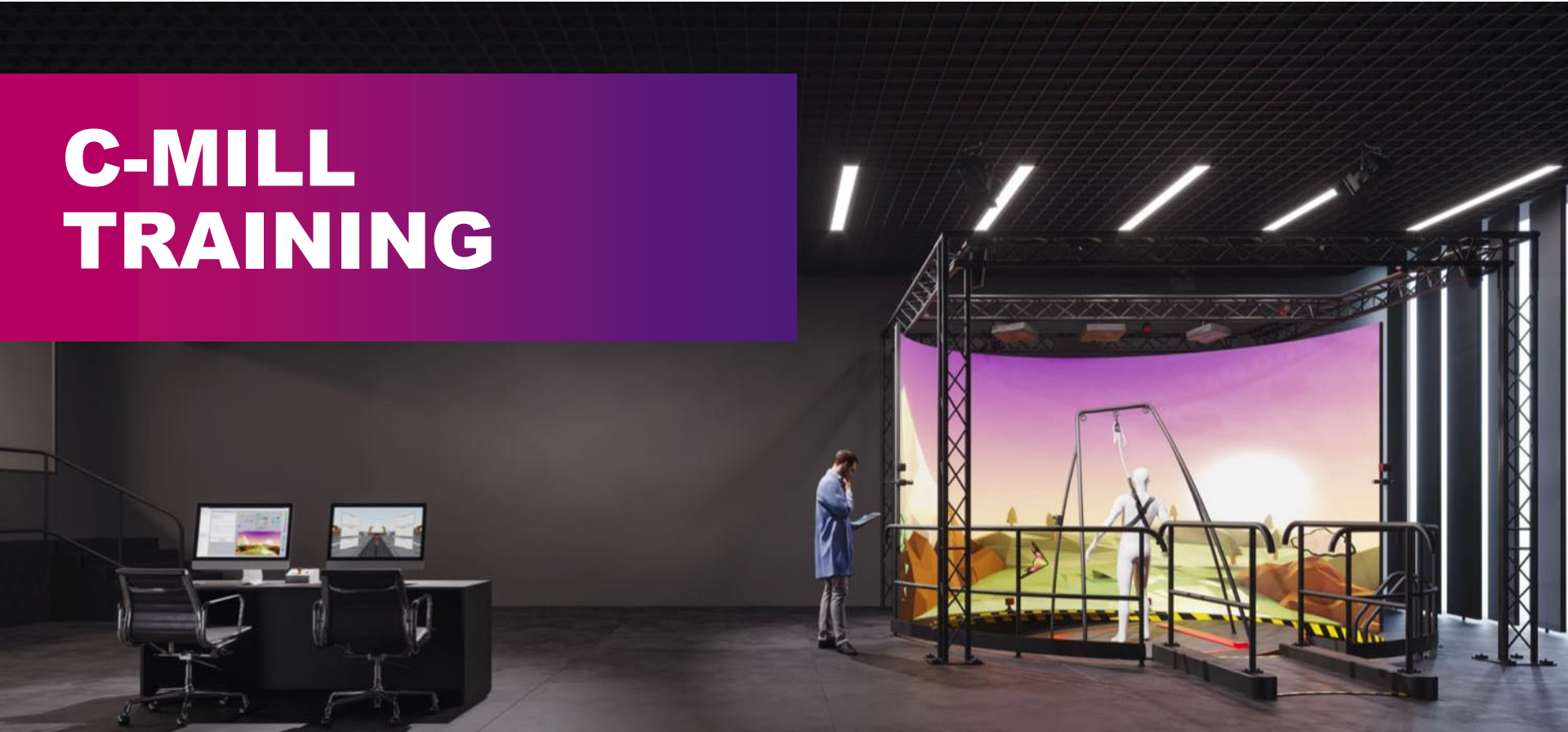
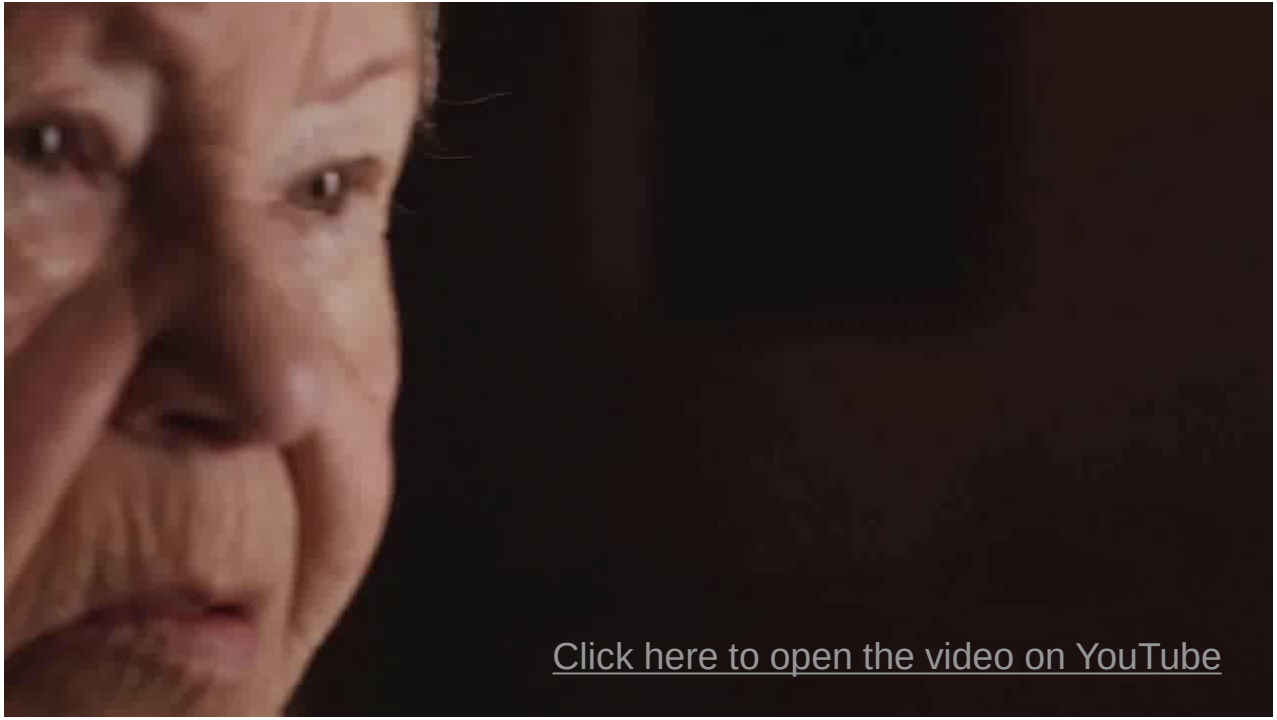
Motek
a DIH brand

C-MILL TRAINING



WHY?



DAILY LIFE OUTSIDE WALKING & C-MILL

Step over obstacles

Avoid obstacles

Speed up / slow down

THE C-MILL

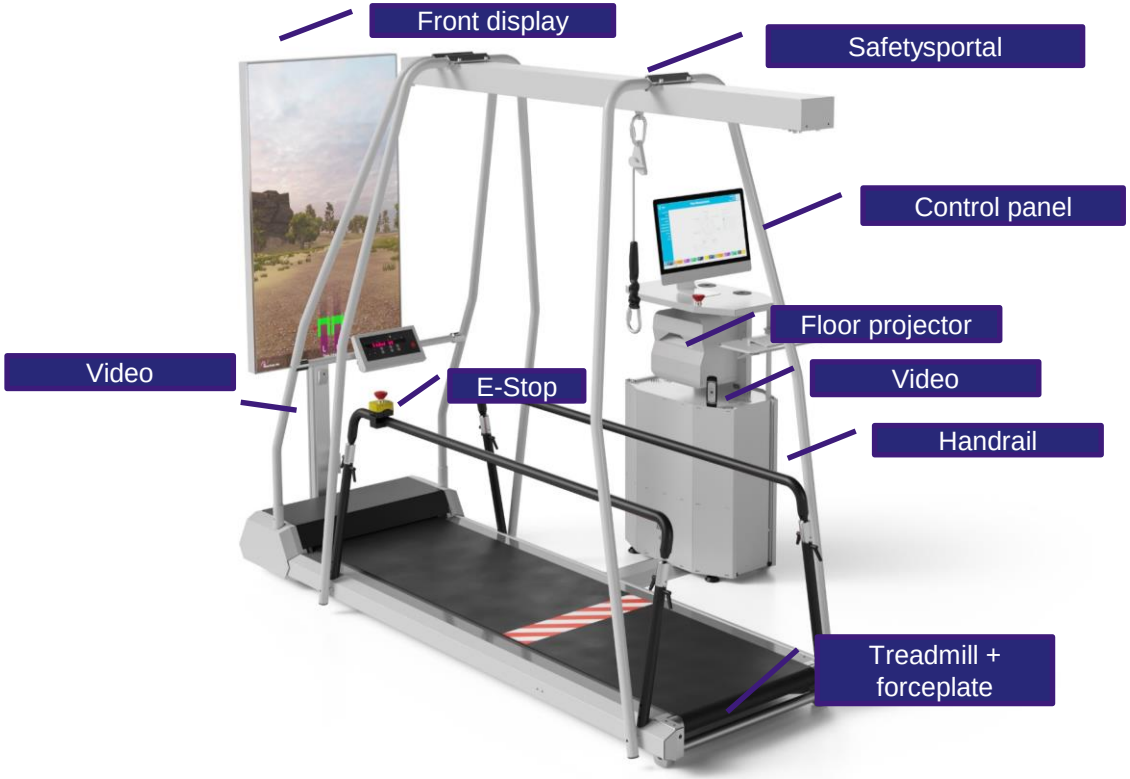
- **Effective functional gait therapy** (Heeren et al. 2013)
- **Incorporate motor learning principles** (Papegaaij et al. 2017)
- **Fun and motivative therapy in a safe environment** (Houdijk et al. 2012)
- **Objective balance and gait assessment results** (Roerdink et al. 2014)
- **Monitor progression over time**

PROGRAM C-MILL TRAINING

1. Hardware C-Mill
2. Safety C-Mill
3. Prepare C-Mill session
4. C-Mill Therapy Workflow
5. Assessment & Training
6. Patient Session
7. Manual control & Make your own protocol
8. Advanced Items

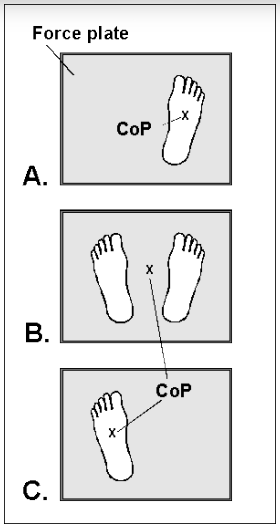
C-Mill hardware

C-MILL VR

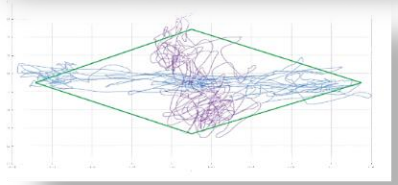

Front display
Safetysportal
Control panel
Floor projector
Video
E-Stop
Video
Handrail
Video
Treadmill +
forceplate

C-MILL FORCE PLATE

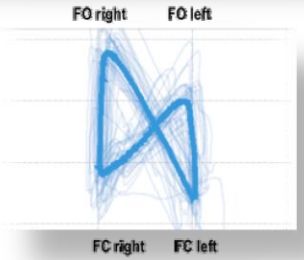
Centre of Pressure (CoP)



Balance measurement



Gait measurement



Safety C-Mill

SAFETY C-MILL

Safety C-Mill
• Preventive measures • Passive safety → Harness + Safety line + Support bars • Active safety → E-stop 2x + E-stop safety portal + Light gate*

Prepare C-Mill Session

C-Mill Therapy Workflow

THERAPY WORKFLOW

Indication/Contraindications?

Start level patient?

Baseline level patient?

Treatment goals?

Effect training?

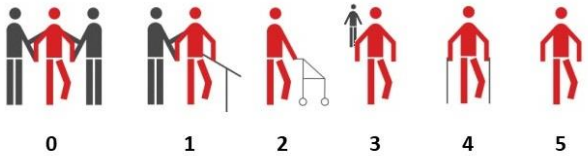
Patient improved in performance?

REFERRAL

Referral | Intake | Assessment | Training | Re-Assessment | Evaluation

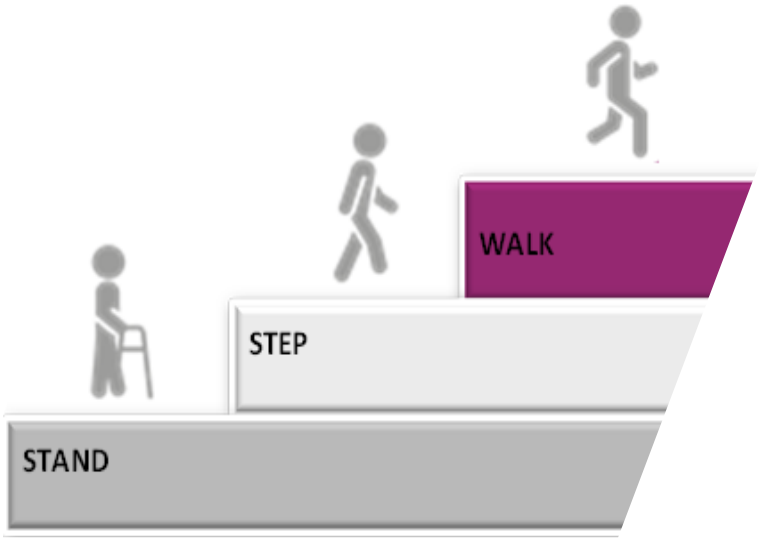
Contraindications C-Mill
▪ A severe cognitive, visual or hearing impairment where the patient is not able to follow the instructions of the operator. ▪ More than 135 kg total bodyweight or less than 25 kg ▪ More than 2.00 meter body height ▪ Open skin lesion or bandage in the area of harness contact. ▪ < FAC 2
Risk factors C-Mill
▪ Severe reduced bone density ▪ Spinal instability or unstable fractures. ▪ Severe vascular disorders or cardiac abnormalities that affect the ability to exercise safely ▪ Running < FAC 5

FAC: functional ambulation categories



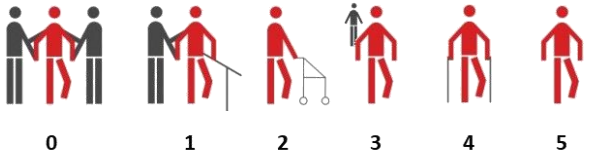
INTAKE

Referral | Intake | Assessment | Training | Re-Assessment | Evaluation



	Indication	Training goals
Stand	FAC level 2	- Dynamic balance - Weight shifting
Step	FAC level ≥ 2	- Stepping balance - One leg stance
Walk	FAC level ≥ 3	- Gait - Gait adaptability

FAC: functional ambulation categories



ASSESSMENT

Referral | Intake | Assessment | Training | Re-Assessment | Evaluation

STAND	
Goal	Assessment
Static balance	Postural control
Dynamic balance	Limits of Stability

ASSESSMENT

Referral | Intake | Assessment | Training | Re-Assessment | Evaluation

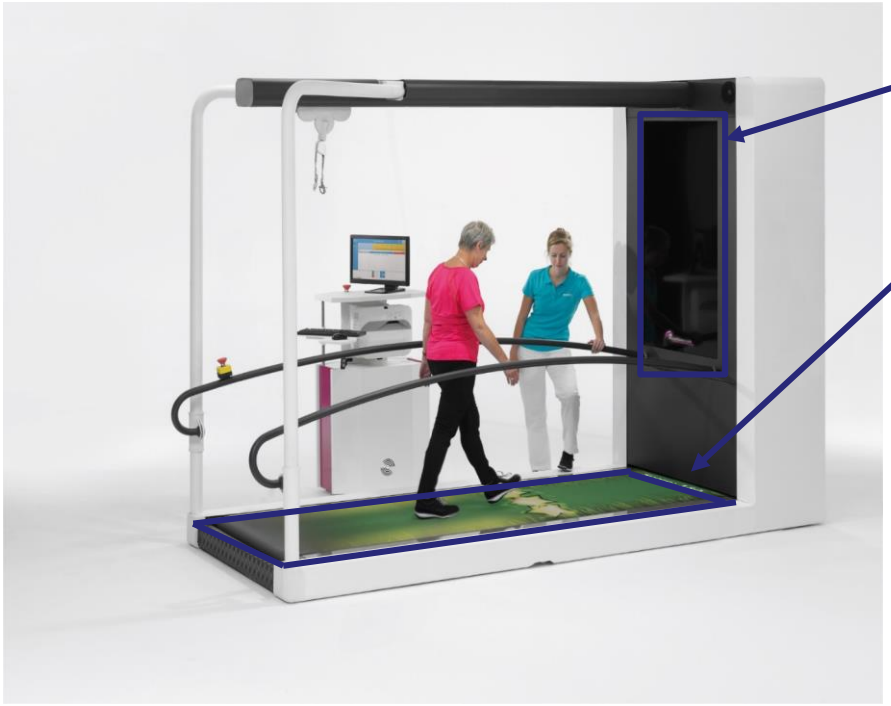
WALK	
Goal	Assessment
Walk pattern	Gait Assessment
Gait Adaptability	C-Gait

TRAINING

Referral | Intake | Assessment | Training | Re-Assessment | Evaluation

TRAINING

Referral | Intake | Assessment | Training | Re-Assessment | Evaluation



Virtual Reality

Augmented Reality

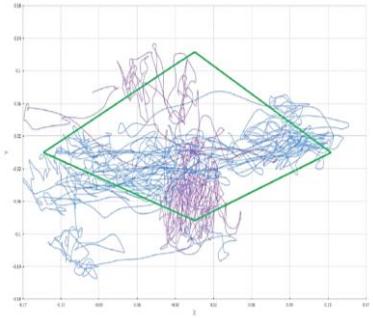
MOTOR LEARNING PRINCIPLES

- Training intensity
- Variable practice
- External focus of attention
- Implicit learning
- Task-specific
- Feedback

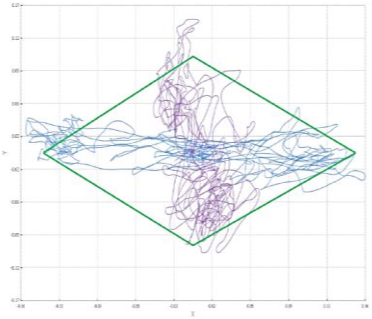
RE-ASSESSMENT

Referral | Intake | Assessment | Training | Re-Assessment | Evaluation

T0



T1



Assessment

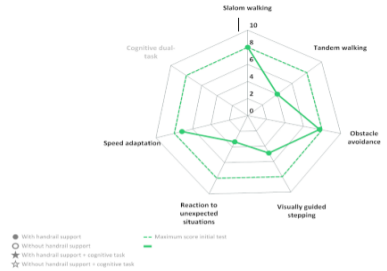
Training

EVALUATION

Motek a DIH brand

Referral | Intake | Assessment | Training | Re-Assessment | Evaluation

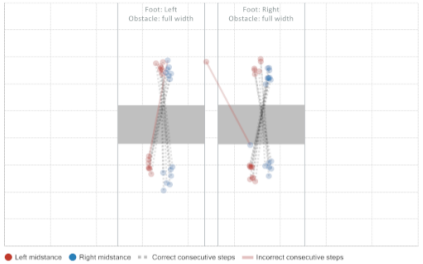
C-Gait



Avg. speed	2.3 km/h
Duration	33 sec
Distance	21.5 m
Steps	38
Step frequency	33.2 steps/min

	Left	Right
Step length [m]	0.617	0.516
% stride length	54.5	45.5
Step time [s]	1.3	1.21
% stride duration	69.9	64.9
Stride length [m]	1.13	
Step width [m]	0.17	

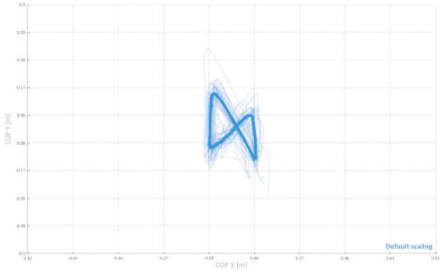
Obstacle avoiding



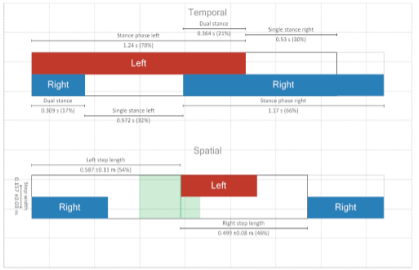
Left foot full width: 14/14

Right foot full width: 15/16

Butterfly



Spatial temporal



Assessments & Training

THERAPY WORKFLOW

Indication/Contraindications?

Start level patient?

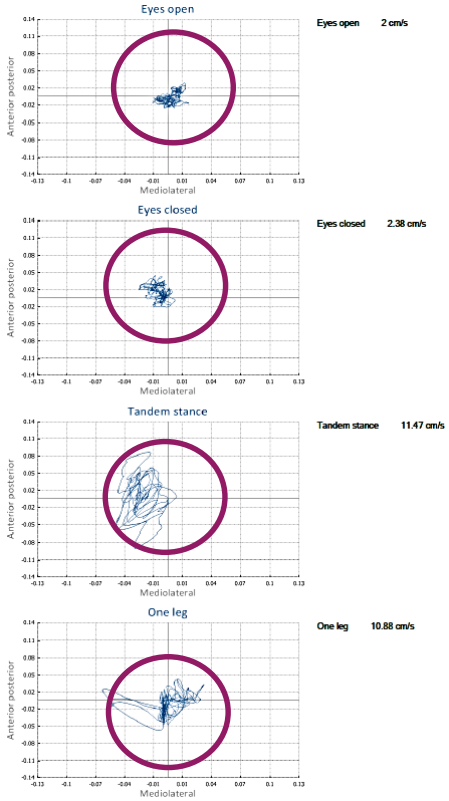
Baseline level patient?

Treatment goals?

Effect training?

Patient improved in performance?

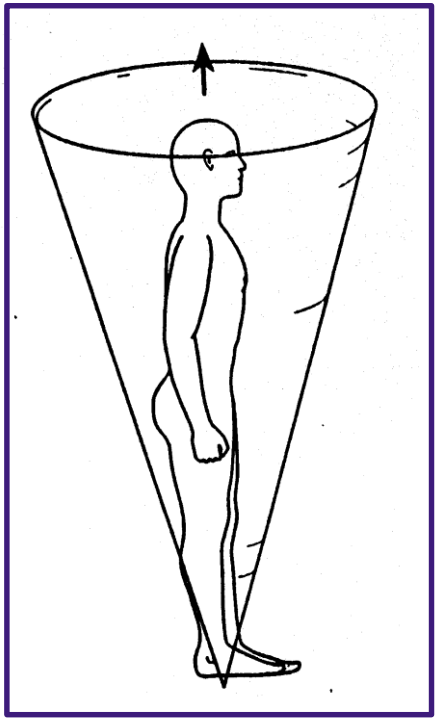
POSTURAL CONTROL



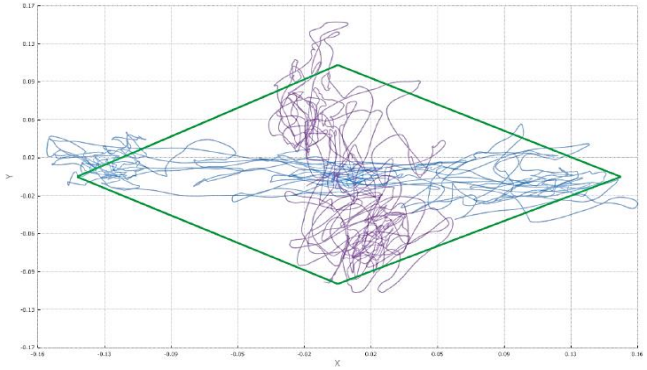
- **GOAL**: measures static postural control in 4 different postures.
  - Eyes open
  - Eyes closed
  - Tandem stance
  - One-leg stance

- **OUTCOME**: Center of Pressure (CoP) velocity in cm/s
- **Low** CoP velocity = **Better** postural control

LIMIT OF STABILITY



- **GOAL**: measures the dynamic stability without moving the BOS
- **OUTCOME**: Medio-lateral and Anterior-posterior CoP displacement in cm

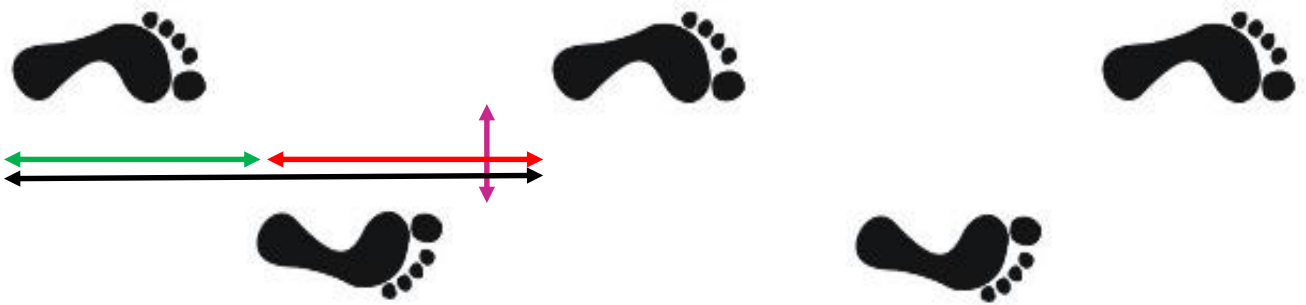


- **Higher** CoP displacement = **Better** stability

GAIT ANALYSIS

- Step length
- Stride length
- Step width
- Distance

Spatial parameters (distance)



Left step length (m)

Step width (m)

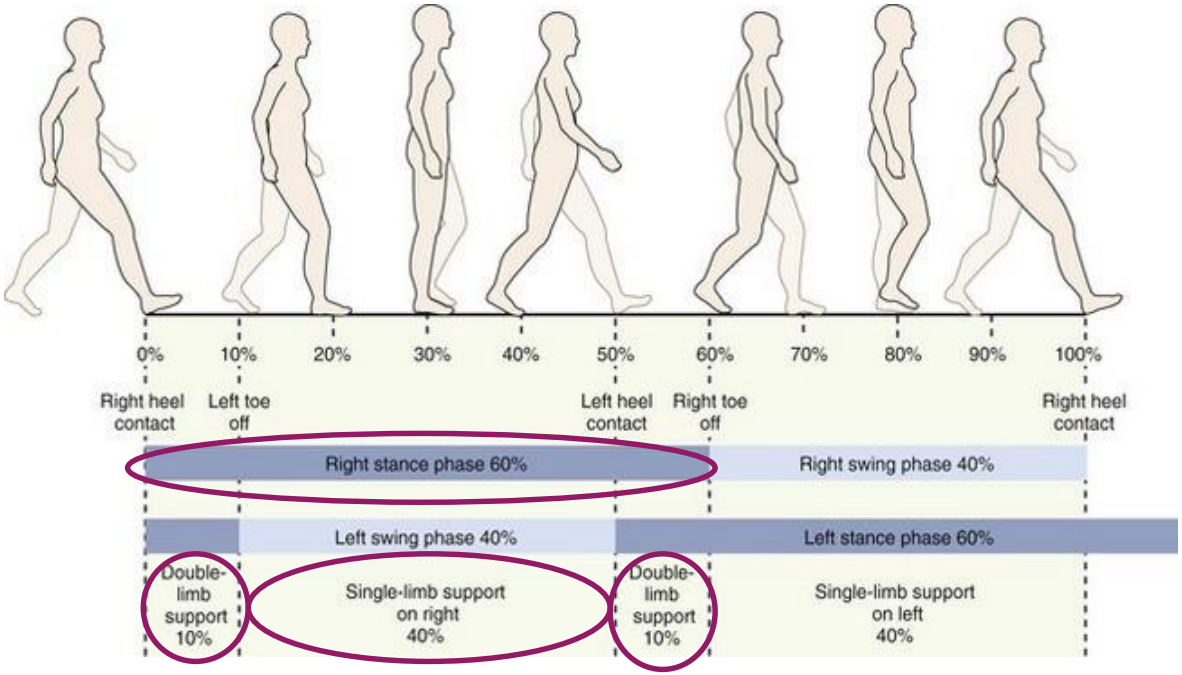
Right step length (m)

Stride length (m) = right step length + left step length

GAIT ANALYSIS

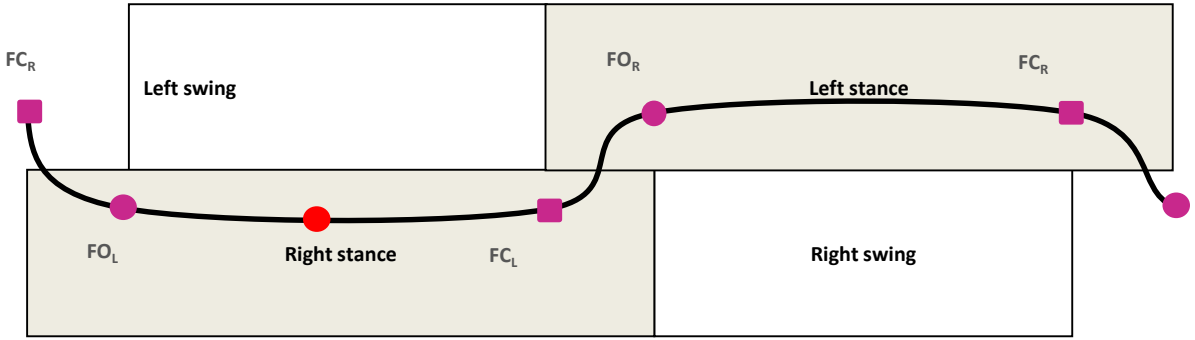
- Total stance time
- Unipedal stance time
- Bipedal stance time
- Cadence

Temporal parameters (time)



BUTTERFLY (COP GAITOGRAM)

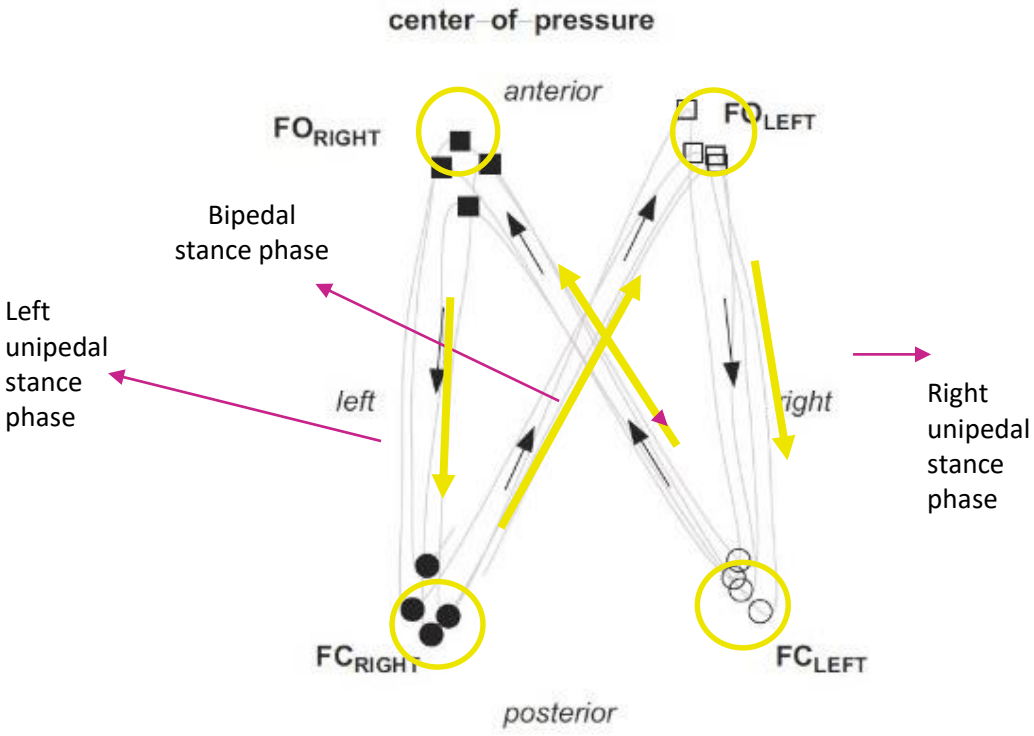
Top view COP traject



Walking direction ----->

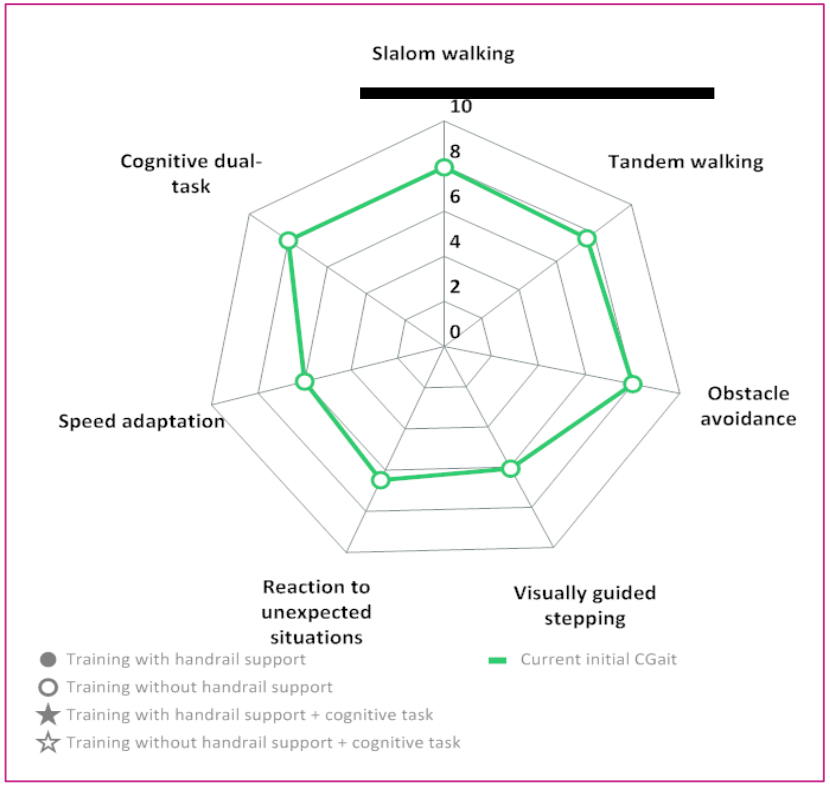
FO left: Foot Off left
FO right: Foot Off right
FC left: Foot Contact left
FC right: Foot Contact left

BUTTERFLY (COP GAITOGRAM)



FO left: Foot Off left
FO right: Foot Off right
FC left: Foot contact left
FC right: Foot contact left

C-GAIT (GAIT ADAPTATION OUTCOME)



C-Gait assessment		
Familiarization on the treadmill	±3 min	Determine comfortable walking speed
Gait adaptability assessment Low difficulty level	±10 min	1.5 min: visually guided stepping 2 min: obstacle avoidance 1.5 min: slalom walking 2 min: speed adaptations 1.5 min: tandem walking 1.5 min: reaction to unexpected situations
Assessment of cognitive dual task	±1 min	Walking while performing an auditory Stroop task
Gait adaptability assessment High difficulty level	±10 min	1.5 min: visually guided stepping 2 min: obstacle avoidance 1.5 min: slalom walking 2 min: speed adaptations 1.5 min: tandem walking 1.5 min: reaction to unexpected situations

THERAPY WORKFLOW

Indication/Contraindications?

Start level patient?

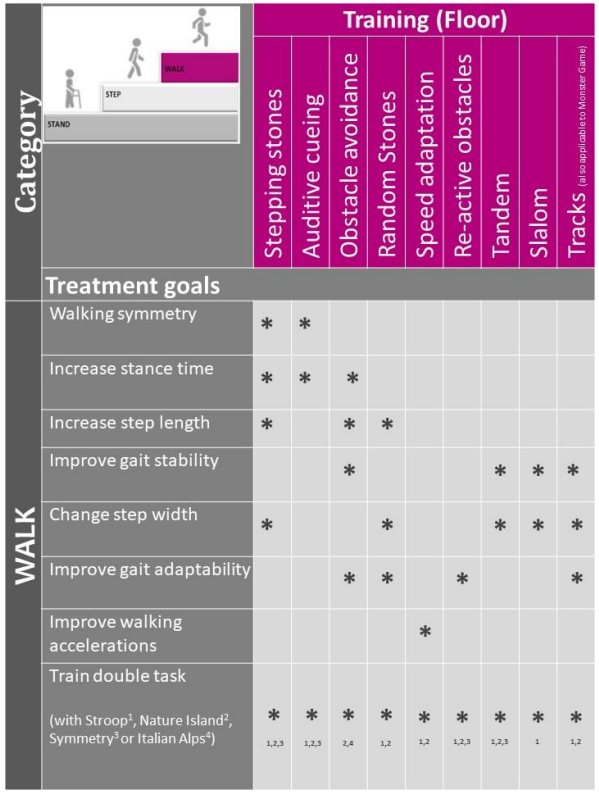
Baseline level patient?

Treatment goals?

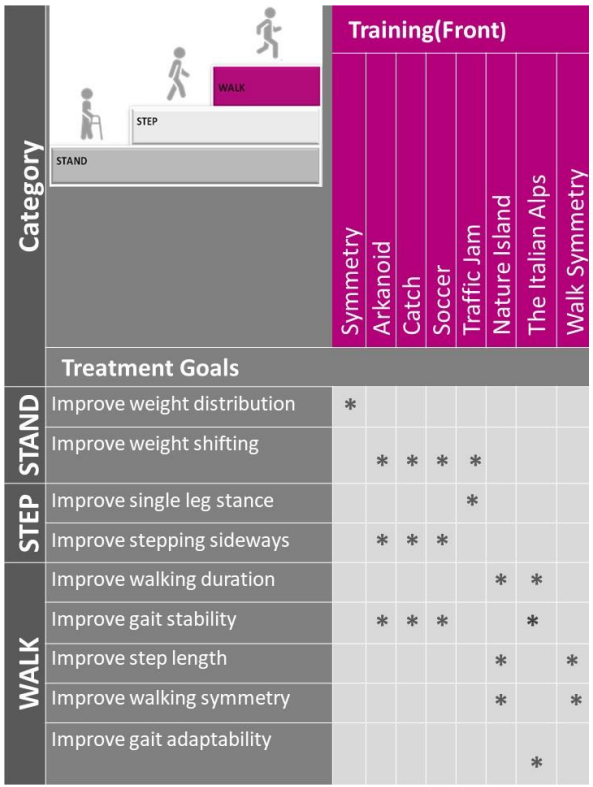
Effect training?

Patient improved in performance?

TRAINING



Category	Treatment goals	Stepping stones	Auditive cueing	Obstacle avoidance	Random Stones	Speed adaptation	Re-active obstacles	Tandem	Slalom	Tracks (al so applicable to Monster Game)
		Training (Floor)								
WALK	Walking symmetry	*	*							
	Increase stance time	*	*	*						
	Increase step length	*		*	*					
	Improve gait stability			*				*	*	*
	Change step width	*			*			*	*	*
	Improve gait adaptability			*	*		*			*
	Improve walking accelerations					*				
	Train double task (with Stroop[1], Nature Island[2], Symmetry[3] or Italian Alps[4])	* 1,2,3	* 1,2,3	* 2,4	* 1,2	* 1,2	* 1,2,3	* 1,2,3	* 1	* 1,2



Category	Treatment Goals	Symmetry	Arkanoid	Catch	Soccer	Traffic Jam	Nature Island	The Italian Alps	Walk Symmetry
		Training(Front)							
STAND	Improve weight distribution	*							
	Improve weight shifting		*	*	*	*			
STEP	Improve single leg stance					*			
	Improve stepping sideways		*	*	*				
WALK	Improve walking duration						*	*	
	Improve gait stability		*	*	*			*	
	Improve step length						*		*
	Improve walking symmetry						*		*
	Improve gait adaptability							*	

Manual control & Make your own protocol

Patient Session

Advanced Items

CONFIGURATION MENU

- Admin account
- Belt projection
- Create new users

TROUBLESHOOT C-MILL

- Cue Display
- Update CueFors
- Logfiles
- Support/ Clinical Applications contact

TAKE HOME MESSAGE

Virtual/Augmented reality is a powerful tool for rehabilitation:
optimizing therapy outcome by following the **motor learning principles.**