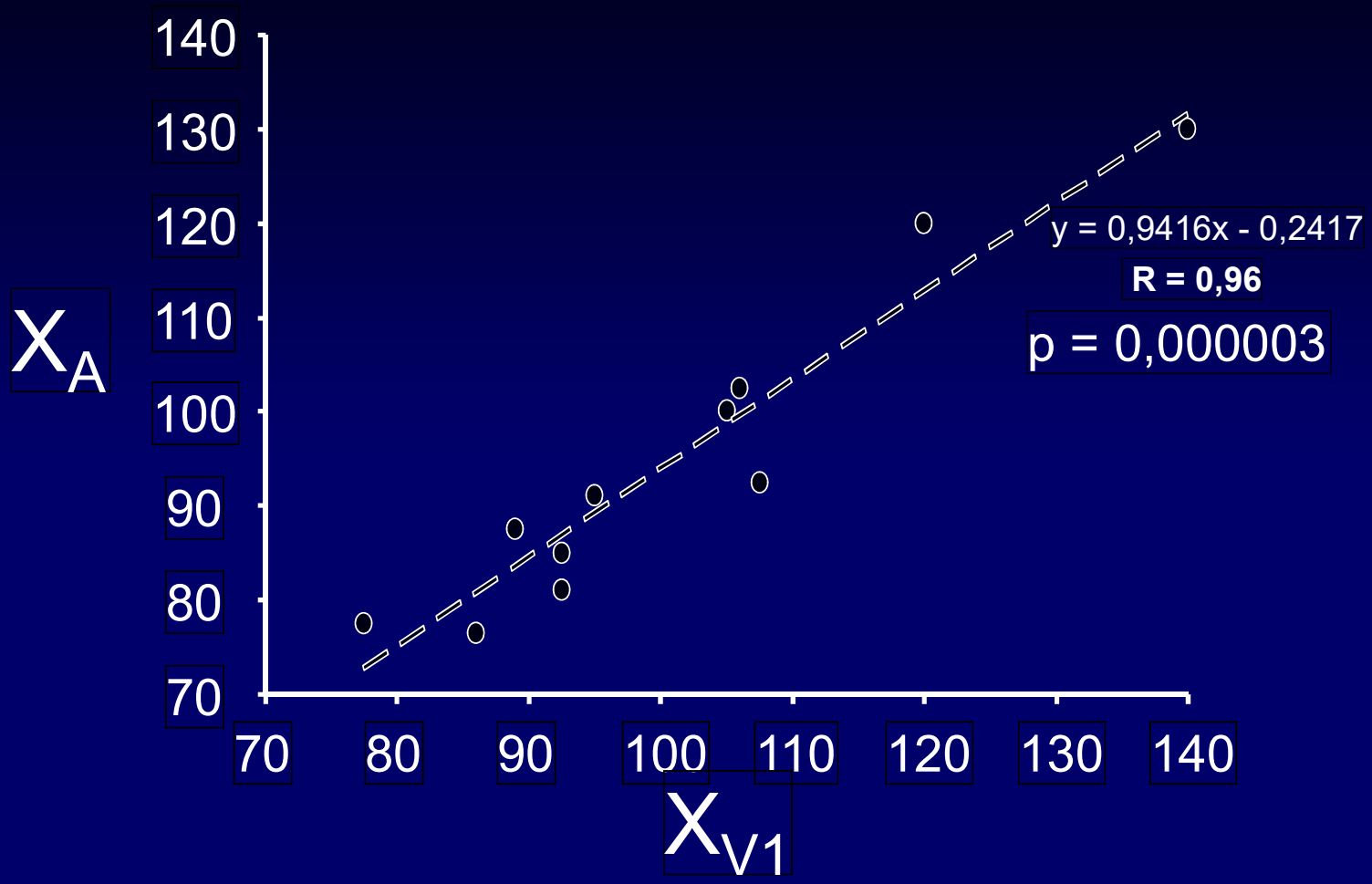
Pradines et al, Does the muscle disorder contribute to the neurological disorder in spastic paresis? Front Neurol. 2022 Mar 14;13:817229

In words..

In the paretic lower limb (~50%) and to a lesser degree in the paretic upper limb (~16%?),

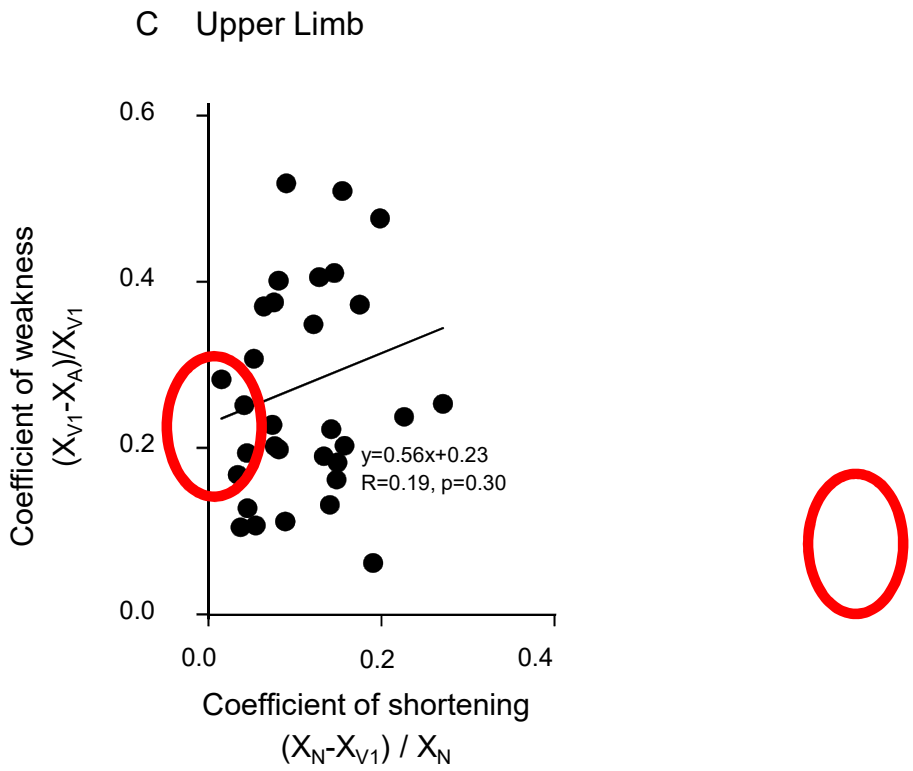
<u>active</u> movement capacities *are determined by* <u>passive</u> movement capacities.

X_{V1} et X_A – Glut Max – Infant paresis



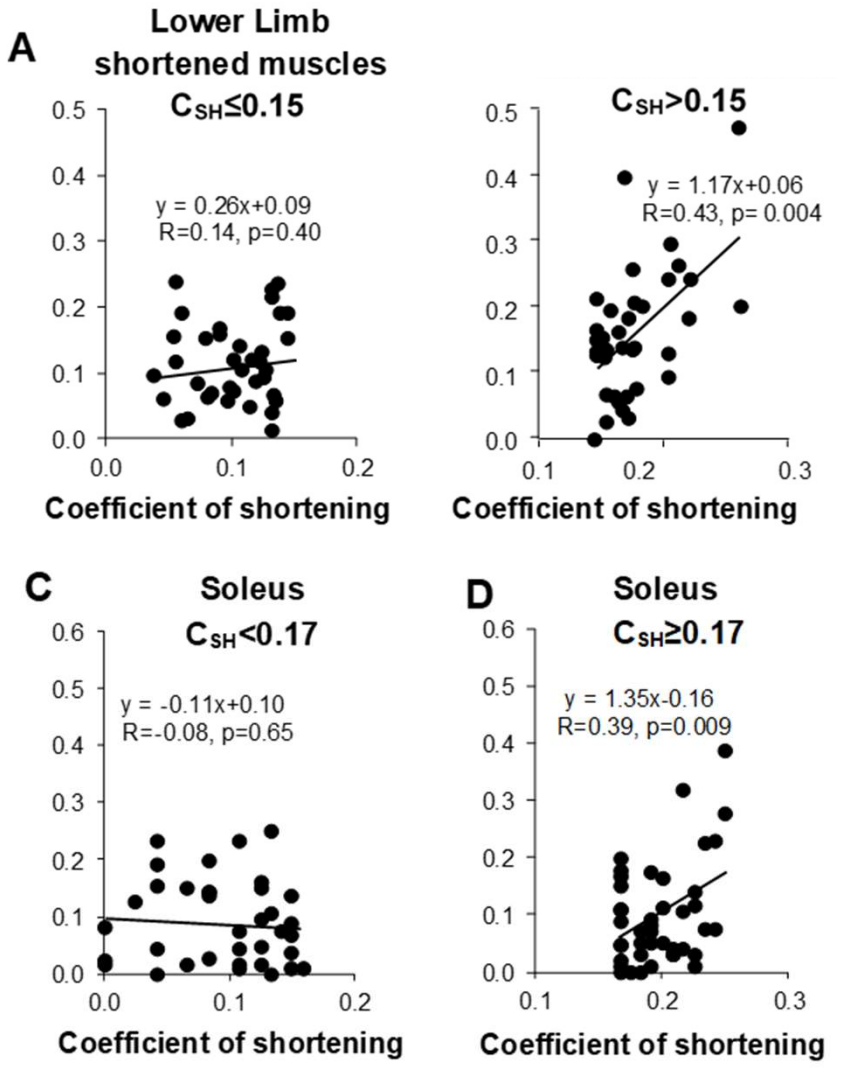
Van Reeth C, Pauwels C, Bayle N, Loche CM, Gracies JM. Predominant factors of motor deficiencies in adult spastic paresis: Infant vs adult-acquired lesions. Ann Phys Rehabil Med 2013; 56 S1: e385-e386

Paretic upper and lower limb are two different beasts



Pradines et al, Does the muscle disorder contribute to the neurological disorder in spastic paresis? Front Neurol. 2022 Mar 14;13:817229

Role of histological muscle changes in *increasing cocontractions*?



Pradines et al, Does the muscle disorder contribute to the neurological disorder in spastic paresis? Front Neurol. 2022 Mar 14;13:817229

Gioux et Petit - J Applied Physiol 1993-75-6-2629

\+ *(Rosant et al, Exp Neurol, 2006)*

- Healthy brain

- 2ry ending firing for a given stretch ← m. immobilized 5 sem short position > neutral position

- Baseline firing *without* relative stretch = doubles from *control* to *imm in neutral position* and doubles again from *neutral to short*

- Unchanged response to ɣ stim = extrafusal origin

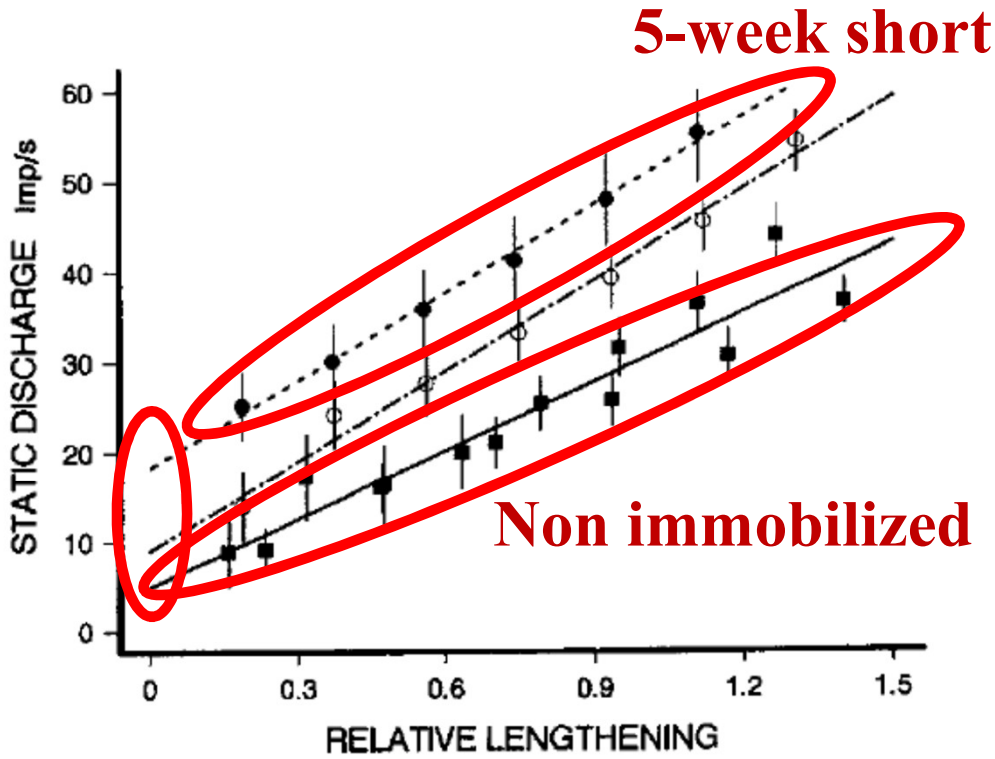
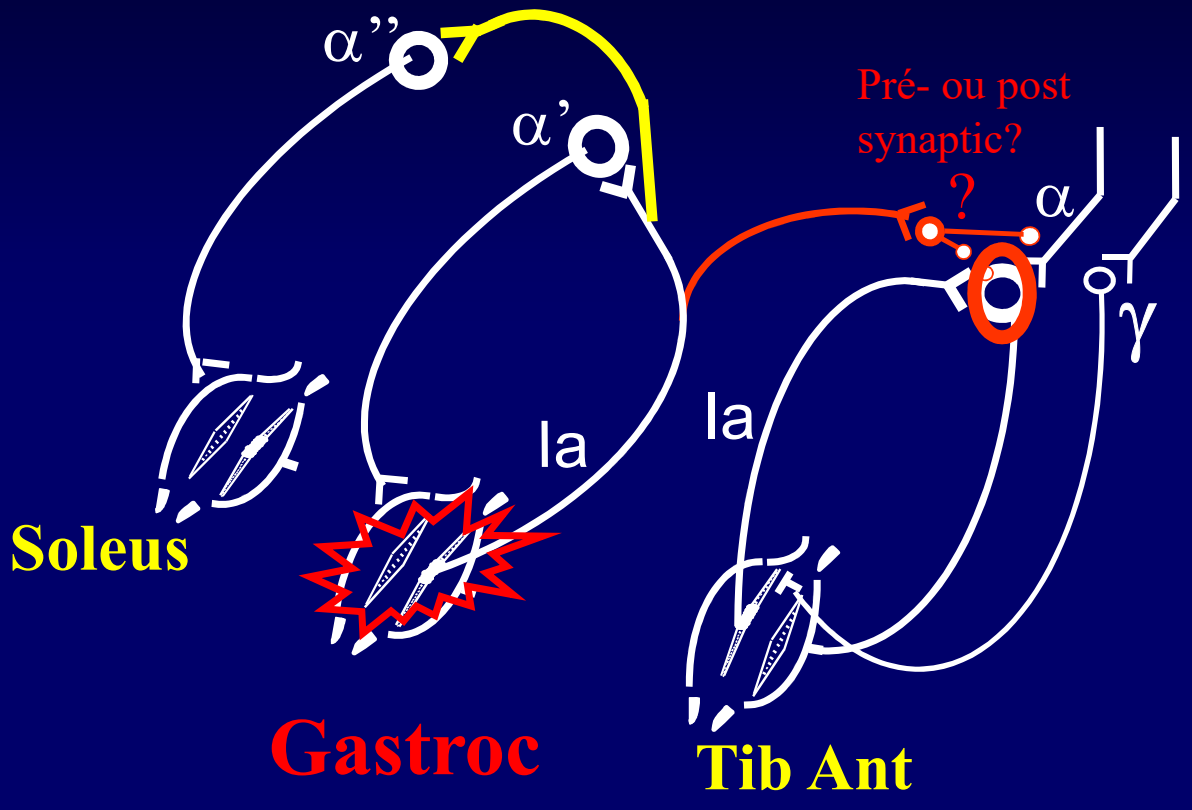


FIG. 5. Relationship between static discharge of secondary endings and muscle relative lengthening for control muscles (■), muscles fixed for 5 wk at short length (●), and muscles fixed for 5 wk at neutral length (○). Vertical bars, standard errors.

Hypothesis for stretch-sensitive paresis and for spastic cocontraction



Gracies, 2021

The Syndrome of
Deforming Spastic Paresis
=
Spastic Myopathy
+ *Spastic Cocontraction*

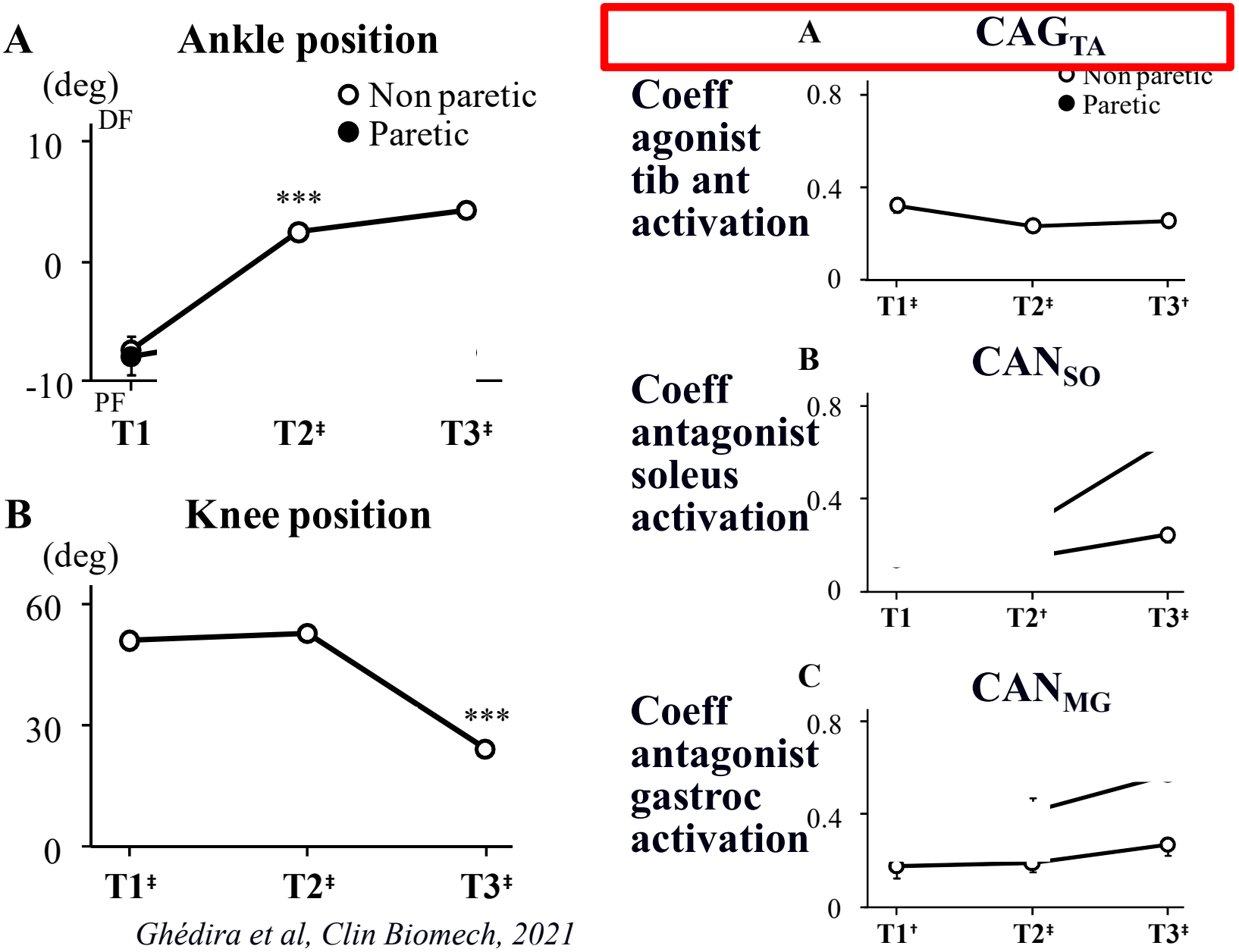
Spastic cocontraction recording during gait

Ghédira et al, Clin Biomech, 2021

Agonist and antagonist activation around the ankle during the swing phase of gait in hemiparesis

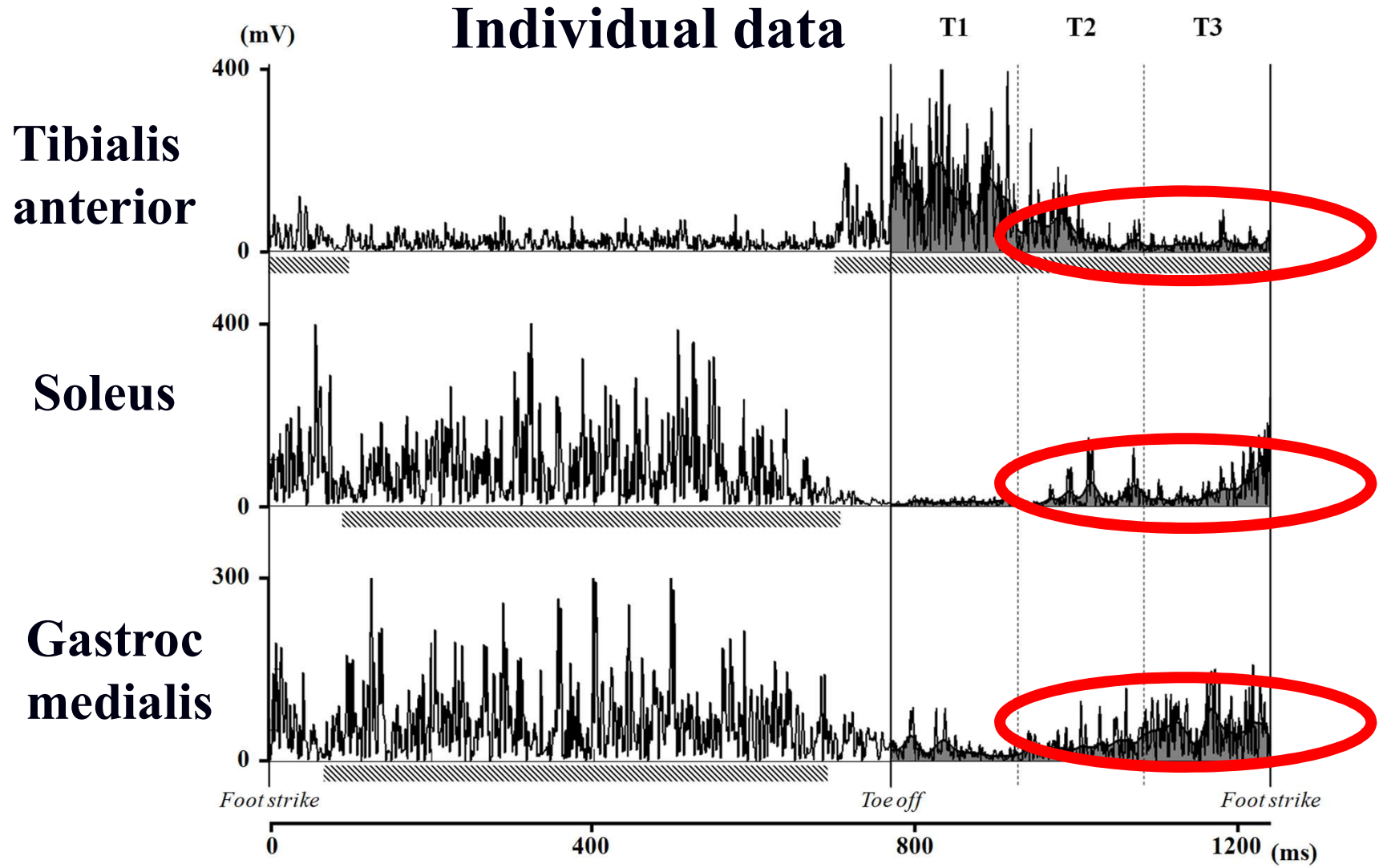
Subjects (n)	42
Age (y)	50 ± 15
Time since paresis onset (y)	7 ± 7
Gender	
Female (n)	14
Male (n)	28
Paretic side	
Left (n)	28
Right (n)	14
Cause	
Ischemic stroke (n)	21
Hemorrhagic stroke (n)	10
Non-evolutive tumor (n)	6
Traumatic brain injury (n)	5
Comfortable gait	
Speed (m/s)	0.66 ± 0.26
Paretic step length (m)	0.47 ± 0.12
Non paretic step length (m)	0.41 ± 0.16
Cadence (step/s)	1.47 ± 0.27

Ghédira M, Albertsen IM, Mardale V, Loche CM, Vinti M, Gracies JM, Bayle N, Hutin E. Agonist and antagonist activation at the ankle monitored along the swing phase in hemiparetic gait. Clin Biomech (Bristol, Avon). 2021 Oct;89:105459

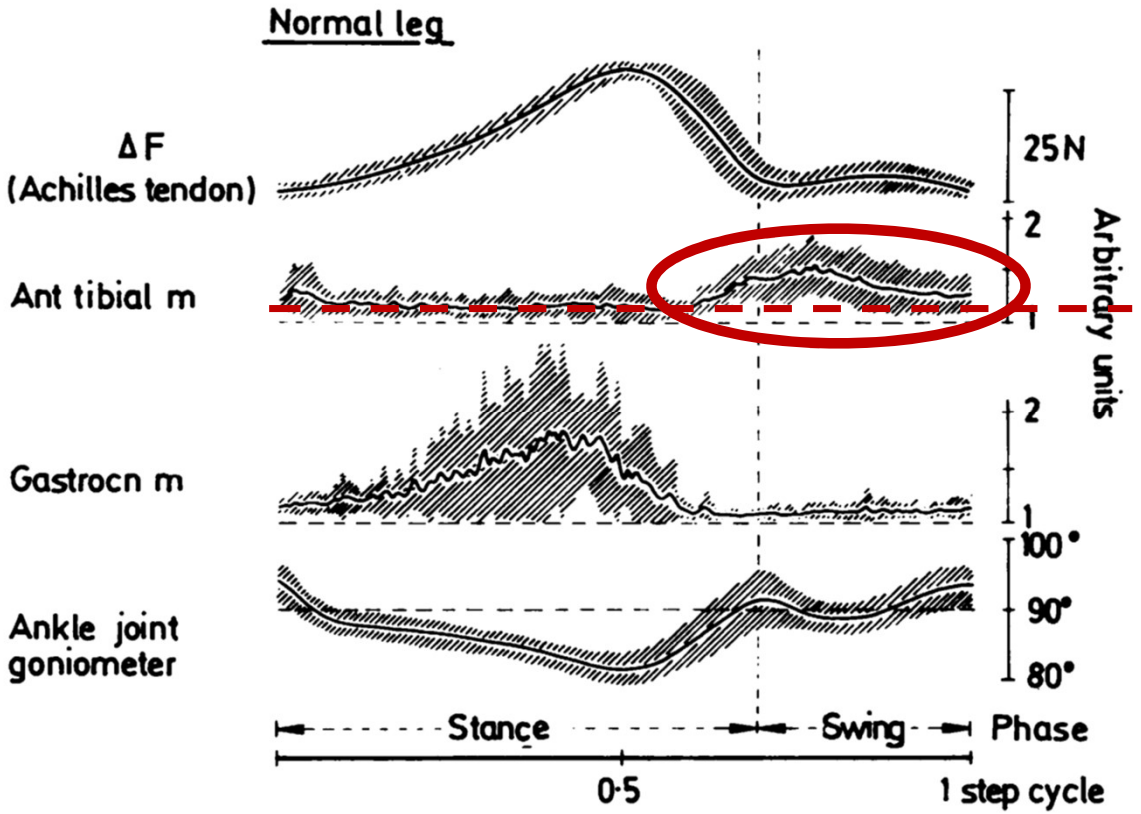


Ghédira et al, Clin Biomech, 2021

Wagner JM, Dromerick AW, Sahrmann SA, Lang CE. Upper extremity muscle activation during recovery of reaching in subjects with post-stroke hemiparesis. Clin Neurophysiol. 2007;118(1):164-76

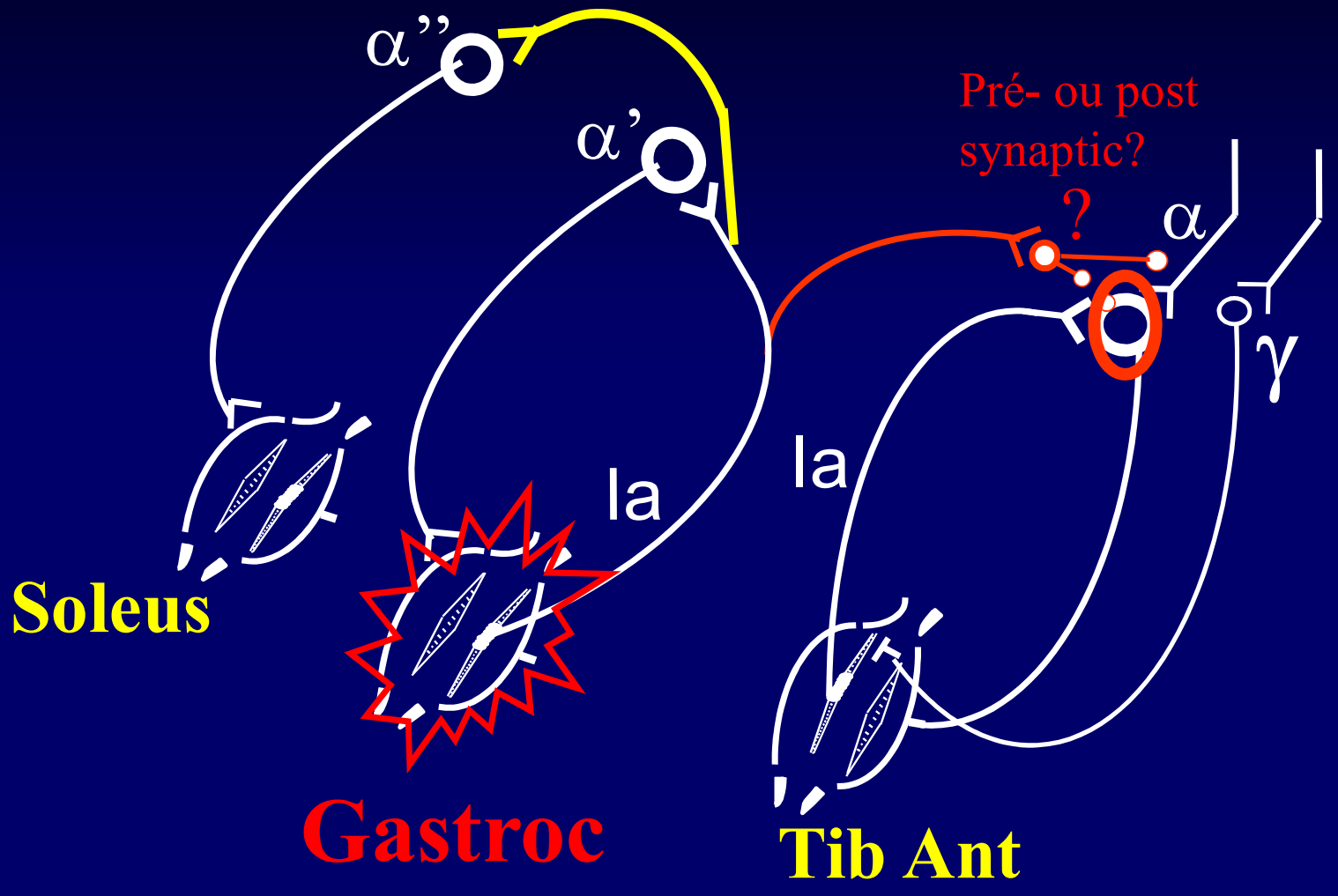


Ghédira M, Albertsen IM, Mardale V, Loche CM, Vinti M, Gracies JM, Bayle N, Hutin E. Agonist and antagonist activation at the ankle monitored along the swing phase in hemiparetic gait. Clin Biomech (Bristol, Avon). 2021 Oct;89:105459



Berger W, Horstmann G, Dietz V.
J Neurol Neurosurg Psychiatry. 1984;47(9):1029-33

Hypothesis for stretch-sensitive paresis and for spastic cocontraction



Gracies, 2021

The Syndrome of
Deforming Spastic Paresis
=
Spastic Myopathy
+ Spastic Cocontraction !

- Botulinum toxins ~ effective but crude way to take care of excessive muscle activations (only)
- Comprehensive approach? → Let us start by trying to take care of the *sick muscle*

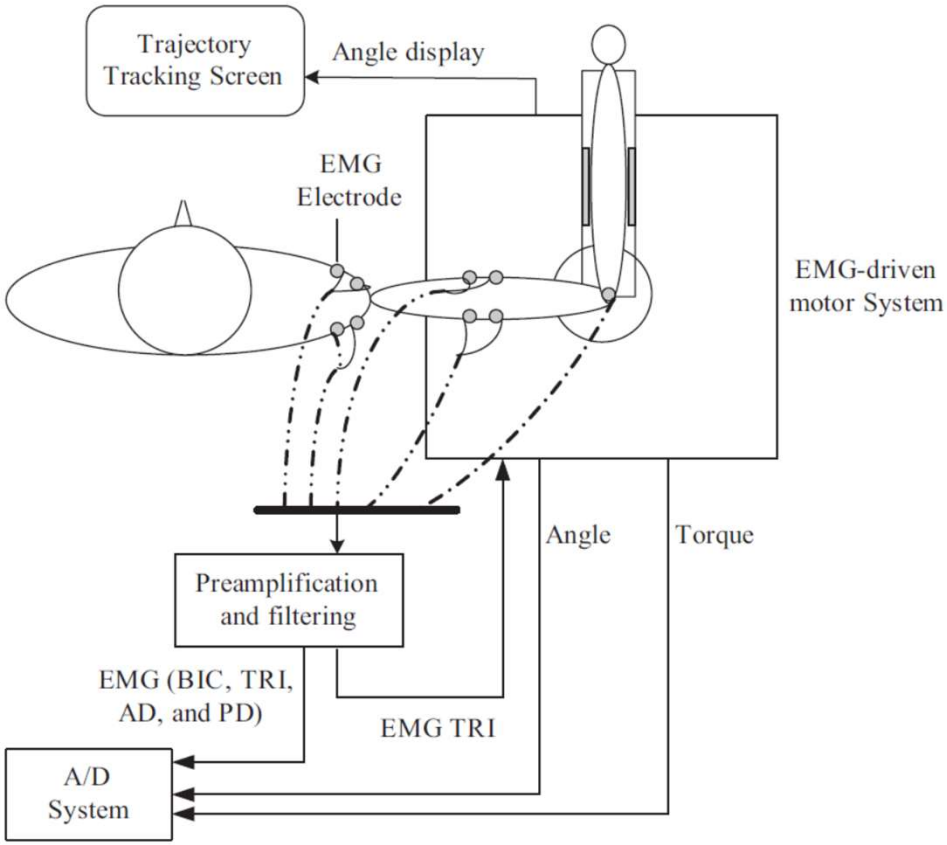
Spastic Myopathy post Immobilisation = THERAPEUTIC OPTIONS

- Denervation? McLachlan → Botulinum toxin?
- Electrical stimulation, vibration, US, shock/short waves?
- Nutrition? → leucine *(Baptista et al, 2010)?*
- Pharmacological?
  - → tétracyclines (effects on muscle and bone..)
  - → water saturated with hydrogen (antioxydant)

→ **<u>Minimisation of immobilisation</u>? <u>Stretching?</u> Kelleher, 2015 = genetic *reversibility* of spastic myopathy**

Nagata et al, 2009; Carmeli et al, 2009; Baptista et al., 2010; Dirks et al, 2014

Treatment of cocontraction : alternating efforts



***Hu X** et al. Variation of muscle coactivation patterns in chronic stroke during robot-assisted elbow training.*

***Arch Phys Med Rehabil. 2007**;88(8):1022-9.*

Hu X et al. Variation of muscle coactivation patterns in chronic stroke during robot-assisted elbow training

Results

- Overall biceps et triceps EMG ↓ from 8th to 12th sessions
- EMG deltoid Ant ↓ from 8th to 20th sessions
- ↓ cocontractions of all muscle pairs in all subjects
- Cocontraction biceps/triceps ↓ as overall EMG levels stable from 10th to 20th sessions
- ↑ Fugl-Meyer and MSS,↓ MAS

Hu X et al. Arch Phys Med Rehabil, 2007;88:1022–1029.

Gracies et al. BMC Neurology (2019) 19:59
https://doi.org/10.1186/s12883-019-1257-y

BMC Neurology

STUDY PROTOCOL Open Access

Guided Self-rehabilitation Contract vs conventional therapy in chronic stroke-induced hemiparesis: NEURORESTORE, a multicenter randomized controlled trial

Jean-Michel Gracies[1,2], Maud Pradines[1,2*], Mouna Ghédira[1,2], Catherine-Marie Loche[2], Valentina Mardale[2], Catherine Hennegrave[2], Caroline Gault-Colas[2], Etienne Audureau[3,4], Emilie Hutin[1,2], Marjolaine Baude[1,2], Nicolas Bayle[1,2] and the Neurorestore Study Group

Original Research Article

ASNR AMERICAN SOCIETY OF NEUROREHABILITATION

Neurorehabilitation and
Neural Repair
1–15

DOI: 10.1177/1545968319829455
journals.sagepub.com/home/nnr
SAGE

Ultrasound Structural Changes in Triceps Surae After a 1-Year Daily Self-stretch Program: A Prospective Randomized Controlled Trial in Chronic Hemiparesis

Maud Pradines, PT, PhD[1,2], Mouna Ghedira, PT, PhD[1,2], Raphaël Portero, PhD[1], Ingrid Masson, PhD[1], Christina Marciniak, MD[3], Dawn Hicklin, PT[4], Emilie Hutin, PhD[1,2], Pierre Portero, PhD[1], Jean-Michel Gracies, MD, PhD[1,2], and Nicolas Bayle, MD[1,2]

Pradines et al. Neurorehabil Neural Repair. 2019;33(4):245-259

Self-stretching and structural muscle changes

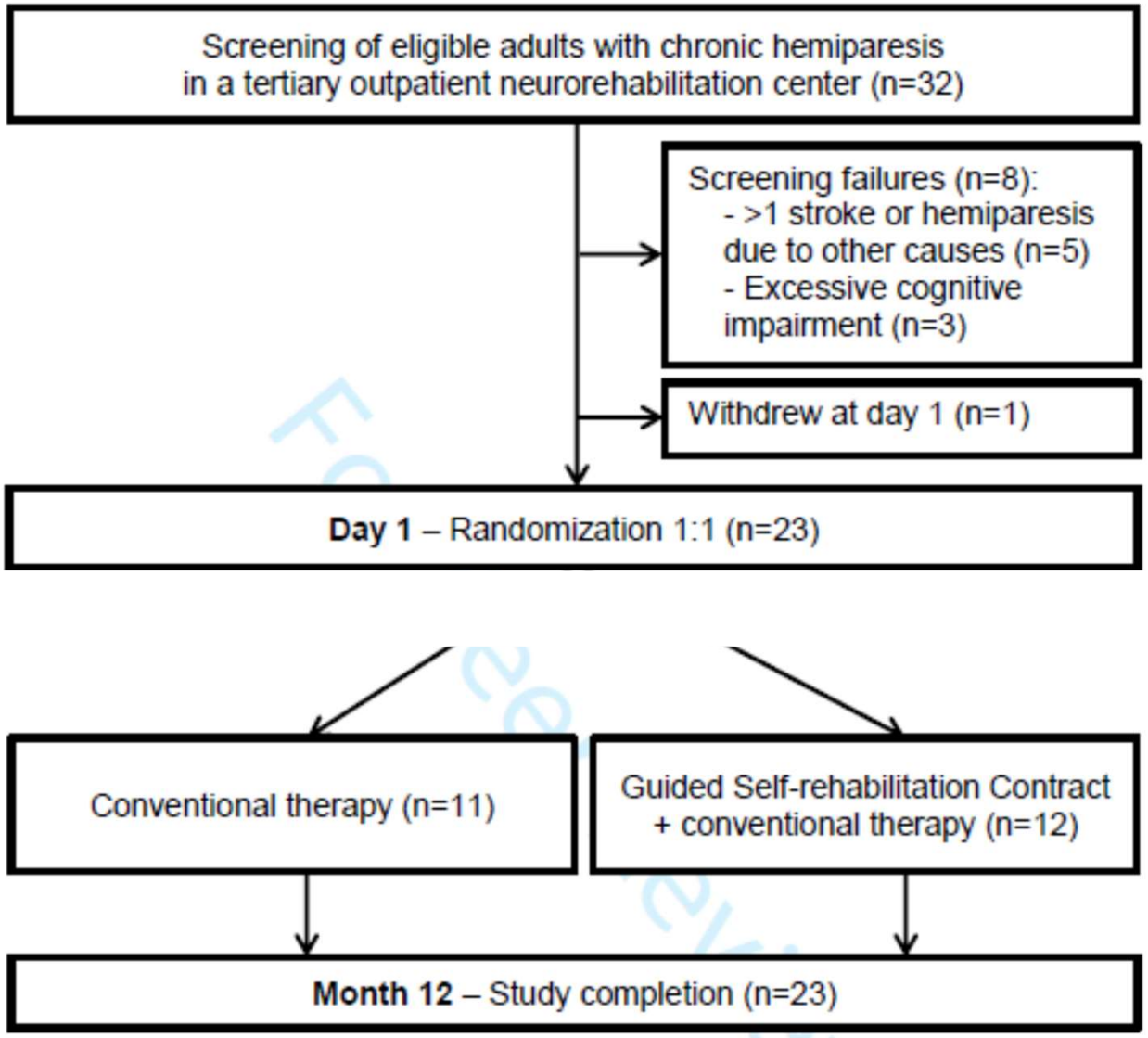
Objectives : Assess structural changes and passive extensibility in triceps surae + function, following a guided self-stretching program

Inclusion : 1st stroke > 1 year ; comfortable barefoot walking speed >0.1 et <1.2m/sec

Ancillary to ***Neurorestore***

Pradines et al. Neurorehabil Neural Repair. 2019;33(4):245-259

Publicly funded *Neurorestore* project - Flow chart



Pradines et al. Neurorehabil Neural Repair. 2019;33(4):245-259

Description of the two groups

- **CONV group:** conventional community-based therapy sessions, based upon prescription by physician and patient requests

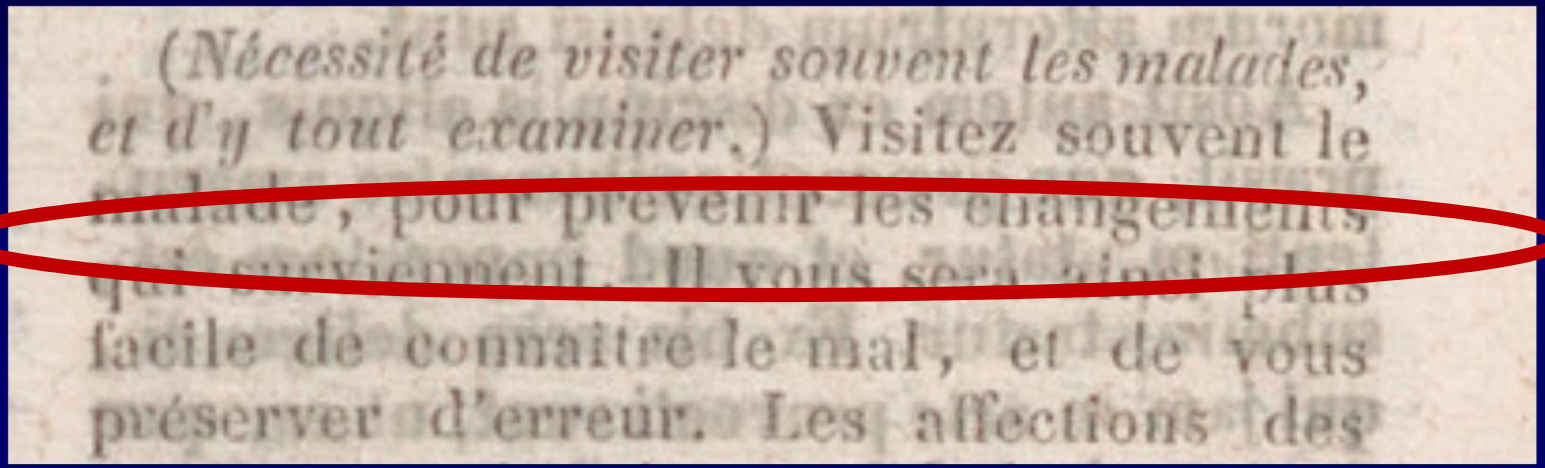
- **GSC group:** conventional sessions allowed, plus one visit every other week by study therapist to prescribe the program, teach self-stretching techniques on specific muscles and verify diaries

- **In both groups:** local treatment with BoNT (+/- systemic) allowed

Pradines et al. Neurorehabil Neural Repair. 2019;33(4):245-259

Therapeutic frequency?

Hippocrates (*de la Décence* – traduction Gardeil 1836)



(*Nécessité de visiter souvent les malades, et d'y tout examiner.*) Visitez souvent le malade, pour prévenir les changements qui surviennent. Il vous sera ainsi plus facile de connaître le mal, et de vous préserver d'erreur. Les affections des

Hippocrate (460-377 av. J.-C.). *- Foës, Anuce (1528-1595).*
Traducteur Gardeil, Jean-Baptiste (1726-1808).
Paris, 1836-1837. *http://gallica.bnf.fr/ark:/12148/bpt6k9659638z -* ***p.451***

Therapeutic frequency?
Methods

Retrospective, monocentric study

Inclusion criteria

1)Age > 18

2)Stroke-induced chronic spastic paresis (or due to chronic non-evolutive disorder)

3)> 6 months since onser of disorder

4) F/U with GSC by the same clinician (JMG) for > 7 months

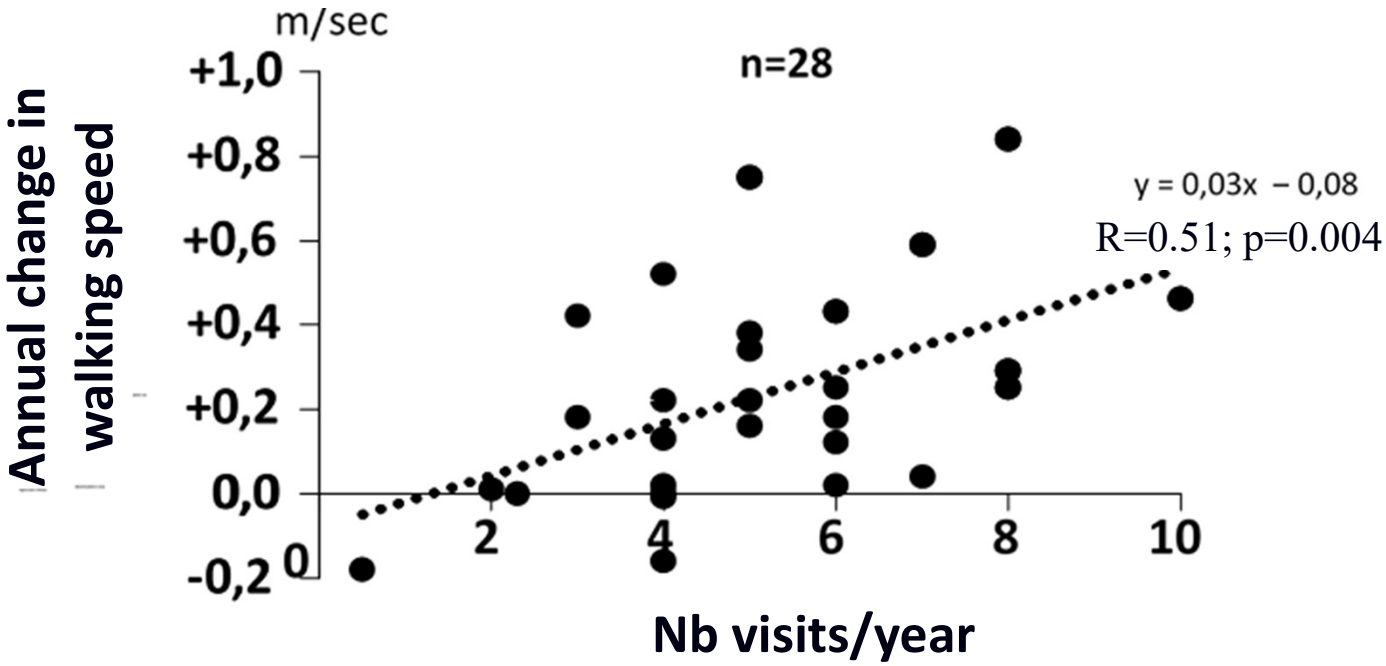
5) GSC dedicated to LL = nb minutes prescribed stretch in LL > in UL

Etude Rétrospective –*Mistry, Gracies, en préparation*

Therapeutic frequency in neurorehabilitation

Annual gain in walking speed *vs* number of clinic visits/year with GSC

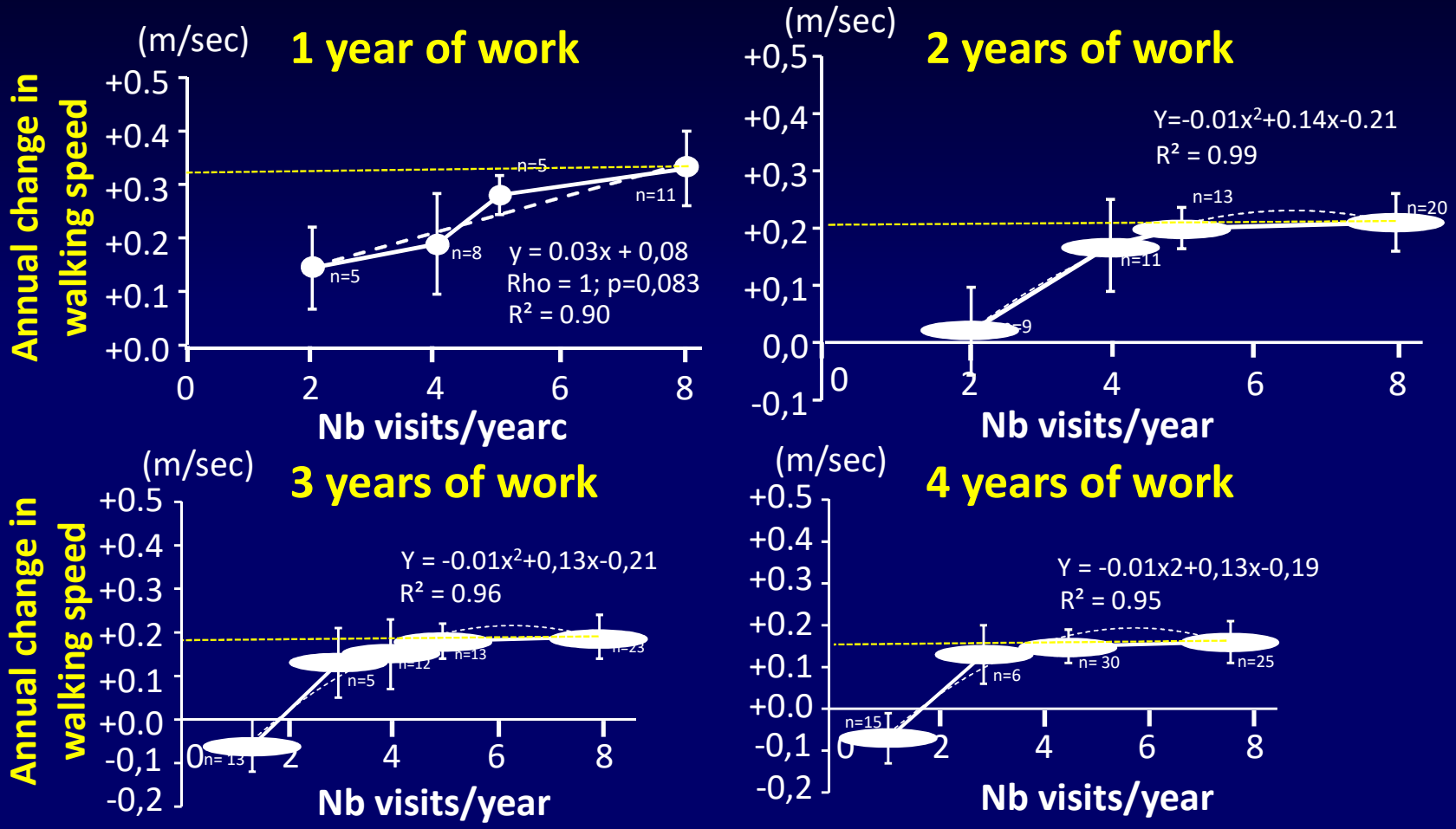
First year of work in GSC



Retrospective study - *Mistry, Gracies, in preparation*

Therapeutic frequency in neurorehabilitation

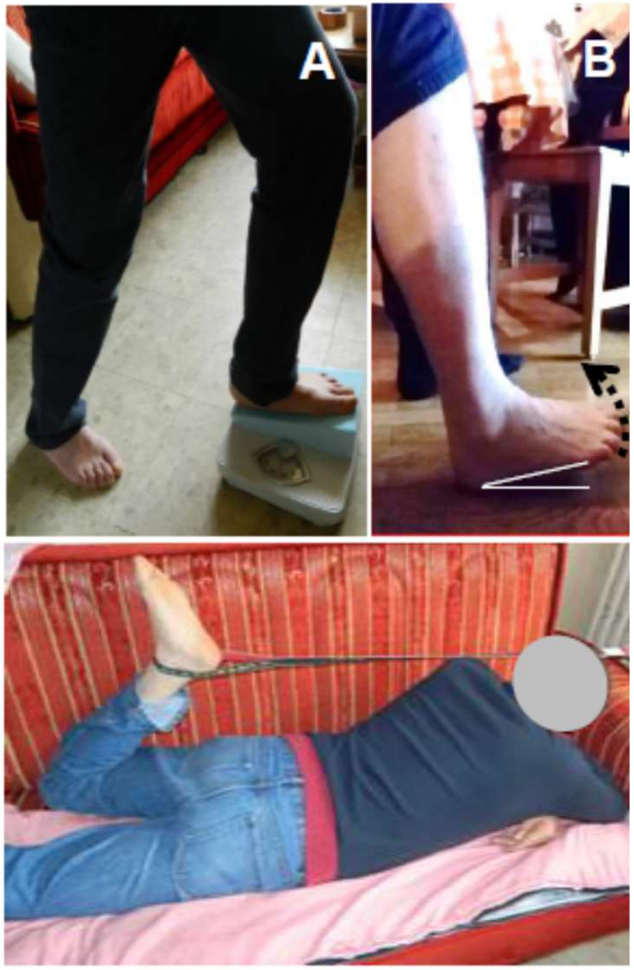
Annual gain in walking speed *vs* number of clinic visits/year



Retrospective study - *Mistry, Gracies, in preparation*

En aigu et sub-aigu: positionner en situation allongée les muscles habituellement abandonnés en position courte (+ éviter écharpe et minimiser attelle releveurs)

En chronique : enseignement de techniques d’auto-étirement



Pradines et al. Neurorehabil Neural Repair. 2019;33(4):245-259

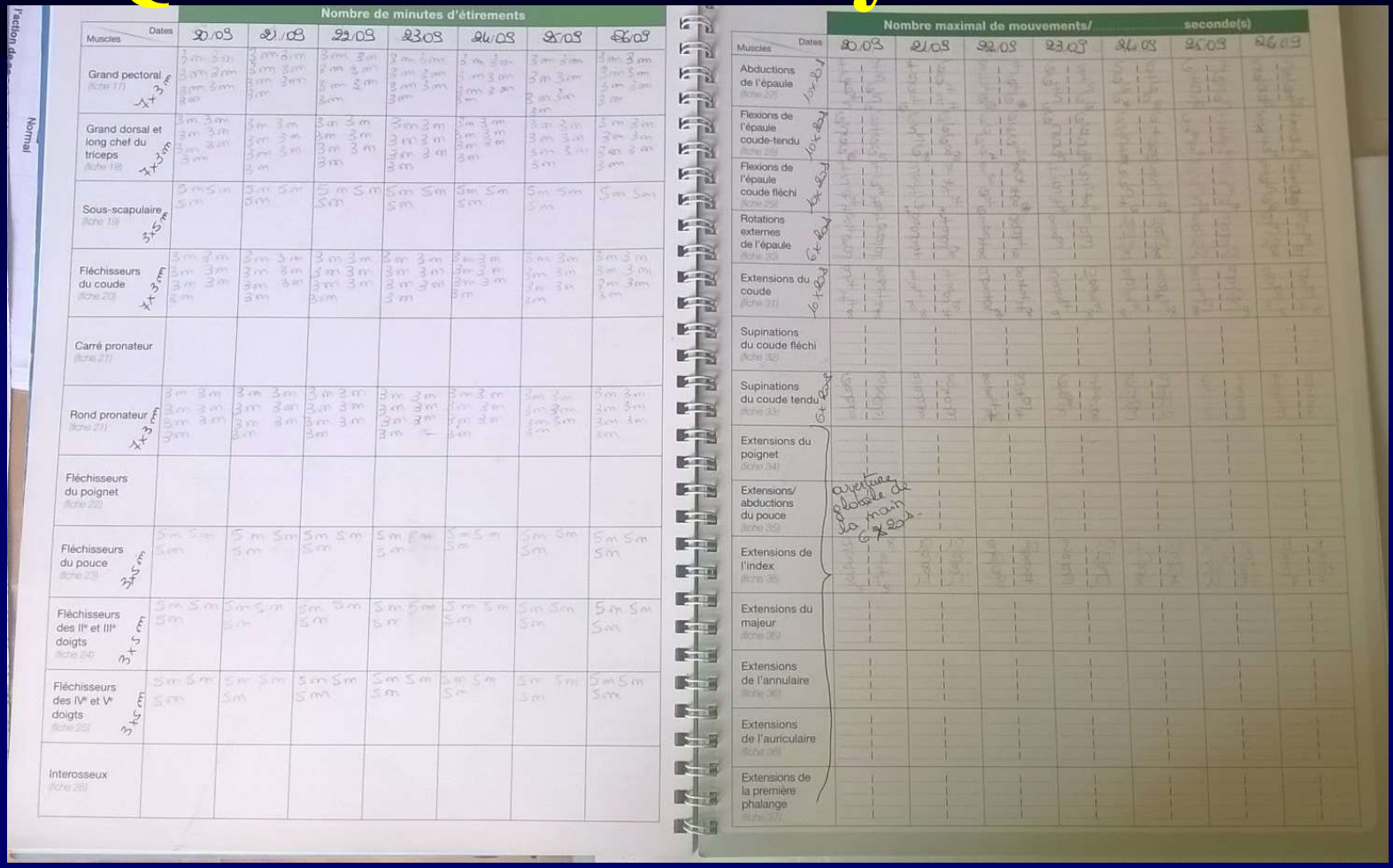
En chronique : enseignement de techniques d'auto-étirement

Pradines et al. Neurorehabil Neural Repair. 2019;33(4):245-259

Quantified Diary+++++

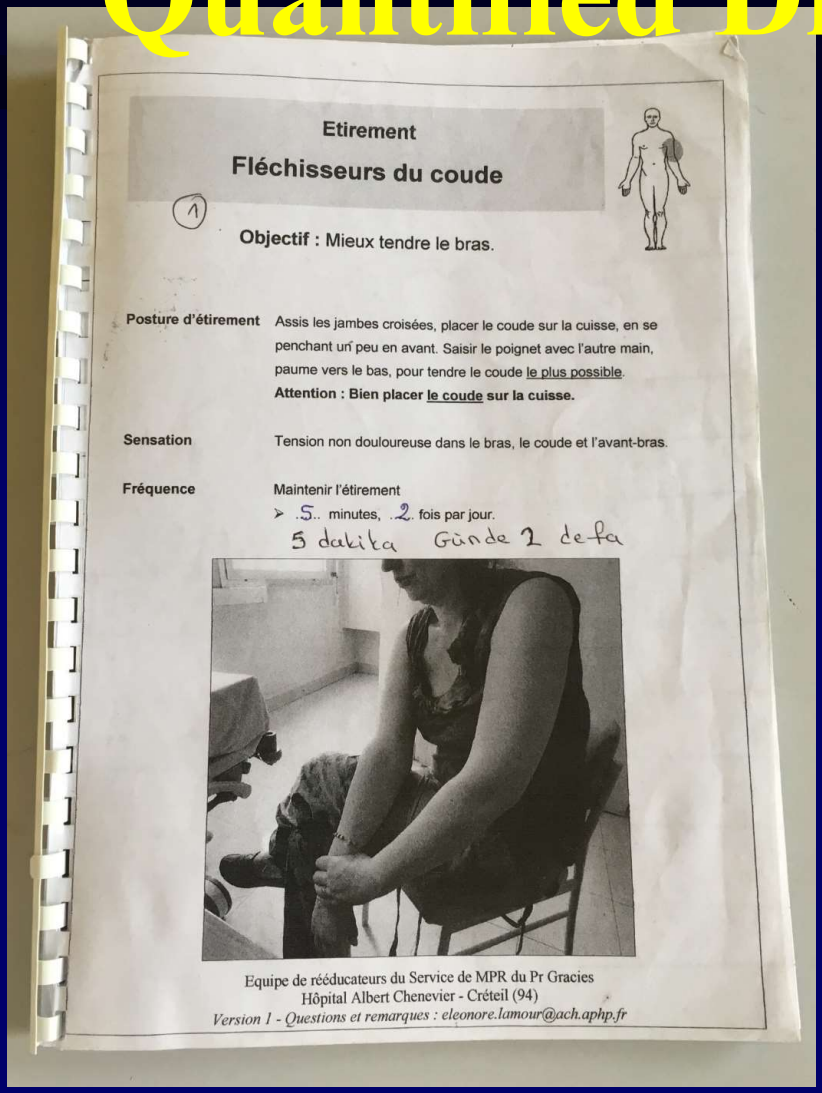
Catherine		20 mn Etirement Grand Fessier	Flexion/mn hanche genou plié	20 mn Etirement Ischio jambier	Flexion/mn hanche genou droit	5 mn Etirement Droit antérieur	Flexion/mn genou fesse	Soléaire	Moment	Divers	relevés de Pied
jeudi	26/01/12	20	3X21	20	3X23	10	3X26	3	10H00	Kiné	3X19
vendredi	27/01/12										
samedi	28/01/12	20	3X21	20	3X24	10	3X27		17H00		3X18
dimanche	29/01/12										
lundi	30/01/12										3X17
mardi	31/01/12	20	3X20	20	3X25	10	3X26	5	10H00	Kiné	3X19
mercredi	01/02/12										
jeudi	02/02/12	20	3X21	20	3X24	10	3X26	5	10H00	Kiné	3X19
vendredi	03/02/12										
samedi	04/02/12	20	3x20	20	3X23	10	3X25		18H00		3X19
dimanche	05/02/12										4X17
lundi	06/02/12										3X17
mardi	07/02/12	20	3X21	20	3X24	10	3X26	5	10H00	Kiné	3X17
mercredi	08/02/12										3X17
jeudi	09/02/12	20	3X21	20	3X24	10	3X26	5	10H00	Kiné	3X17
vendredi	10/02/12										
samedi	11/02/12	20	3X21	20	3X23	10	3X26		21H00		3X17
dimanche	12/02/12										3X17
lundi	13/02/12										
mardi	14/02/12	20	3X19	20	3X23	10	3X26	5	10H00	Kiné	3X15
mercredi	15/02/12										3X18
jeudi	16/02/12	20	3X21	20	3X23	10	3X26	5	10H00	Kiné	3X17
vendredi	17/02/12										3X18
samedi	18/02/12	20	3X19	20	3X23	10	3X26		10H00		3X18
dimanche	19/02/12	20	3X21	20	3X24	10	3X26		10H00	Kiné	3X17
lundi	20/02/12										3X19
mardi	21/02/12	20	3X19	20	3X24	10	3X26	5	10H00	Kiné	3X19
mercredi	22/02/12										3X20
jeudi	23/02/12	20	3X20	20	3X24	10	3X26	5	10H00	Kiné	3X19
vendredi	24/02/12										3X20
samedi	25/02/12										3X20
dimanche	26/02/12	20	3X21	20	3X23	10	3X26		10H00		3X21

Quantified Diary+++++



Pradines et al. Neurorehabil Neural Repair. 2019;33(4):245-259

Quantified Diary+++++



Etirement

Fléchisseurs du coude

1

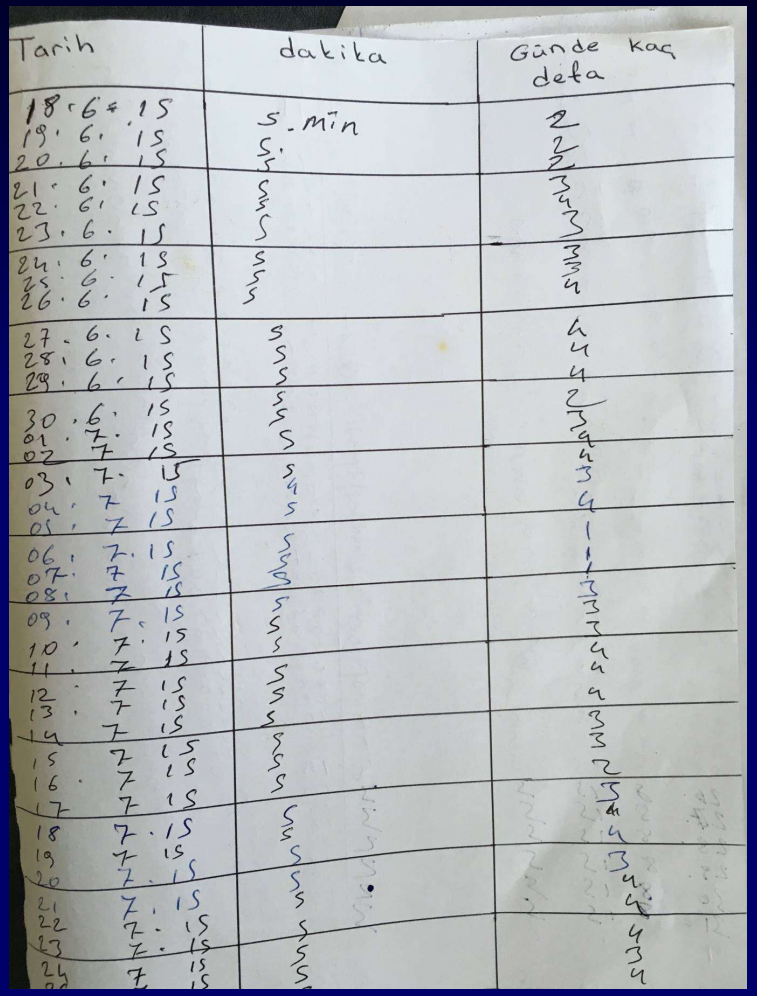
Objectif : Mieux tendre le bras.

Posture d'étirement Assis les jambes croisées, placer le coude sur la cuisse, en se penchant un peu en avant. Saisir le poignet avec l'autre main, paume vers le bas, pour tendre le coude le plus possible.
Attention : Bien placer le coude sur la cuisse.

Sensation Tension non douloureuse dans le bras, le coude et l'avant-bras.

Fréquence Maintenir l'étirement
➢ 5 minutes, 2 fois par jour.
5 dakika Günde 2 defa

Equipe de rééducateurs du Service de MPR du Pr Gracies
Hôpital Albert Chenevier - Créteil (94)
Version 1 - Questions et remarques : eleonore.lamour@ach.aphp.fr



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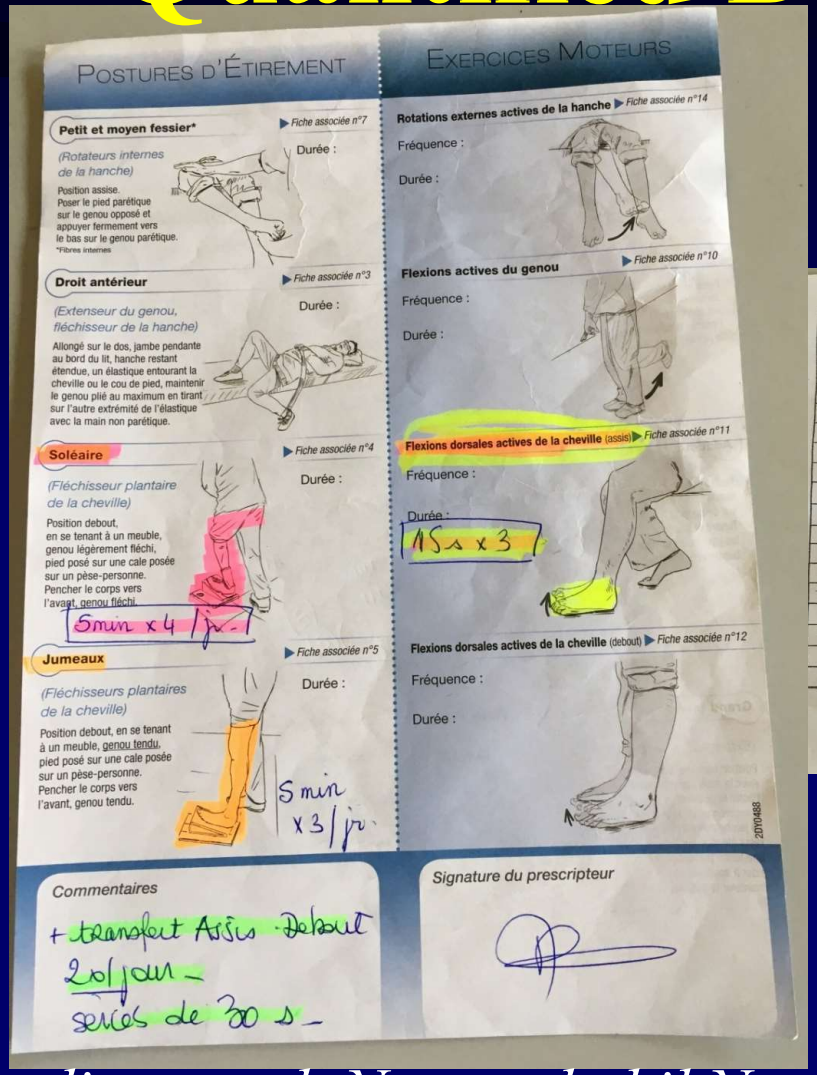
Quantified Diary+++++



POSTURES D'ÉTIREMENT

Petit et moyen fessier* ▶ Fiche associée n°7

(Rotateurs internes de la hanche)

Position assise. Poser le pied parétique sur le genou opposé et appuyer fermement vers le bas sur le genou parétique.

*Fibres internes

Durée :

Droit antérieur ▶ Fiche associée n°3

(Extenseur du genou, fléchisseur de la hanche)

Allongé sur le dos, jambe pendante au bord du lit, hanche restant étendue, un élastique entourant la cheville ou le cou de pied, maintenir le genou plié au maximum en tirant sur l'autre extrémité de l'élastique avec la main non parétique.

Durée :

Soléaire ▶ Fiche associée n°4

(Fléchisseur plantaire de la cheville)

Position debout, en se tenant à un meuble, genou légèrement fléchi, pied posé sur une cale posée sur un pèse-personne. Pencher le corps vers l'avant, genou fléchi.

5min x4 /jr

Durée :

Jumeaux ▶ Fiche associée n°5

(Fléchisseurs plantaires de la cheville)

Position debout, en se tenant à un meuble, genou tendu, pied posé sur une cale posée sur un pèse-personne. Pencher le corps vers l'avant, genou tendu.

5 min x3/jr

Durée :

EXERCICES MOTEURS

Rotations externes actives de la hanche ▶ Fiche associée n°14

Fréquence :

Durée :

Flexions actives du genou ▶ Fiche associée n°10

Fréquence :

Durée :

Flexions dorsales actives de la cheville (assis) ▶ Fiche associée n°11

Fréquence :

Durée : 15 s x 3

Flexions dorsales actives de la cheville (debout) ▶ Fiche associée n°12

Fréquence :

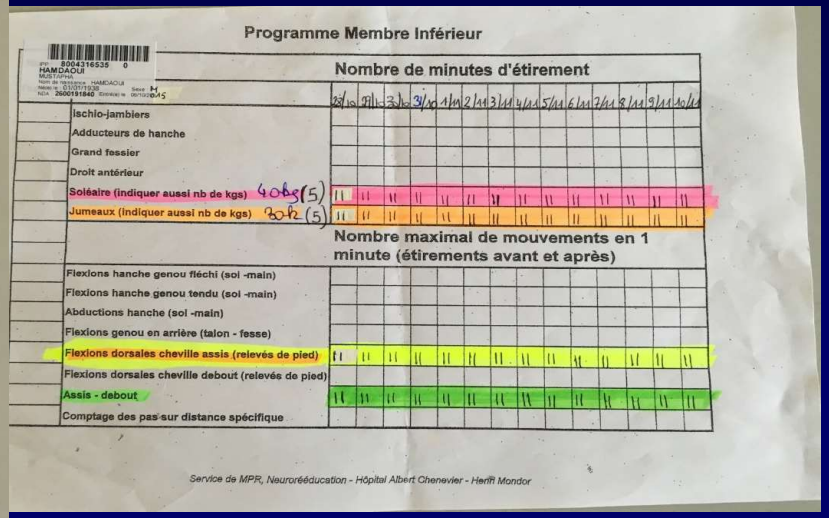
Durée :

2DY0488

Commentaires

+ transfert Assis - Debout
2 o/ jour -
séries de 30 s -

Signature du prescripteur



Programme Membre Inférieur

IPP: 8004316535 0
HAMDAOUI
MUSTAPHA
NDA: 2500191840 Sexe: M

Nombre de minutes d'étirement

	28/10	29/10	30/10	31/10	1/11	2/11	3/11	4/11	5/11	6/11	7/11	8/11	9/11	10/11
Ischio-jambiers														
Adducteurs de hanche														
Grand fessier														
Droit antérieur														
Soléaire (indiquer aussi nb de kgs) 40kg (5)														
Jumeaux (indiquer aussi nb de kgs) 30kg (5)														

Nombre maximal de mouvements en 1 minute (étirements avant et après)

Flexions hanche genou fléchi (sol -main)
Flexions hanche genou tendu (sol -main)
Abductions hanche (sol -main)
Flexions genou en arrière (talon - fesse)
Flexions dorsales cheville assis (relevés de pied)
Flexions dorsales cheville debout (relevés de pied)
Assis - debout
Comptage des pas sur distance spécifique

Service de MPR, Neurorééducation - Hôpital Albert Chenevier - Henri Mondor

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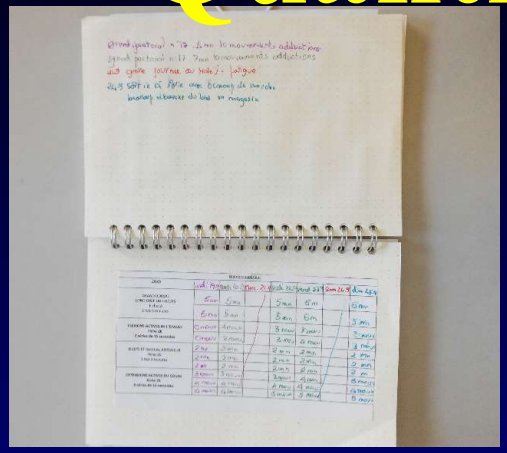
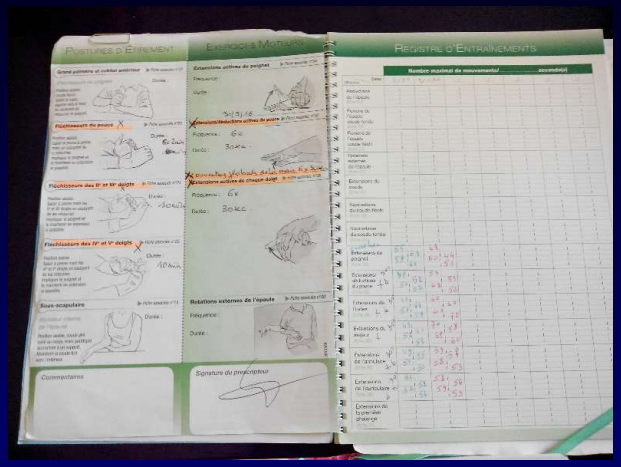
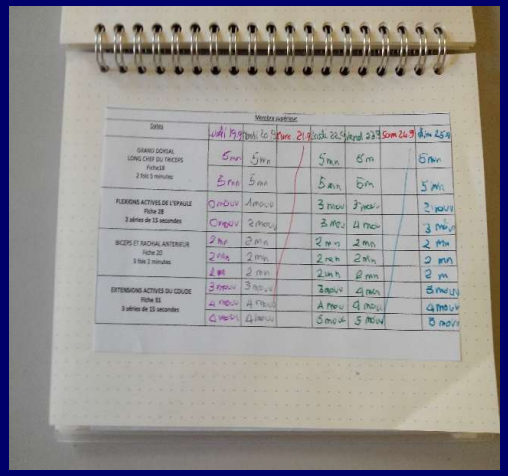
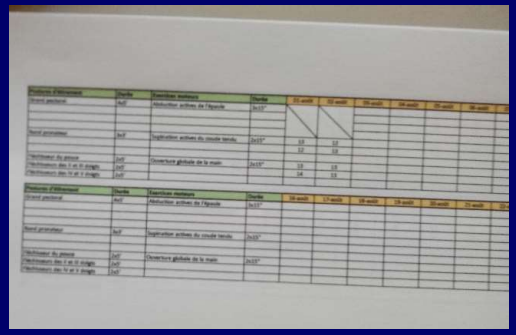
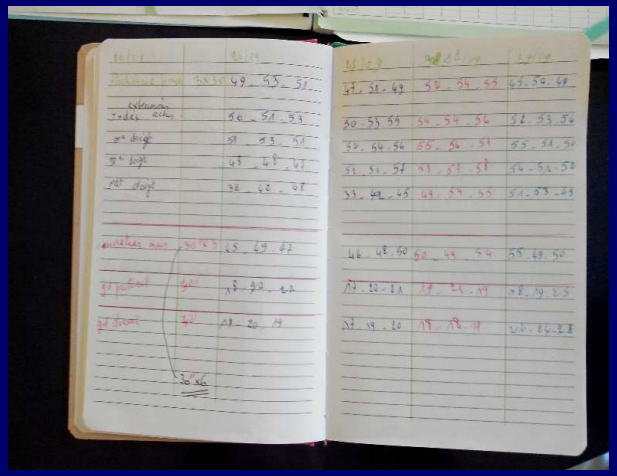
Quantified Diary+++++









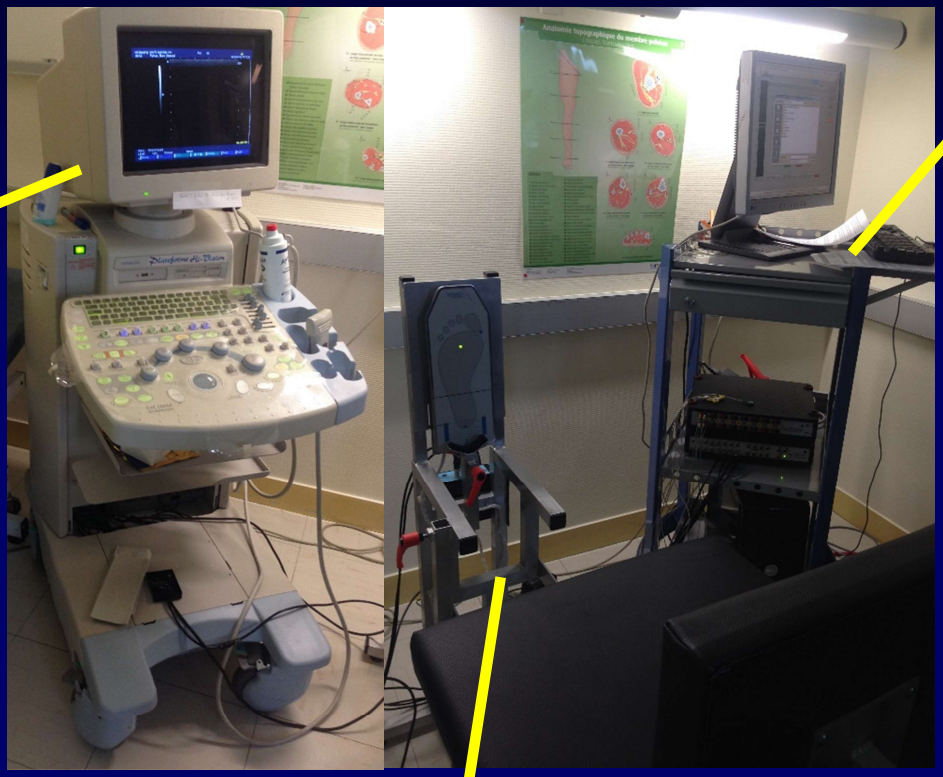


Pradines et al. Neurorehabil Neural Repair. 2019;33(4):245-259

Biomechanical assessment

Ultrasound diagnostic scanner model EZU-MT24-S1 (Hitachi)

Calibrated image
Frequency 13Mhz
Depth 50mm



g-BS amp *g-tech*
Surface EMG

Ankle ergometer with two force platforms (*Techno Concept*)

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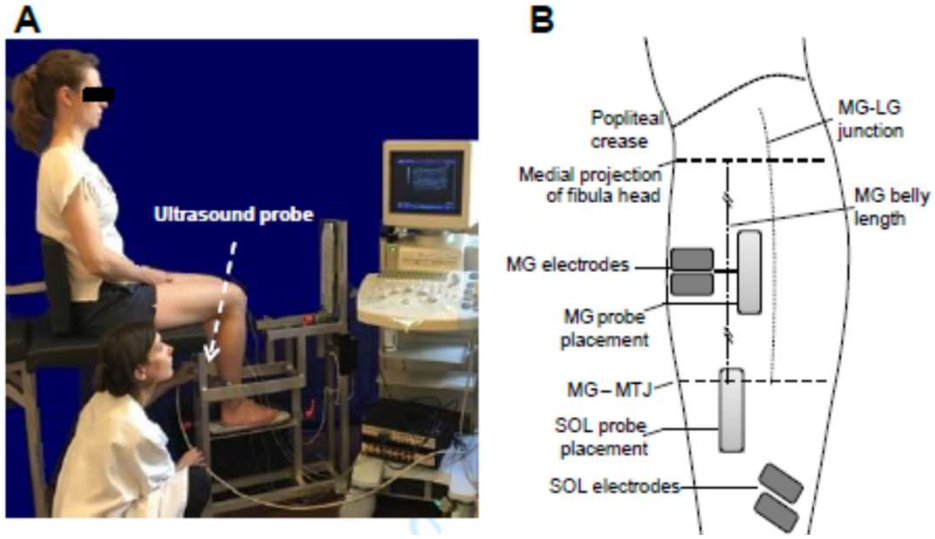
Methods



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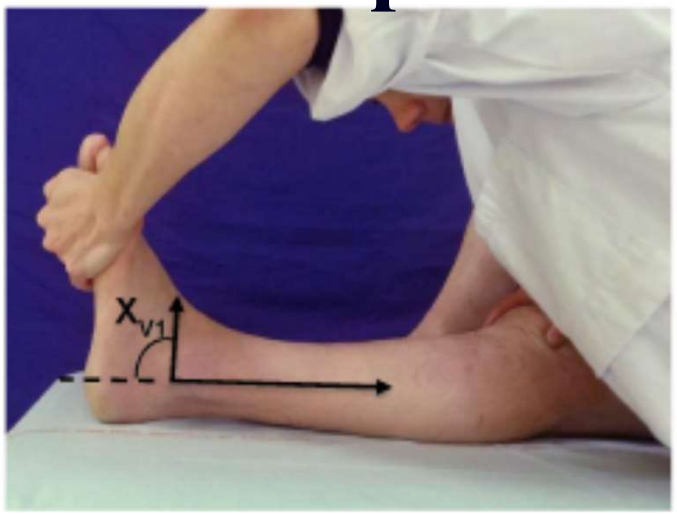
Clinical assessment = Five Step Assessment



$$X_{V1}\ \text{Composite} = (X_{V1GAS} + X_{V1SOL} + X_{V1GM} + X_{V1RF}) / 4$$

At baseline..

Subject characteristics	CONV (n=11)	GSC (n=12)
Age (years)	55±13	57±11
Time since lesion (years)	8±5	10±9
Gender	8M	5M
Paretic side	6R	6R
Lesion type	8I	8I

Healthy subjects

43 mm

40 mm

15.5 mm

17 mm

Gao et al, Arch Phys Med Rehabil 2009; Zhao, Appl Physiol 2015; Simpson CL et al, Scand J Med Sci Sports. 2017; Maganaris et al, J; Bolsterlee B… Gandevia SC, Herbert RD. J Biomech. 2015;48(6):1133-40

Pradines et al. Neurorehabil Neural Repair. 2019;33(4):245-259

Descriptive results: treatments

- **Mean time of conventional therapy:**
  - CONV: 81.8±55 min (1h30)/week = 12 min/d
  - GSC: 57.8±37.5 min (1h)/week = 8 min/d
- **GSC: mean reported daily time of self-stretch/muscle:**
  - Soleus: 5.0±3.3 min/d
  - Gastrocs: 5.0±2.1 min/d
  - Glut Max: 6.3±3.2 min/d
  - Rectus fem: 8.4±3.9 min/d
- **BoNT injections:**
  - Triceps surae: CONV n=2, GSC n=3
  - Rect Fem: CONV n=1, GSC n=1

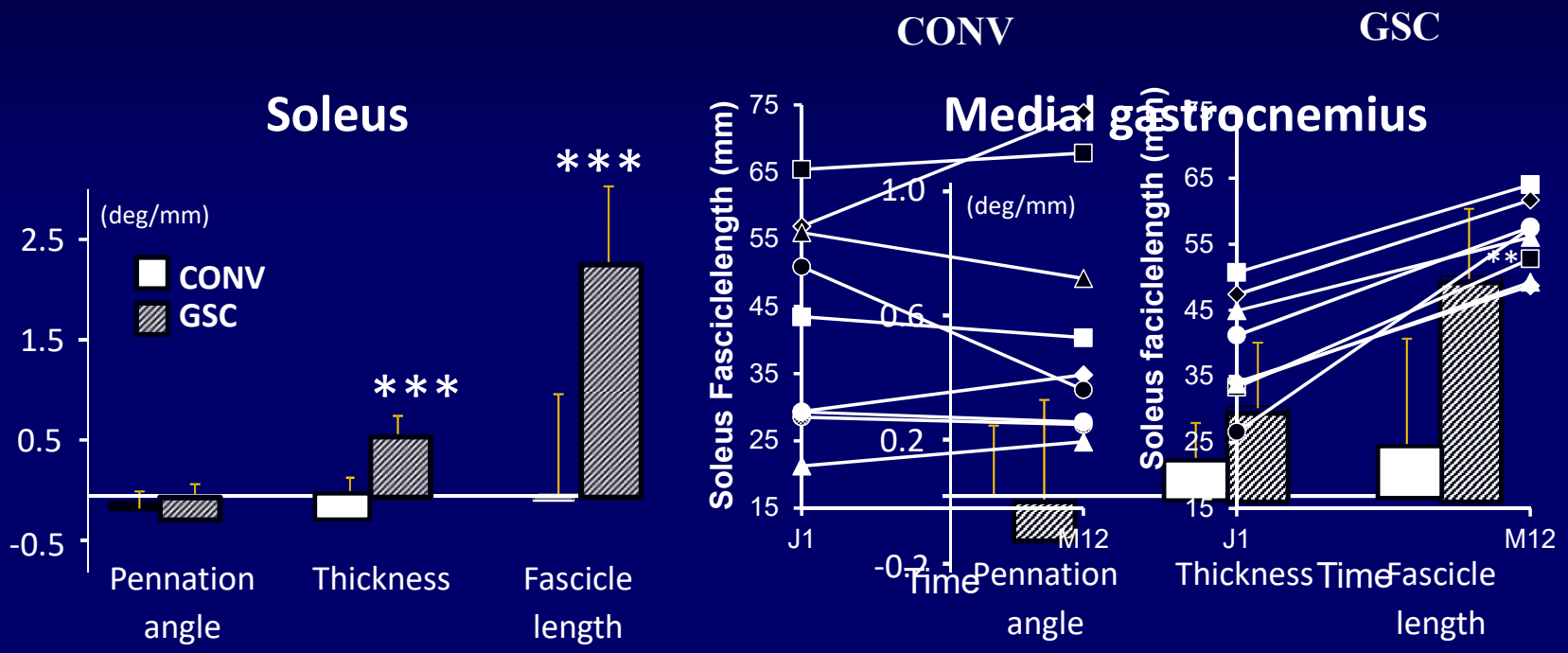
Pradines et al. Neurorehabil Neural Repair. 2019;33(4):245-259

Outcomes

	Sample size		Groups				Differences			Effect size
							Within groups		Between groups	
			Week 0		Week 52		Week 52 - Week 0		Week 52 - Week 0	Cohen's
	CONV	GSC	CONV	GSC	CONV	GSC	CONV	GSC	GSC-CONV	(d)
Muscle architecture (mm)										
Fascicle length - soleus	n=9	n=8	40 (16)	37.9 (9.7)	39.9 (18.4)	55.9 (5)	-0.1 (10.2)	18.0 (7.8)	18.1 [9.3 ;26.9]	2.0 [1.54;2.46]

Pradines et al. Neurorehabil Neural Repair. 2019;33(4):245-259

Outcomes: muscle ultrasonography



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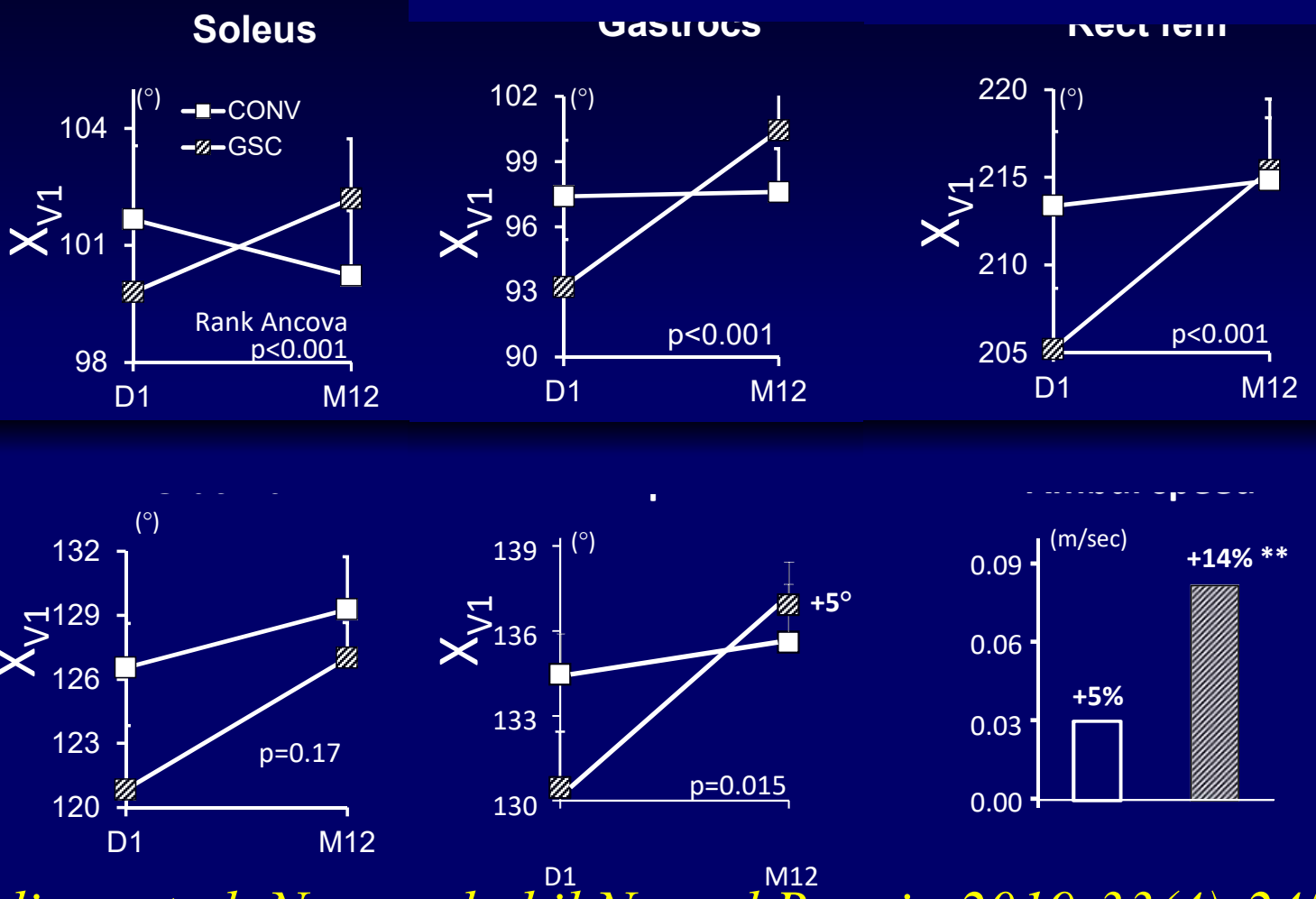
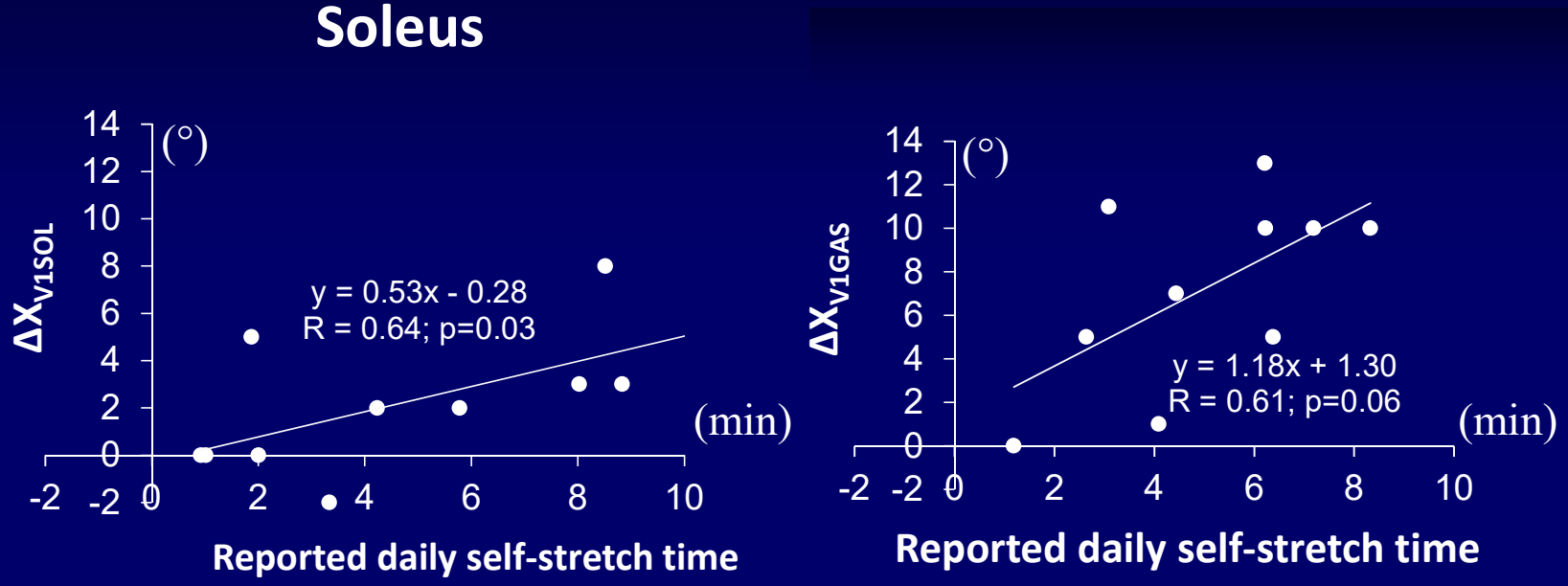
Clinical outcomes



Pradines et al. Neurorehabil Neural Repair. 2019;33(4):245-259

Relation
self-stretch time – extensibility changes



ΔX_{V1GF} → NS
ΔX_{V1DA} → NS

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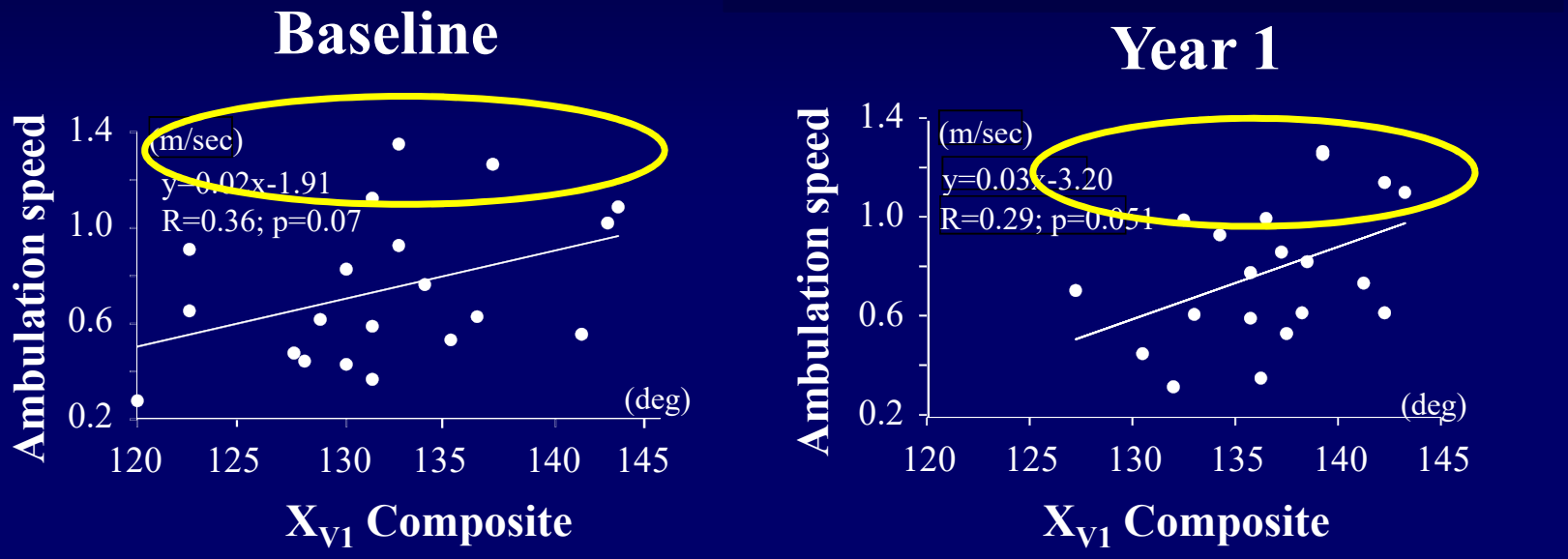
Relation extensibility – function



Pradines et al. Neurorehabil Neural Repair. 2019;33(4):245-259

Discussion

Limitations

- Sample size / visibility of fascicles in paretic subjects
- Position in ergometer (soleus pre-tension, not GM)
- Two types of stretching techniques

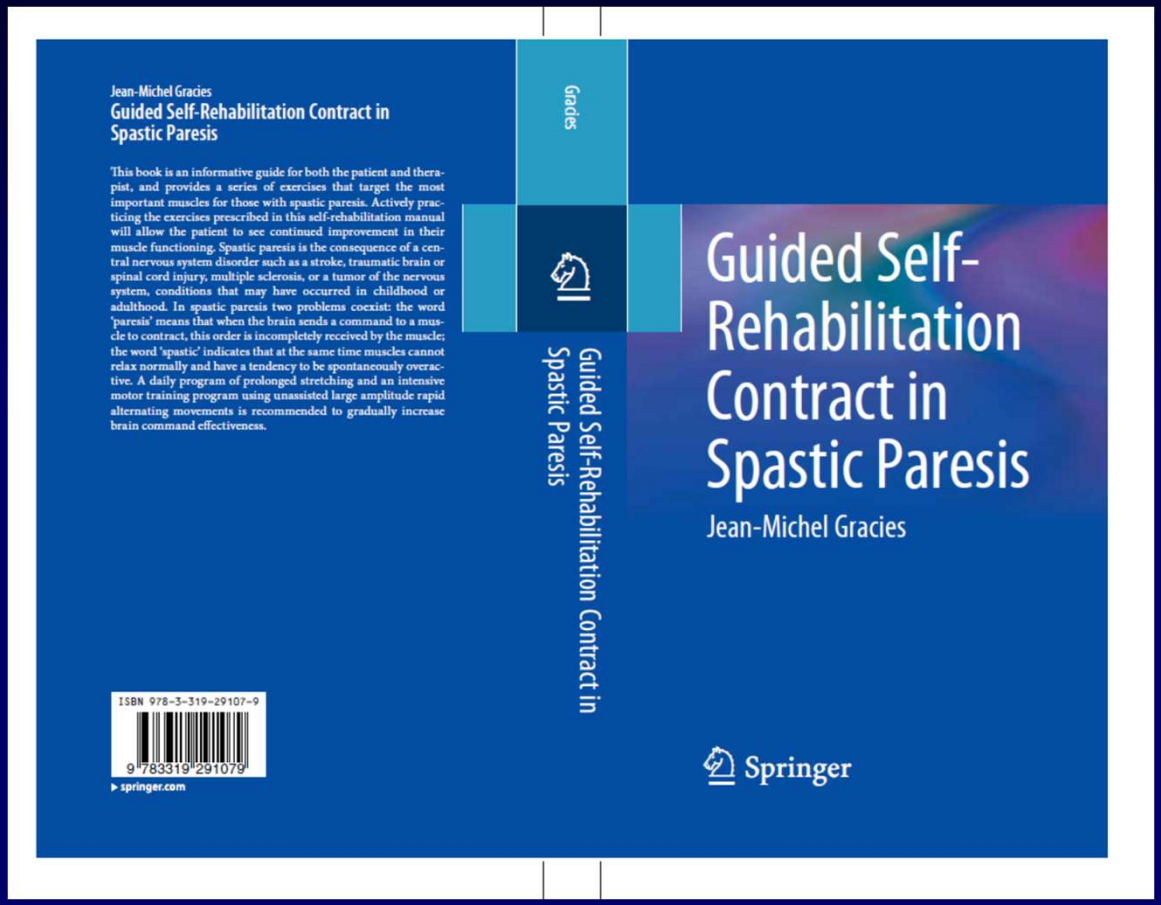
Conclusion: One year prospective randomized controlled trial in chronic spastic paresis: a daily self-stretching program within Guided Self-rehabilitation Contracts (GSC):

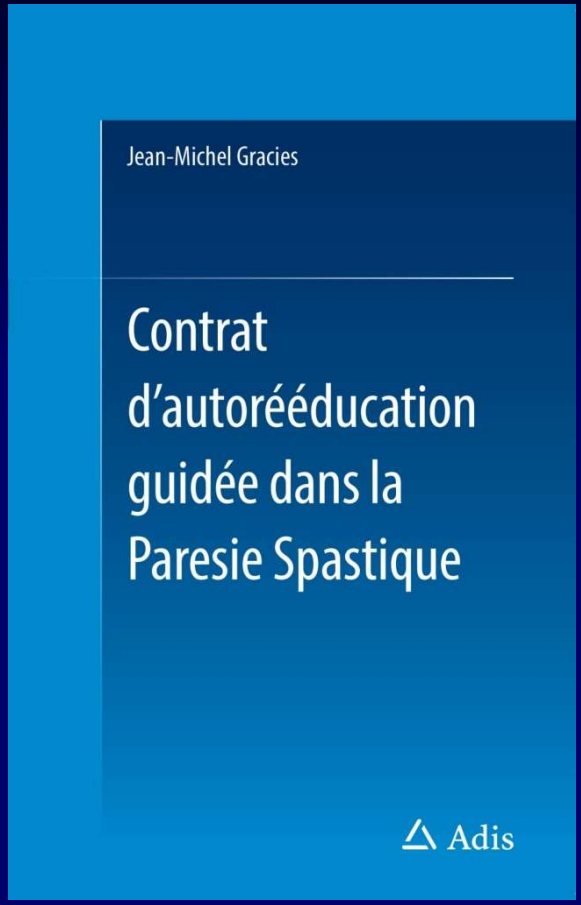
↗ fascicle length
↗ muscle extensibility
↗ ambulation speed

} Compared with conventional therapy

Pradines et al. Neurorehabil Neural Repair. 2019;33(4):245-259

In practice





Springer, 2016

A prescription!

GSC
Guided Self-Rehabilitation Contract
LOWER LIMB

Doctor stamp

Last Name:

First Name:

PASSIVE STRETCH | ACTIVE TRAINING

✓ 2Minx5 ✓ 15 Secx4


Gluteus maximus

Active hip flexion,



Hamstrings

Passive stretch (3)
_____ min _____ times/day

knee extended (4)
_____ sec _____ times/day

HIP



Hip adductors

Passive stretch (5)
Hip flexor - adductors
_____ min _____ times/day

Active hip abduction (7)
_____ sec _____ times/day

Passive stretch (6)
Hip extensor-adductors
_____ min _____ times/day


HIP



Hip internal rotators

Passive stretch (8)
_____ min _____ times/day

Active hip external rotation (9)
_____ sec _____ times/day

KNEE



Rectus femoris

Passive stretch (10)
_____ min _____ times/day

Active knee flexion, knee extended (11)
_____ sec _____ times/day

GSC
Guided Self-Rehabilitation Contract
UPPER LIMB

PASSIVE STRETCH | ACTIVE TRAINING

THUMB

Long thumb flexor



Passive stretch (42)
_____ min _____ times/day

Active long thumb extension (43)
_____ times/day

✓ 2Minx5 ✓ 15 Secx4

THUMB

Short thumb flexor


Active short thumb
_____ sec _____ times/day

THUMB



Passive stretch (46)
Opponens pollicis
_____ min _____ times/day

Active thumb deopposition (48)
_____ sec _____ times/day

Passive stretch (47)
Long abductor of thumb
_____ min _____ times/day


THUMB

Adductor pollicis



Passive stretch (49)
_____ times/day

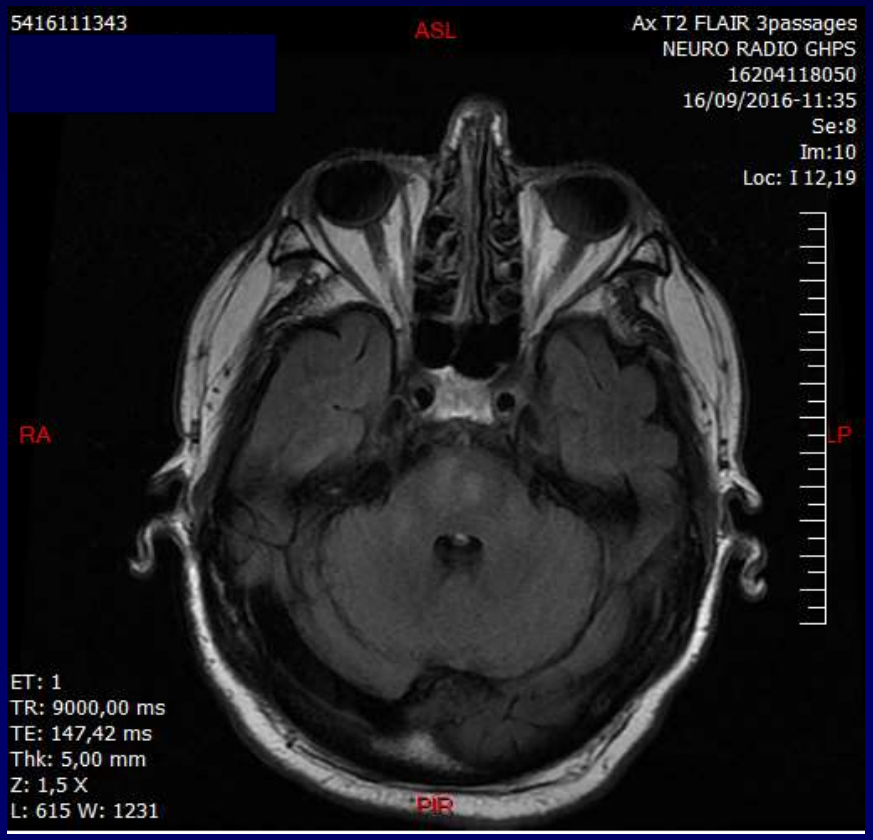
Active short thumb abduction (50)

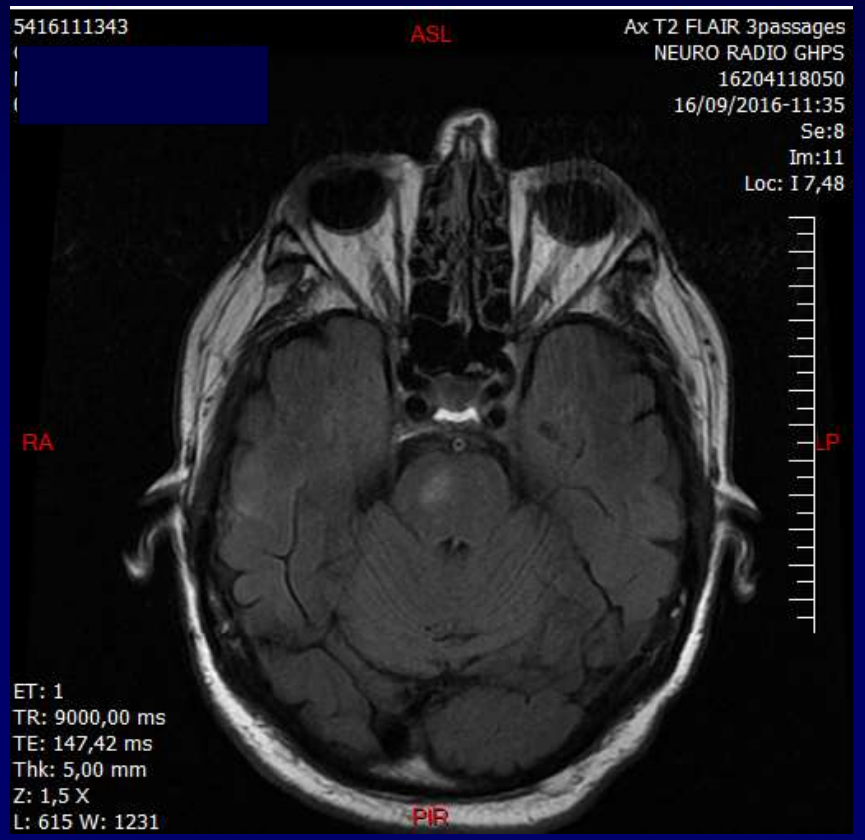
✓ 2 Minx5 ✓ 15 Secx4

In practice

Immersion (few weeks) in a team that practices it

Alain 76 yo – double vertebral dissection on bike accident





Gracies
2013

Alain 76 yo – double vertebral dissection following bike accident

19 june 2017 (Y1) – 0,08 m/sec with cane

Gracies
2013

Alain 76 yo – double vertebral dissection following bike accident – Spastic Dystonia in RF

2019

Gracies
2013

Alain 76 yo
Double vertebral dissection following bike accident

XA15VS-GF

XA15VS-DA

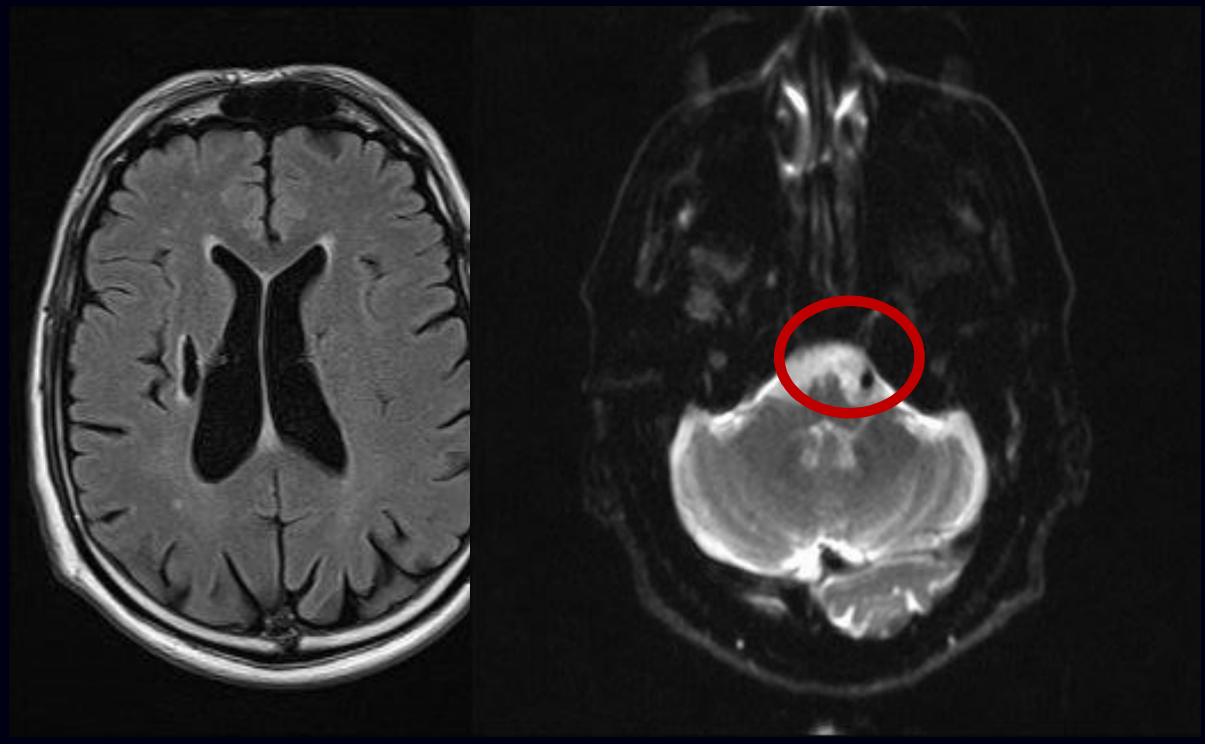
4 dec 2017 (M16)

Bernard
64 yo (DoB 1946)
Stroke March 6, 2009 –

M16 – 0.56 m/s
19 July 2010

IRM Y5

Moderately anterior pattern



Gracies
2013

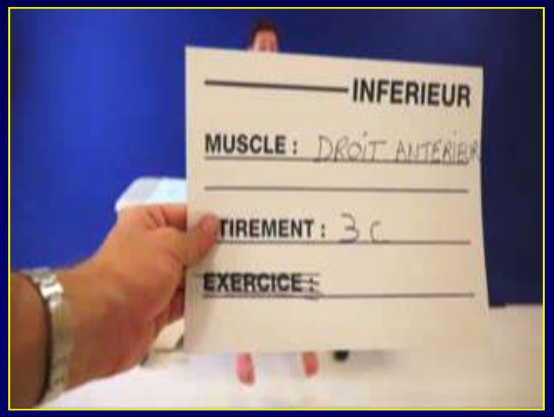
Bernard 64 yo (DoB 1946) Stroke March 6, 2009 –

M16 – 0.56 m/s 19 July 2010

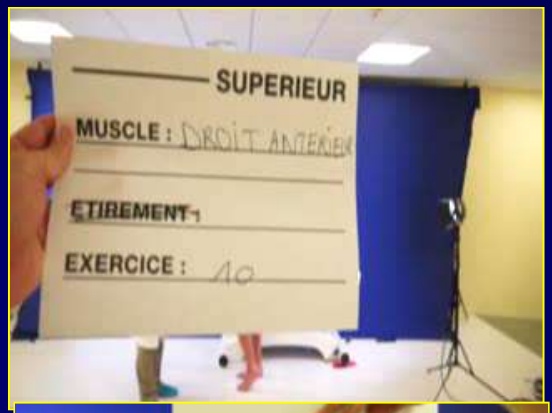
Moderately anterior pattern

Against rectus femoris

Treatment myopathy = Self-stretch postures



Treatment cocontraction Rapid alternating movements of maximal amplitude, unassisted



Injection RF

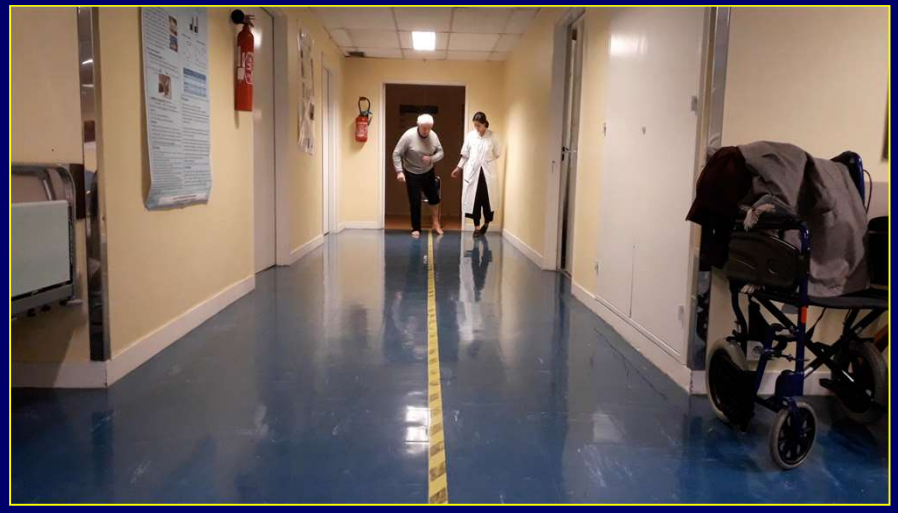
Self-stretch RF

Stretch RF by someone else

Alain 76 yo – double vertebral dissection following bike accident

Y1 – 0.08 m/s - 19/06/17

M16 – 0.16 m/s - 04/12/17



Y3 – 0.29 m/s - 20/05/19

1+. Y6 – 0.49 m/s - 07/03/22

Alain 76 yo – double vertebral dissection following bike accident

M16 - 04/12/17

Y3 - 20/05/19

Work against gluteus maximus

Y5 - 11/10/21

Y6 - 23/05/22

Alain 76-81 yo – double vertebral dissection following bike accident

M16 - 04/12/17

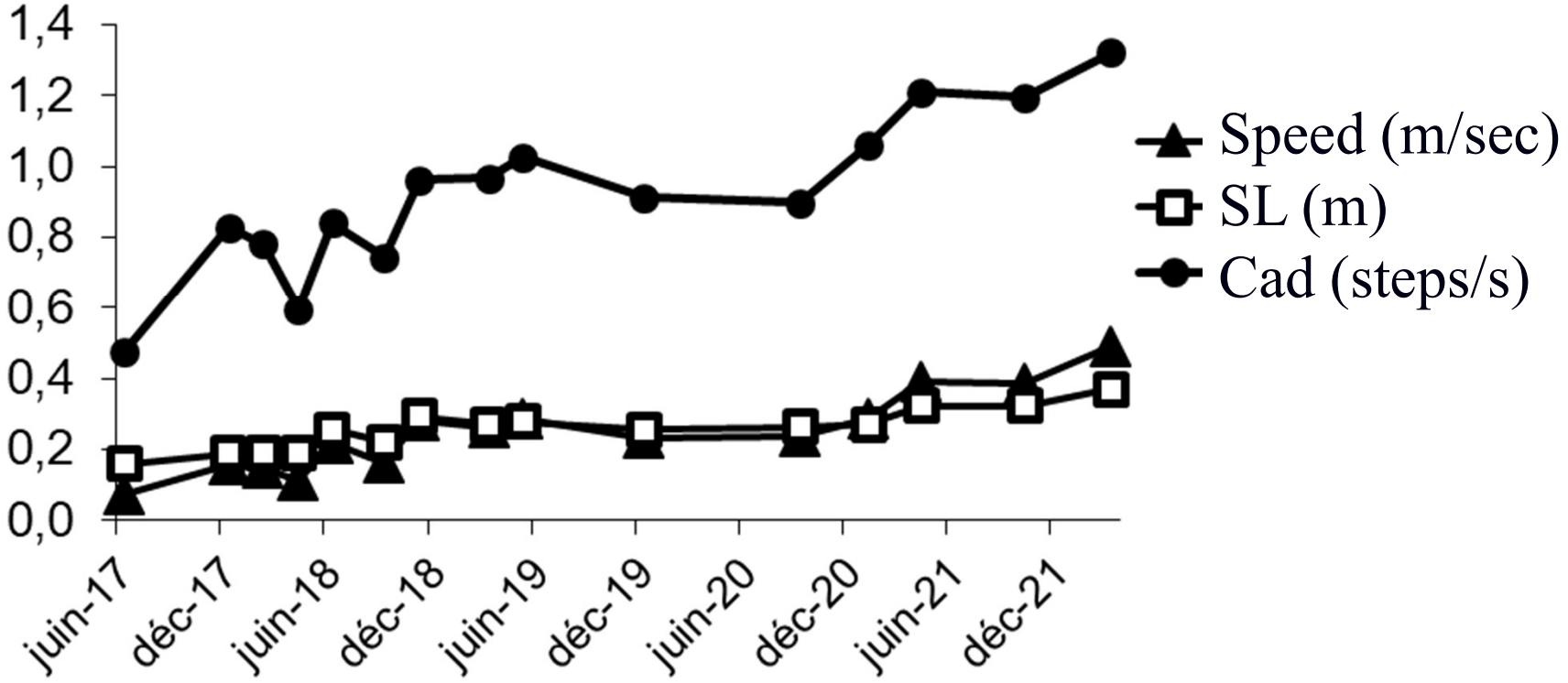
Y3 - 20/05/19

Work against rectus femoris

Y5 - 12/04/21

Y6 - 23/05/22

10 meters barefoot wo cane



Bernard (DoB 1946)
Stroke March 6, 2009

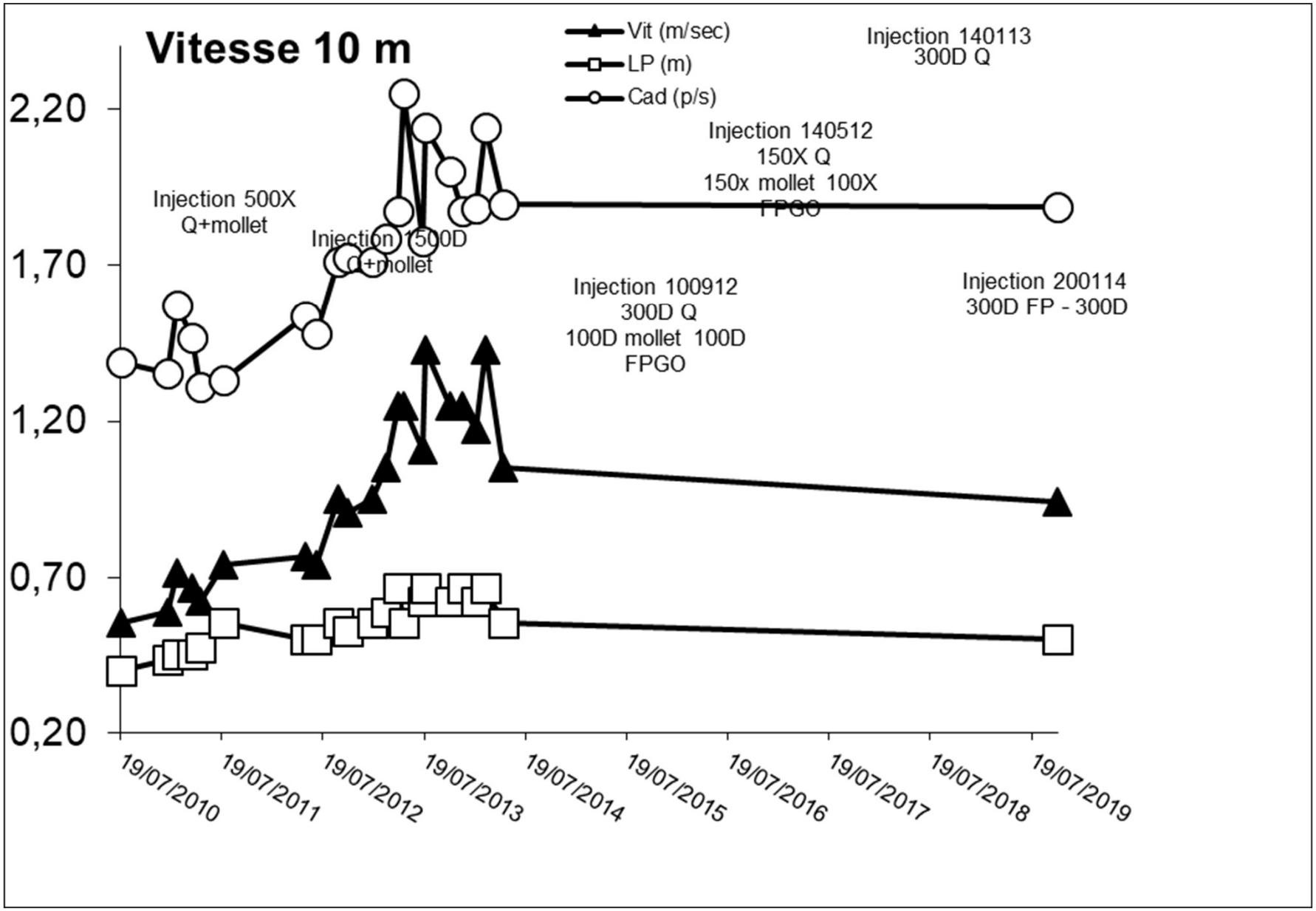
Anterior pattern

Y3 – 0.56 m/s - 19/07/10

Y6 – 1.05 m/s - 04/03/13

Bernard (DoB 1946)
Stroke March 6, 2009

Anterior pattern

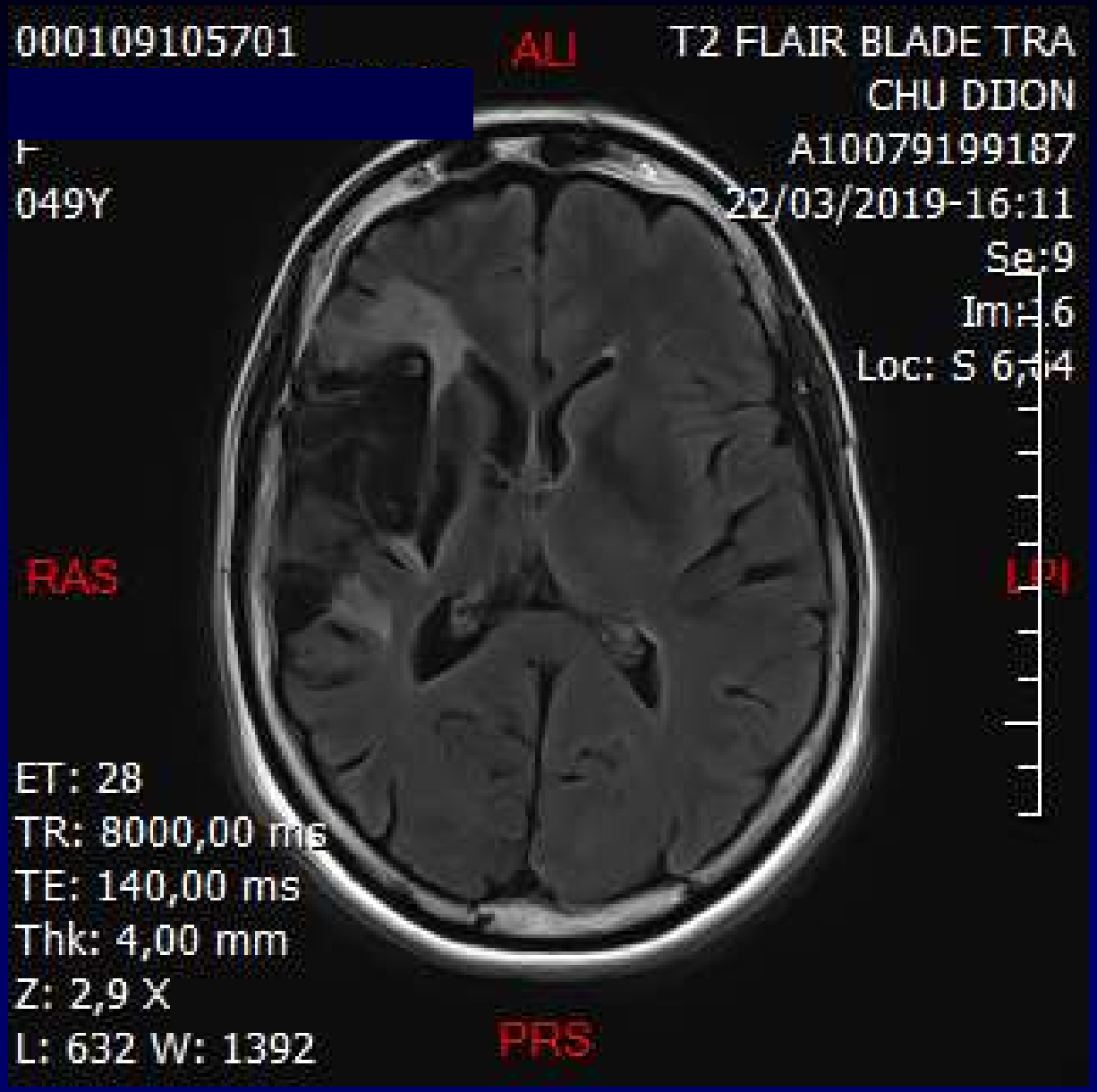


Guided Self-rehab = Contract

1. **Patient works and documents**
2. **Therapist teaches and coaches**

Woman 38 years old
Right MCA stroke Oct 2013
PT twice a week until Feb 2015

Status Feb 2015



Gracies, 2003


Blanchon, Laurence (Mrs),8004489600
Acc : 30029980212
Descr. Examen : IRM cérébrale fonctionnelle (fct motrices)
Descr. Série : Pouce-index Multilabel [1]
1004 - 69
Avec perte (1:18)
06/03/2020 14:11:32
HENRI MONDOR
LT : 0,90 mm
C :476 W :1040
Zoom : 316%
R
P

Feb 2015
M17 post stroke

Gracies, 2019

Shoulder adductors/extensors

Fig. 2.
Subject seated in the ACT[RD] system. His trunk is secured by straps and the arm is attached to the HM with the lightweight forearm-hand orthosis. He is looking at the computer monitor for visual feedback, shown in Fig. 3

Sukal TM, Ellis MD, Dewald JP. Shoulder abduction-induced reductions in reaching work area following hemiparetic stroke: neuroscientific implications. Exp Brain Res. 2007;183(2):215-23

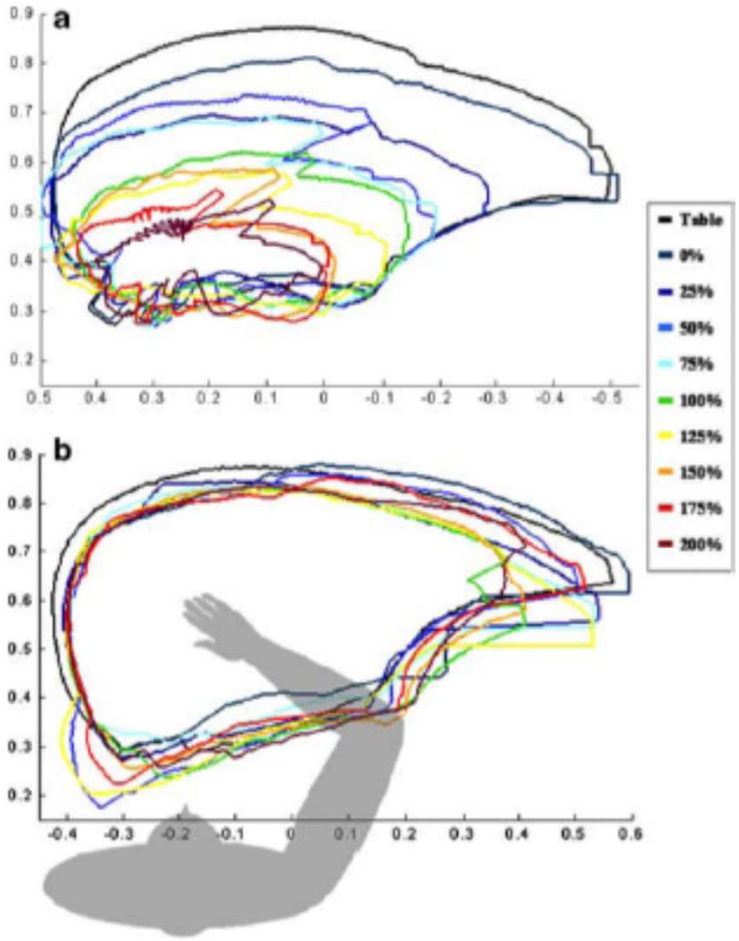
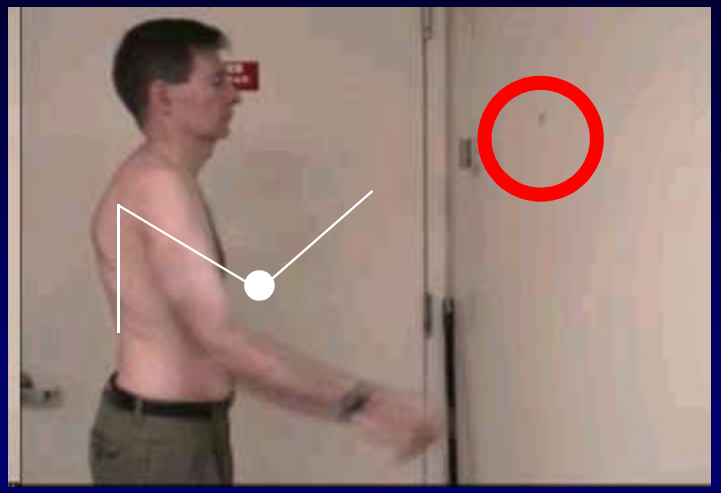


Fig. 4.
Envelope abilities during various levels of limb support in the left, paretic limb (a) of a single subject, inverted for comparison to the non-paretic limb shown in (b). Axes units are in meters, and an individual's outline is provided in the non-paretic (*right*) side for reference

Sukal TM, Ellis MD, Dewald JP. Shoulder abduction-induced reductions in reaching work area following hemiparetic stroke: neuroscientific implications. Exp Brain Res. 2007;183(2):215-23

Decrease in finger flexor cocontraction when fight ↓ against shouder extensors



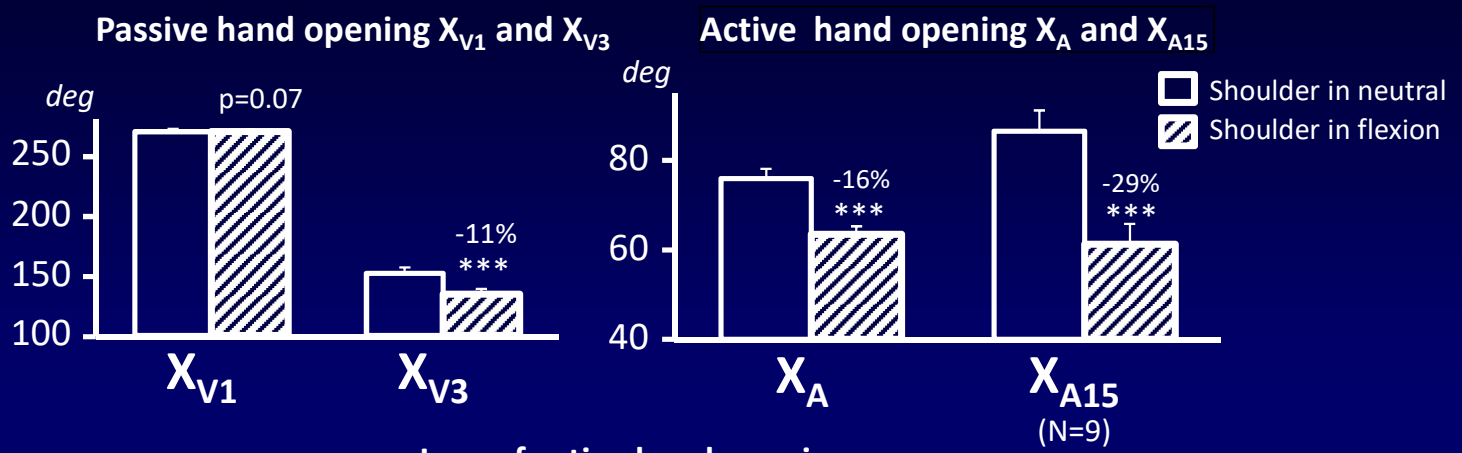
Pre **5 minutes post**

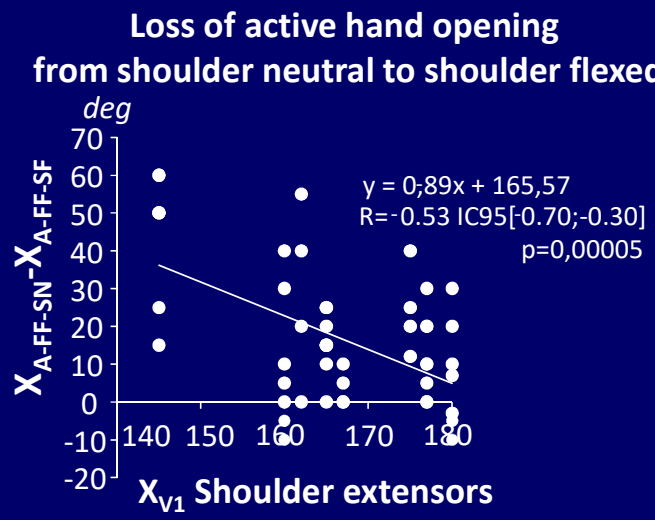
Injection lidocaine 2%

Pectoralis Major:	4 cc
Long head of triceps:	2 cc
Teres major:	1 cc
Latissimus dorsi:	1 cc
Rhomboïds (maj + min)	2 cc

Gracies, 2021

Increase in shoulder extensor extensibility associated with greater hand opening in reaching efforts - n=16





Alhajri, Gracies, in preparation

M13 post stroke

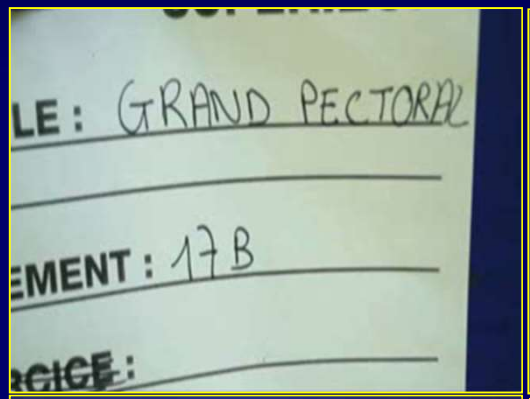
24 nov 2014

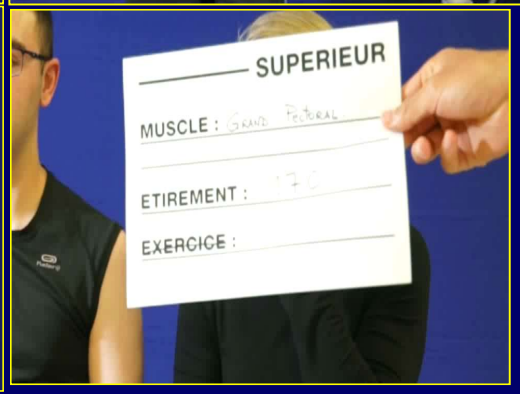
Lang CE, Wagner JM, Bastian AJ, Hu Q, Edwards DF, Sahrmann SA, Dromerick AW. Deficits in grasp versus reach during acute hemiparesis. Exp Brain Res. 2005;166(1):126-36

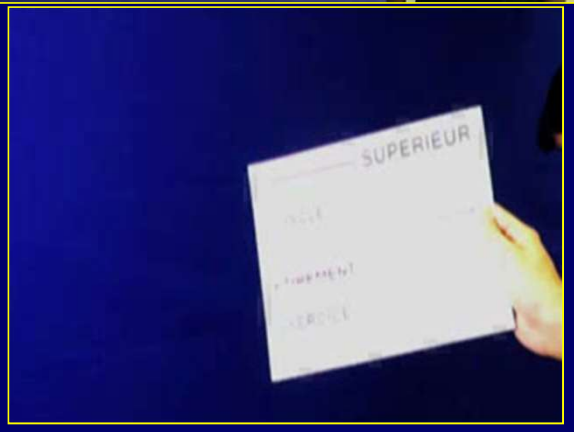
Against pectoralis major

Treatment of **myopathy**
= Stretching postures

Treatment of **cocontraction**
Rapid Alternating Movements of maximal amplitude, unassisted







4 years of Self-Rehabilitation Contract

Nov 14 – M13 post stroke

Jul 15 – M21

Mar 16 – 2,5 yrs post

Mar 17 – 3,5 years post stroke

4 years of Self-Rehabilitation Contract

Nov 14 – M13 post stroke

Jul 16 – 2,5 years

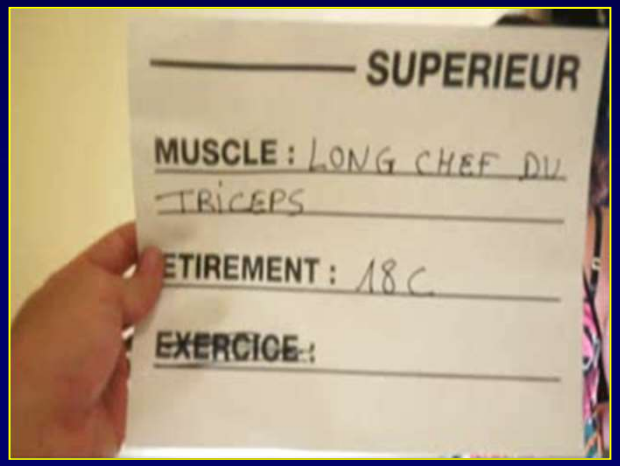
Mar 17 – 3,5 years post stroke

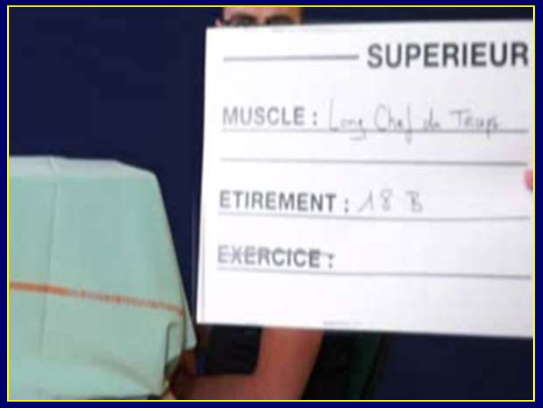
Sept 17 – 4 years post stroke

mp4

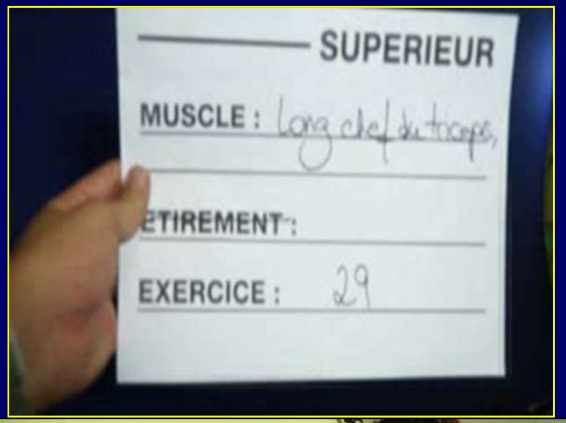
Against long head of triceps

Stretching postures
→ Muscle disorder





Rapid Alternating Movements of maximal amplitude, unassisted
→ Neurological disorder

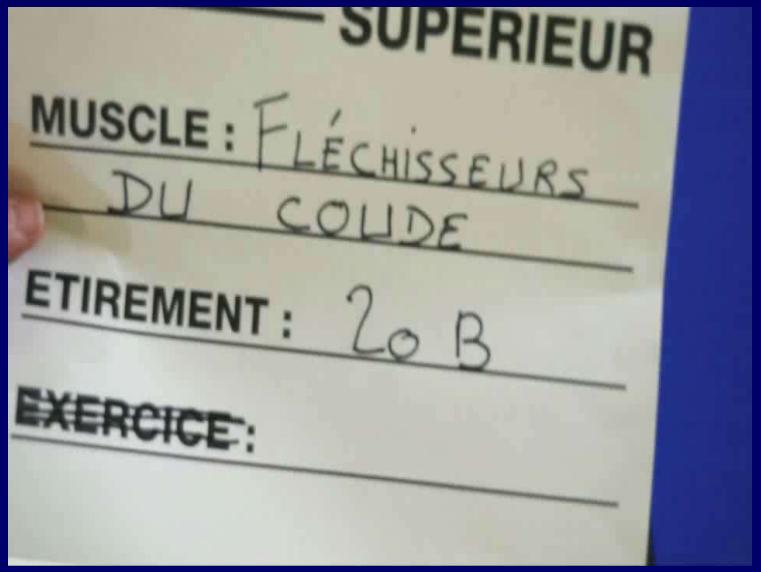


Work against long head of triceps

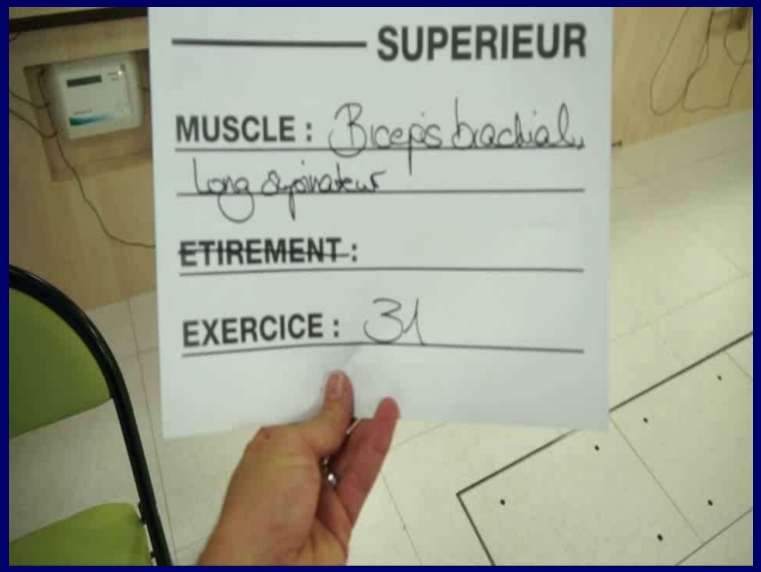
mp4

Against elbow flexors

Stretching postures
→ Muscle disorder



Rapid Alternating Movements of maximal amplitude, unassisted
→ Neurological disorder



4 years of Self-rehabilitation Contract

Nov 14 – M13

Nov 14 - downwards

Dec 16 – M38

Against pronator quadratus
Group workshop

4 years of Self-rehabilitation Contract

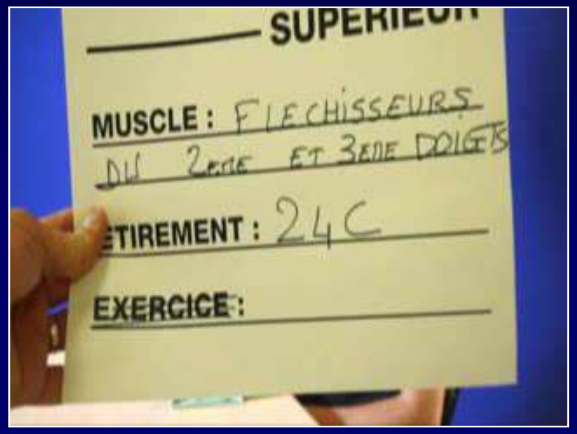
Jan 18 – 4.5 years post stroke

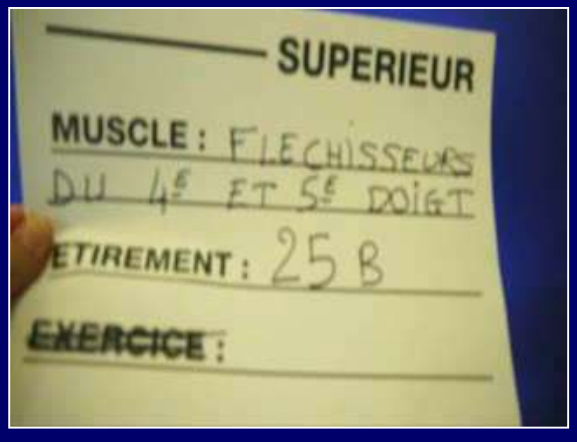
Elbow large supinations *vs* pronator teres

mp4

Against finger flexors

Stretching postures → Muscle disorder





Rapid Alternating Movements of maximal amplitude, unassisted → Neurological disorder

Wrist flexed

Wrist in neutral

Work against cocontraction of extrinsic finger flexors

05/12/17 – Y4

19/06/18 – Y4,5

16/01/18 – Y4,2

13/09/18 – Y4,9

21/03/18 – Y4,5

11/12/18 – Y5

What we need to function is individuation, more than amount of agonist recruitment

Quantification of 2 critical aspects of hand function, 'strength', and independent control of fingers (individuation).

n = 54 patients with hemiparesis over first year after stroke.

→ **Most recovery of strength and individuation occurred within the first 3 mo.**

→ Recovery of 'strength' and individuation tightly correlated up to a 'strength' level of ~60% of estimated premorbid strength; **beyond this threshold, strength improvement was not accompanied by further improvement in individuation.**

Separable systems for recovery of finger strength and control after stroke

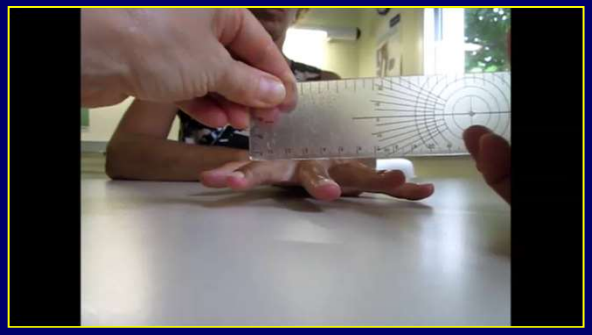
Xu J, Ejaz N, Hertler B, Branscheidt M, Widmer M, Faria AV, Harran MD, Cortes JC, Kim N, Celnik PA, Kitago T, Luft AR, Krakauer JW, Diedrichsen J. J Neurophysiol. 2017;118(2):1151-1163

Work against cocontraction of Palmar IO

Dec 16 – 3 yrs

Jan 18 – M47

Mar 18 – M49



Jun 18 pre – M52

Sep 18 post – M55

Dec 18 – 5 yrs

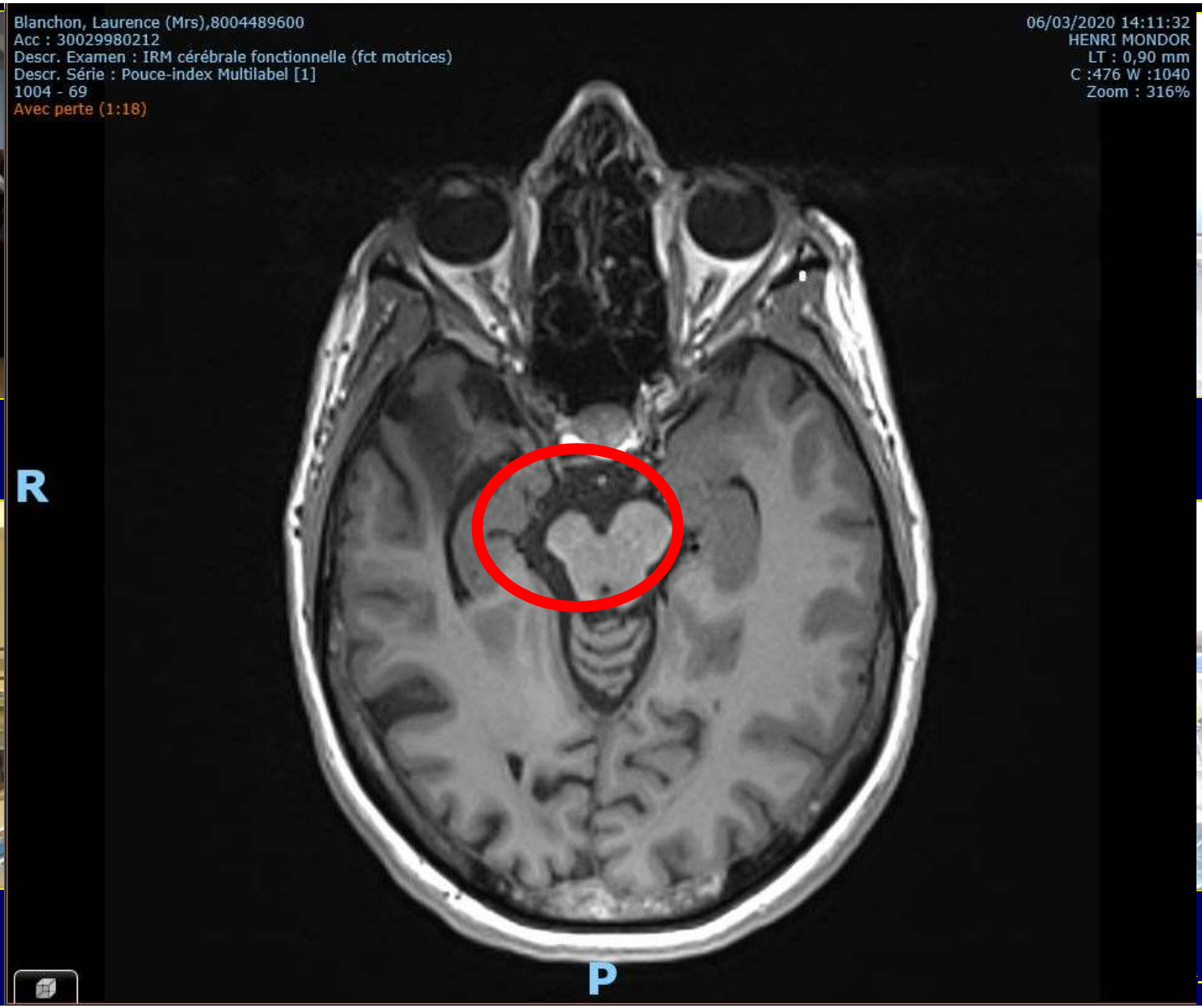
22/03/15 – M18

22/03/16 – M30

15/01/18 – Y4

Thank you !

11/12/18 – Y5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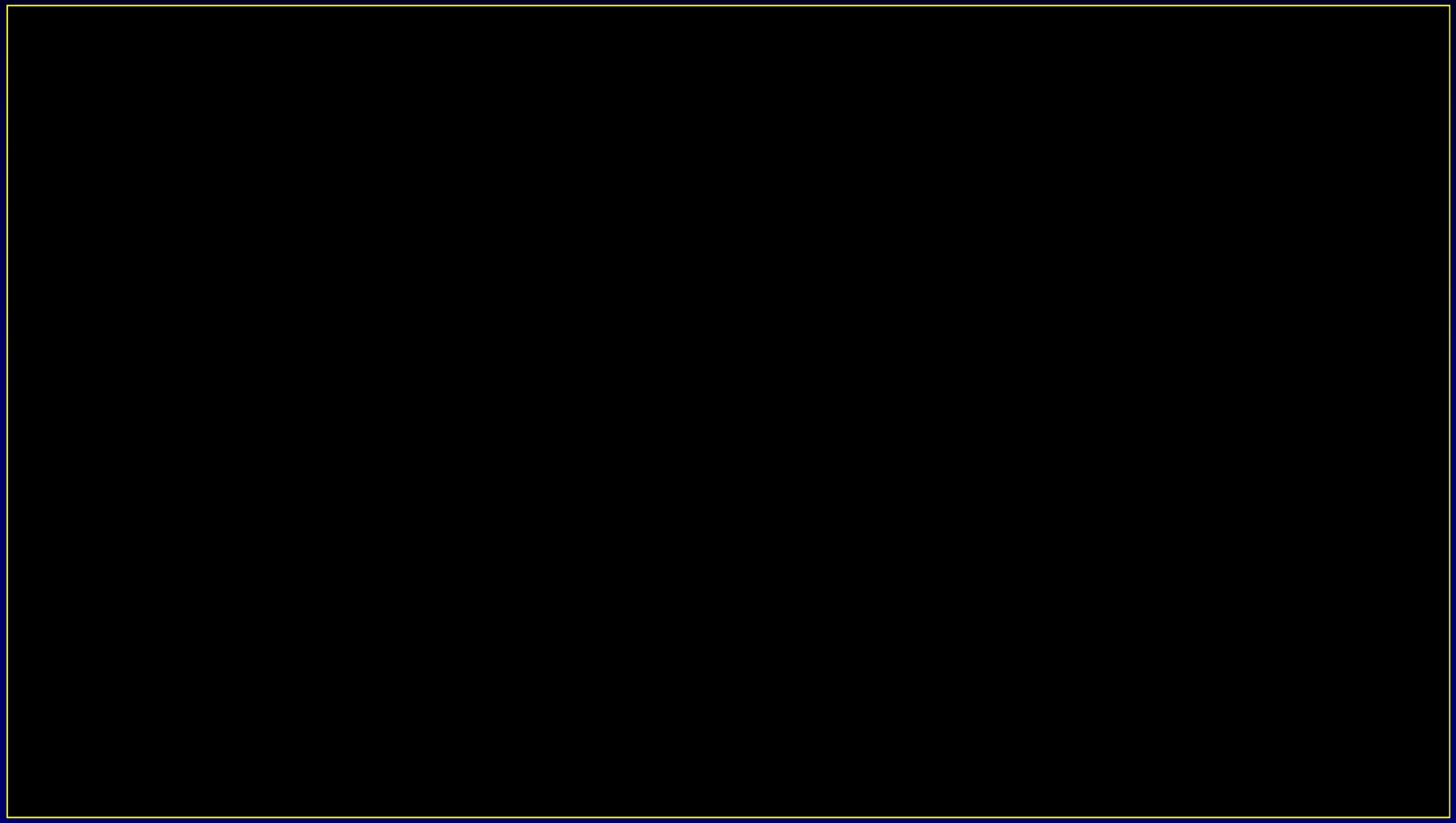
Descr. Série : Pouce-index Multilabel [1]
1004 - 69
Avec perte (1:18)
06/03/2020 14:11:32
HENRI MONDOR
LT : 0,90 mm
C :476 W :1040
Zoom : 316%
R
P

-Colas



Accounts from patients

Remerciements

Mondor-Chenevier, Créteil

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Nicolas BAYLE, MD
Thara SANTIAGO, PT
Mouna GHEDIRA, PT, PhD
Mina BOUTOU, MSc
Marjolaine BAUDE, MD
Caroline COLAS, MD
Damien MOTAVASSELI, MD
Tymothée POITOU, MD
Etienne SAVARD, MD
…

www.neuroloco.org


M 23 Ans
Pos 114.70 mm
CT
cm.
A
R
F
L
P
L 45 / W 90

Total MCA infarct – 4 years of GSC

20/08/19 (Y2)

17/12/19

17/11/20

23/02/21

18/05/21

03/05/22 (Y6)