MOBILITY AFTER STROKE: REHABILITATION APPROACHES TO MAXIMIZE WALKING POTENTIAL

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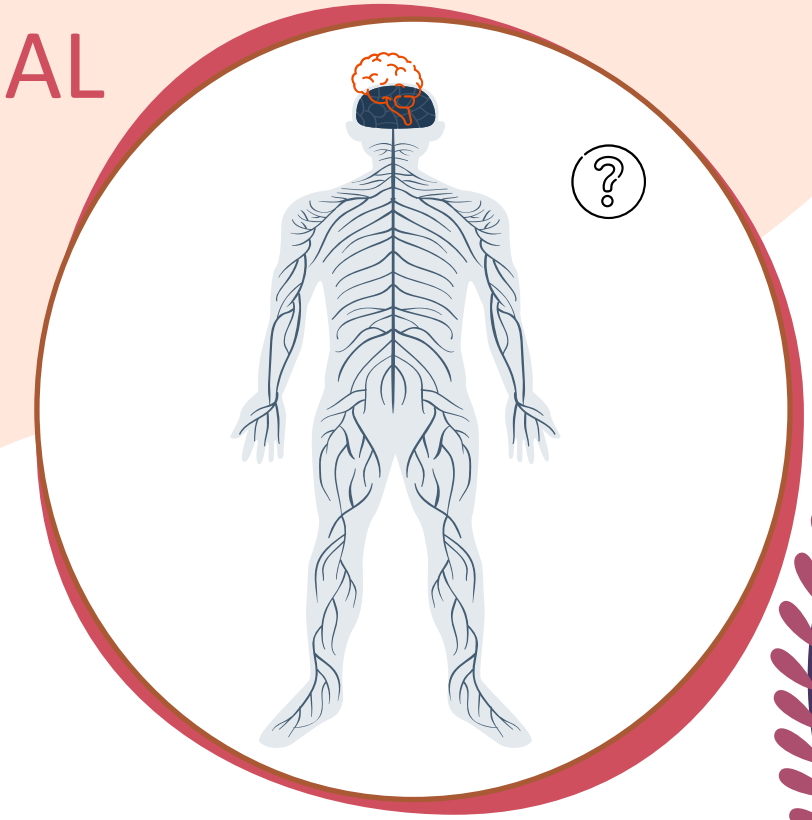


CONTENTS

INTRODUCTION

- Independent and community walking:
  - ✓ One of primary goals in the stroke rehabilitation
  - ✓ Predictor of functional independence and quality of life
- One of two stroke survivors will be unable to walk in the acute stage of stroke

70% to 80%

Independent walking in the chronic stage

20% to 30%

Independent walking in the chronic stage with some impairments (e.g. slower speeds and for limited distances)

30% to 50%

Community ambulation

(Cirstea, 2020; Harris & Eng, 2004; Jorgensen et al., 1995; Kinoshita et al., 2017; Selves et al., 2020; Winstein et al., 2016)

MOBILITY AFTER STROKE

- Outcome measures:
  - ✓ Gait speed
  - ✓ Walking distance using 6-min walking test
  - ✓ Walking ability using the Functional Ambulation Category (FAC) scale

best predictors of walking performance

FAC is a 6-point scale

- 0 = nonambulatory or requires assistance of at least 2 people to walk
- 1 to 3 = assistance or supervision from a person to walk
- 4 = able to walk indoors on level surfaces without hands-on assistance or supervision
- 5 = able to walk up and down stairs, slopes, and outdoors without assistance or supervision

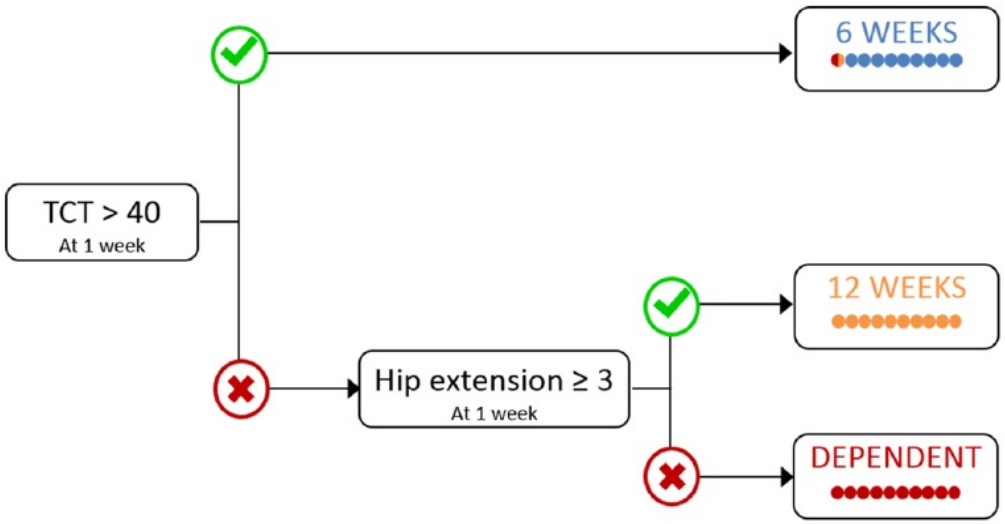
Independent walking = FAC score of 4 or 5

(Rose et al., 2017; Smith et al., 2017)

MOBILITY AFTER STROKE

Time to Walking Independently after STroke (TWIST) algorithm

- Predictions of independent walking (95% accuracy)
- Trunk control test (TCT)
  - > 40 at 1st week → independent walking within 6 weeks
  - < 40 at 1st week → independent walking by 12 weeks if hip extension strength of Medical Research Council grade ≥ 3



TWIST algorithm by Smith et al. (2017)

(Rose et al., 2017; Smith et al., 2017)

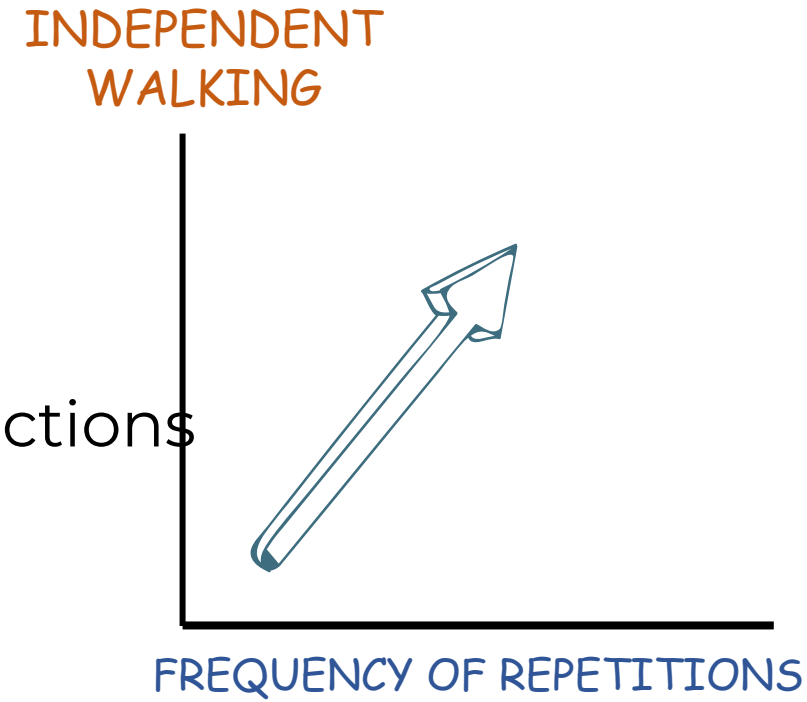
MAXIMIZE WALKING POTENTIAL

Important concepts to boost walking potential

- Neuroplasticity
- Repetitive practice

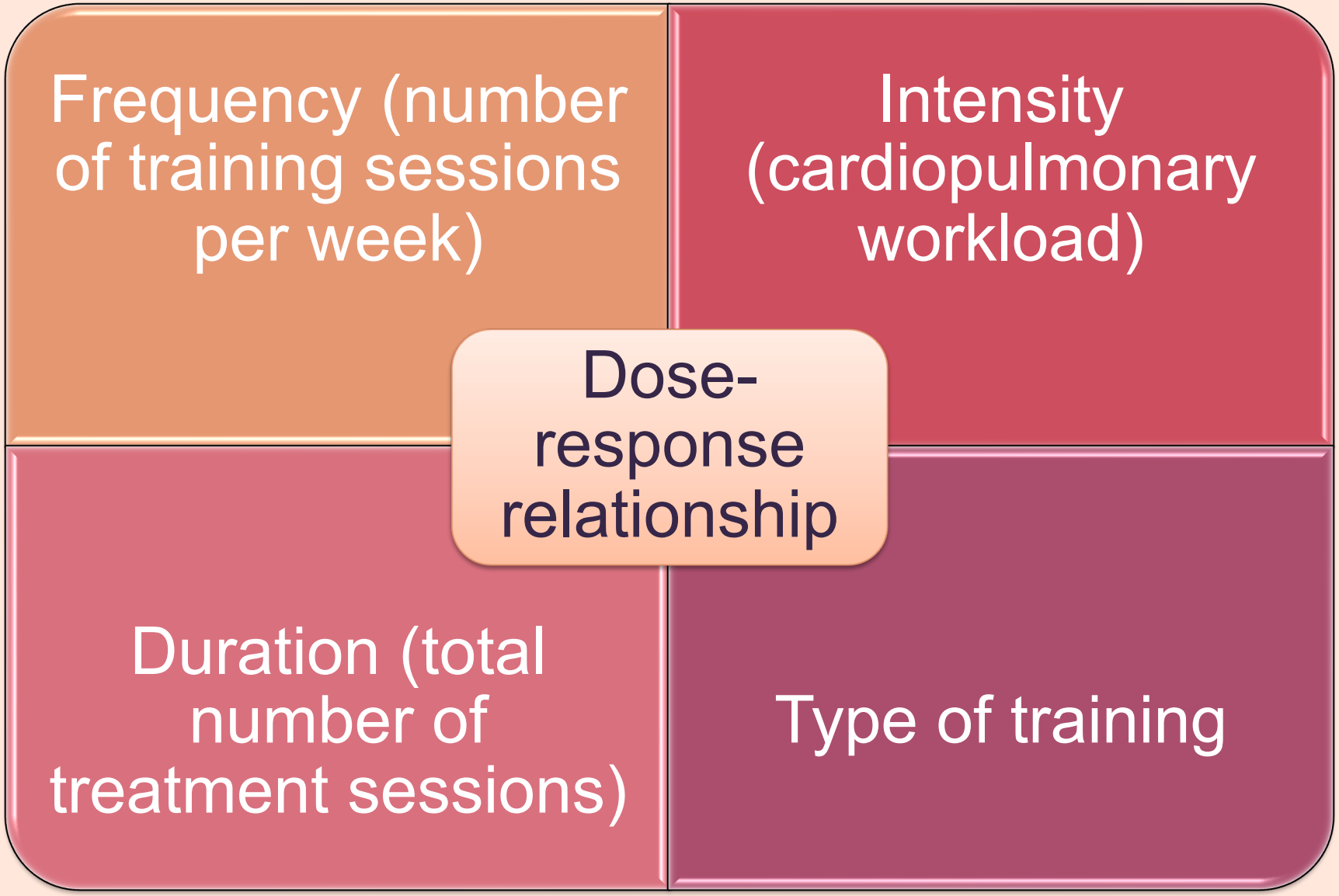
↑ repetition ⇨ Strengthen new neural connections

☞ Accelerate neuroplastic changes

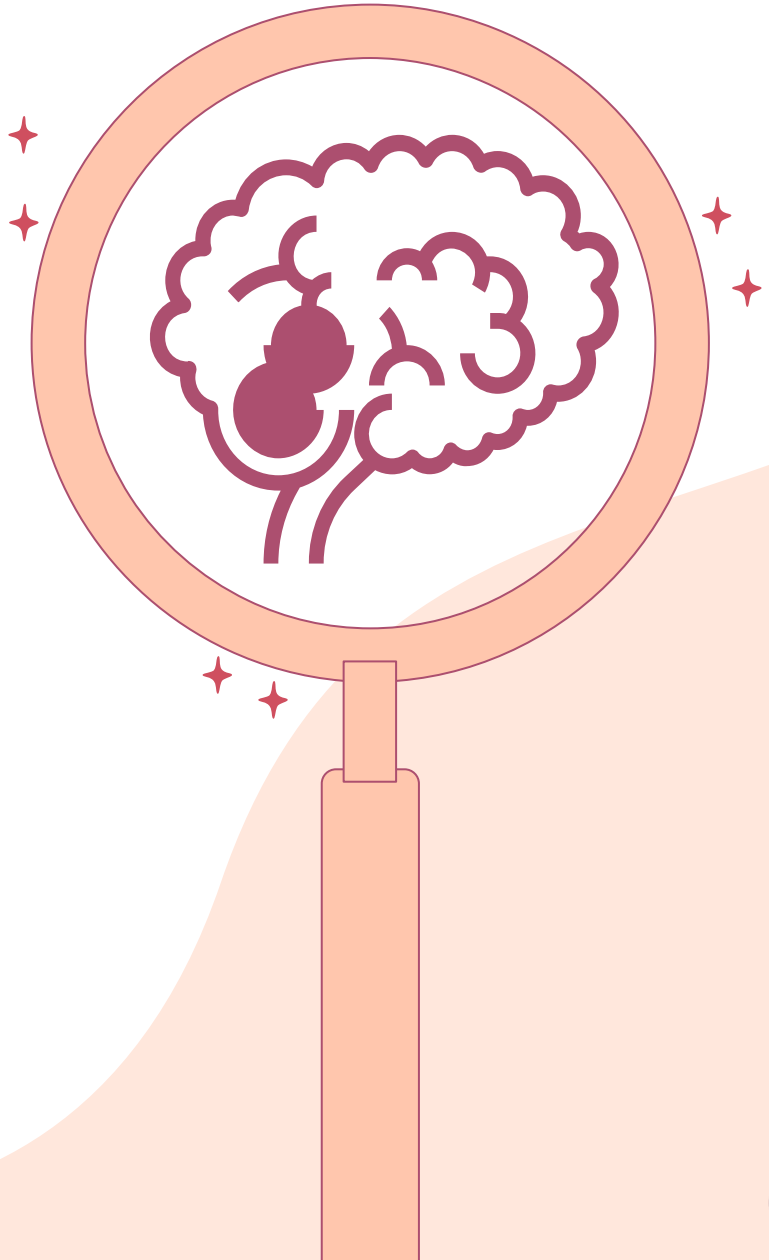


(Cirstea, 2020; Harris & Eng, 2004; Rose et al., 2017)

MAXIMIZE WALKING POTENTIAL



(Rose et al., 2017)



REHABILITATION PHASES

Four phases :

1. Hyper-acute phase (first 48 h)
2. Early rehabilitation phase (48 h to 3 months)
3. Late rehabilitation phase (3 to 6 months)
4. Chronic phase (>6 months)

(Koninklijk Nederlands Genootschap voor Fysiotherapie (KNGF), 2004; Selvesen et al., 2020)

MAXIMIZE WALKING POTENTIAL

Rehabilitation in hyper-acute phase

- Aim: To stimulate motor control recovery
- Techniques: Early bed mobility (e.g. sitting, standing, and walking) and supervised active exercises in bed
- Frequ
- 3 hours a day)
- Ensure stable cardiovascular and satisfied physiological limits: Systolic BP 120-220 mmHg, HR 40-100 bpm, SpO2 92%, and temp 38.5°C

Too much of early mobilization is detrimental for prognosis

(Cumming et al., 2011; Hesse, 2008; KNGF, 2014; Moore et al., 2020; Selves et al., 2020; Winstein et al., 2016; Yelnik et al., 2017)

Adapted from "Treadmill training with partial body weight support after stroke: A review" by Hesse (2008)

MAXIMIZE WALKING POTENTIAL

Gait rehabilitation in early and late rehabilitation phases

- Intensive, repetitive, task oriented, and adapted to the patient's functional status
- Vary exercise with the appropriate progression or com
  improve patient's compliance
- A higher training intensity

Effective
Significant outcome in walking speed

(Cirstea, 2020; Hornby et al., 2015; KNGF, 2004; Kwakkel et al., 2004)

REHABILITATION APPROACHES

01

Lower limb therapy

Mobility training
Strengthening

02

Treadmill training

With or without body-weight support

03

Robotic-assisted therapy

Robots that assist walking

04

Virtual reality training

Computerized technology

05

Circuit class training

Strengthening, balance and steady-state training

06

Self rehabilitation

Home exercise program (HEP)

(Cirstea, 2020; KNGF, 2004)

LOWER LIMB THERAPY

Resistance training

- Ankle plantarflexors, hip flexors, knee extensors, and knee flexors of the paretic leg
- Knee flexors and ankle plantarflexors of the non-paretic leg
- 1-3 sets of 10-15 reps; 8-10 muscle groups; 2-3 times/week

Aerobic endurance

- Walking, treadmill, and exercise stepper
- 20-60 min/session; 3-7 days/week
- Moderate intensity: 40-70% of maximum oxygen consumption (VO2max) or 40-70% of the heart rate reserve (HRR) or 50-80% of the maximum heart rate (maxHR) and a Borg RPE score of 11-14

Ankle Foot Orthosis (AFO)

- Control foot drop
- Efficient gait performance

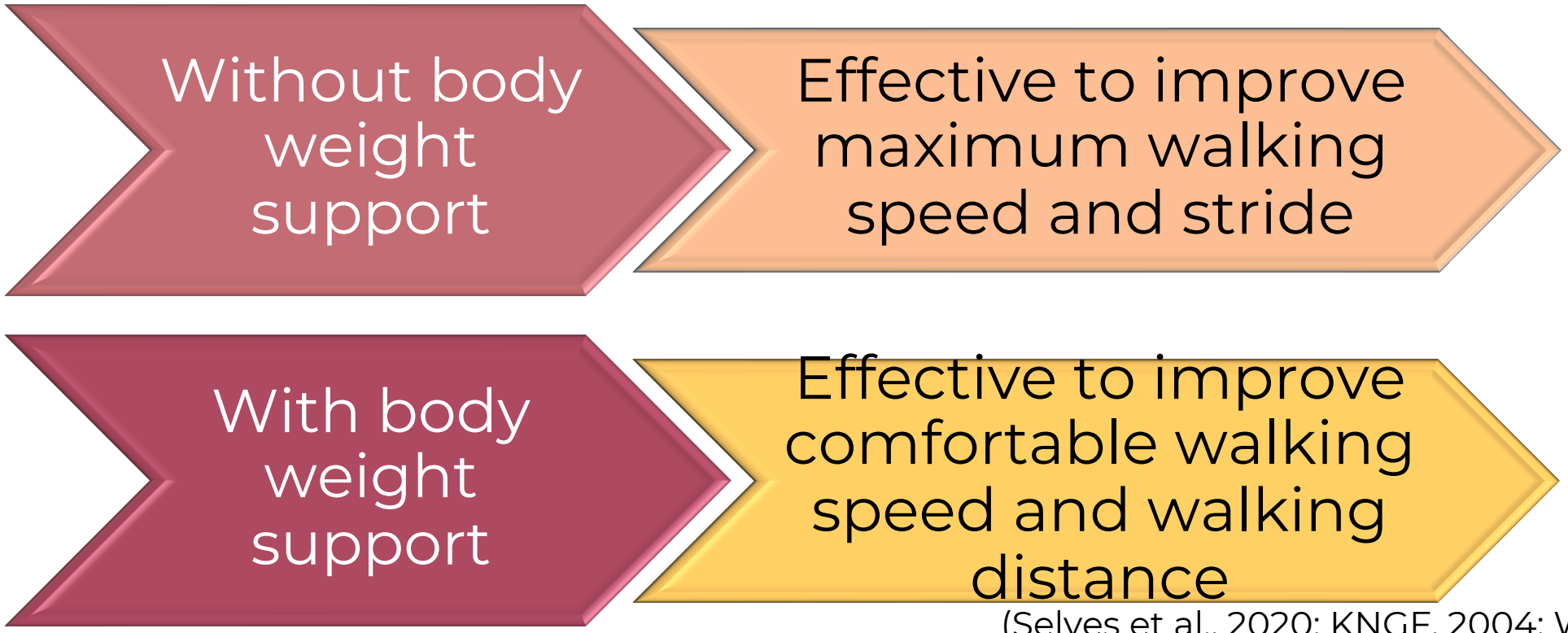
Electrical stimulation

- ~~Neuromuscular electrostimulation (NMES) and transcutaneous electrical nerve~~ stimulation (TENS)
- Activating paretic muscles and control foot drop
- Stimulate the ankle dorsiflexor during the swing phase
- ~~10 to 60 min; 3 times per week for 1 month~~ → ↑gait performance

(Carstea, 2020; Eng & Tang, 2007; KNGF, 2004; Winstein et al., 2016)

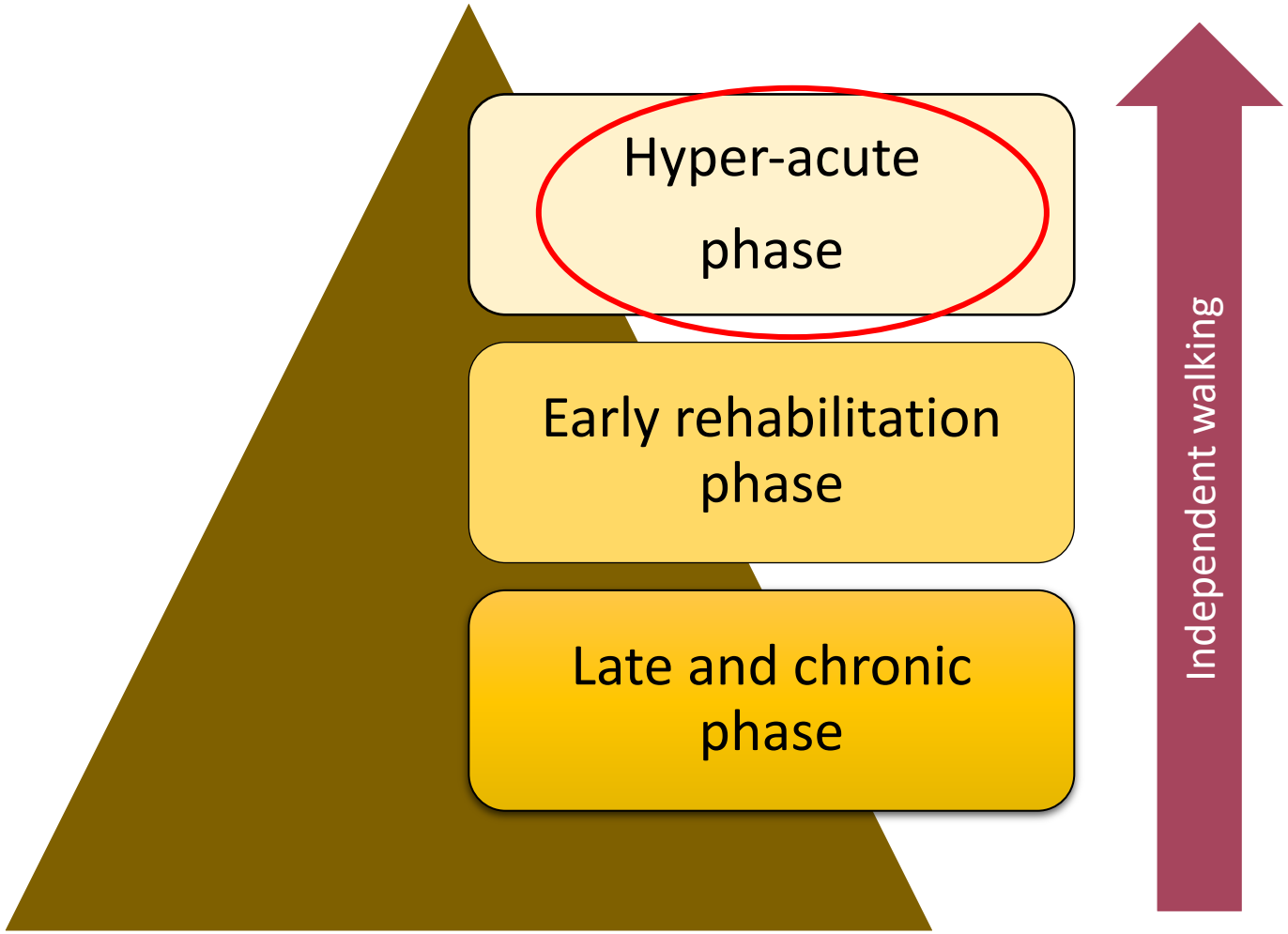
TREADMILL TRAINING

- Assist the paretic lower extremity in stepping
- Treadmill training with and without body weight support
- 20 to 60 min for 3 to 5 times/week



(Selves et al., 2020; KNGF, 2004; Winstein et al., 2016)

TREADMILL TRAINING



Non ambulatory stroke survivors at the hyper acute and early rehabilitation

More effective compared to overground walking

In ↑ independent walking

(Cirstea, 2020; Hornby et al., 2015; KNGF, 2004; Kwakkel et al., 2004; Selves et al., 2020)

Adapted from “Treadmill training with partial body weight support after stroke: A review” by Hesse (2008)

TREADMILL TRAINING

Gait rehabilitation in hyper-acute phase [< 1 month post stroke]

- Aims: To accelerate neuroplastic changes and motor recovery
- Techniques: Gait cycle or/and stepping (forward, backward, or sideways) on a treadmill and overground/stairs with or without bodyweight support or physical assistance
- 45 to 60 min/daily
- Achie[illegible] vigorous intensity (RPE 13 to 14)
- Vital signs monitoring

Repetitive and longer duration

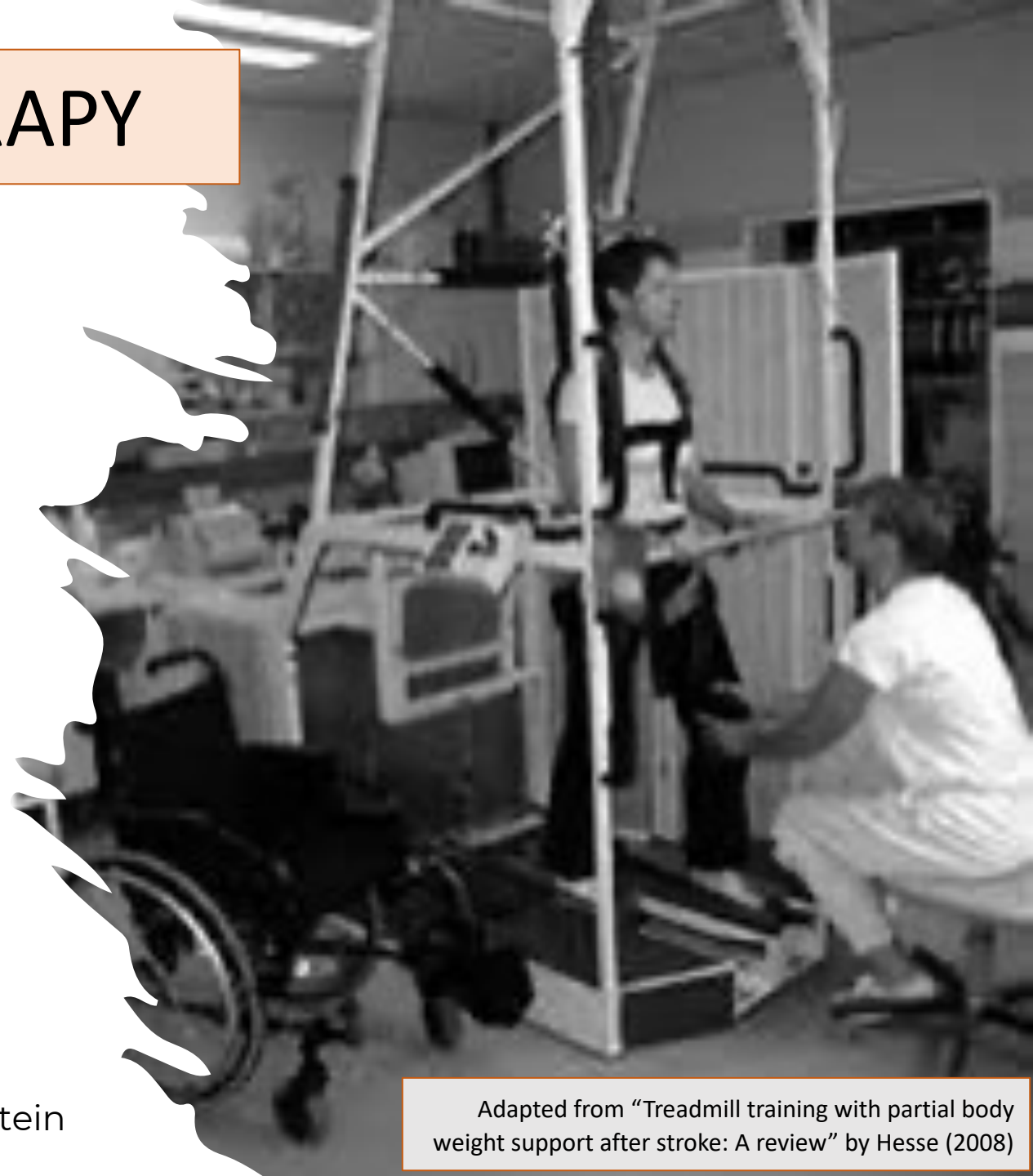
High intensity

(Cirstea, 2020; Hesse, 2008; Hornby et al., 2015; Moore et al., 2020; KNGF, 2004)

ROBOTIC-ASSISTED THERAPY

- Exoskeleton with programmable drives that passively flex the hip and knee joints during the swing phase
- Reduce the physical assistance
- Provide intensive, repetitive

(Belda-Lois et al., 2011; Selves et al., 2020; KNGF, 2004; Winstein et al., 2016).



Adapted from “Treadmill training with partial body weight support after stroke: A review” by Hesse (2008)

ROBOTIC-ASSISTED THERAPY

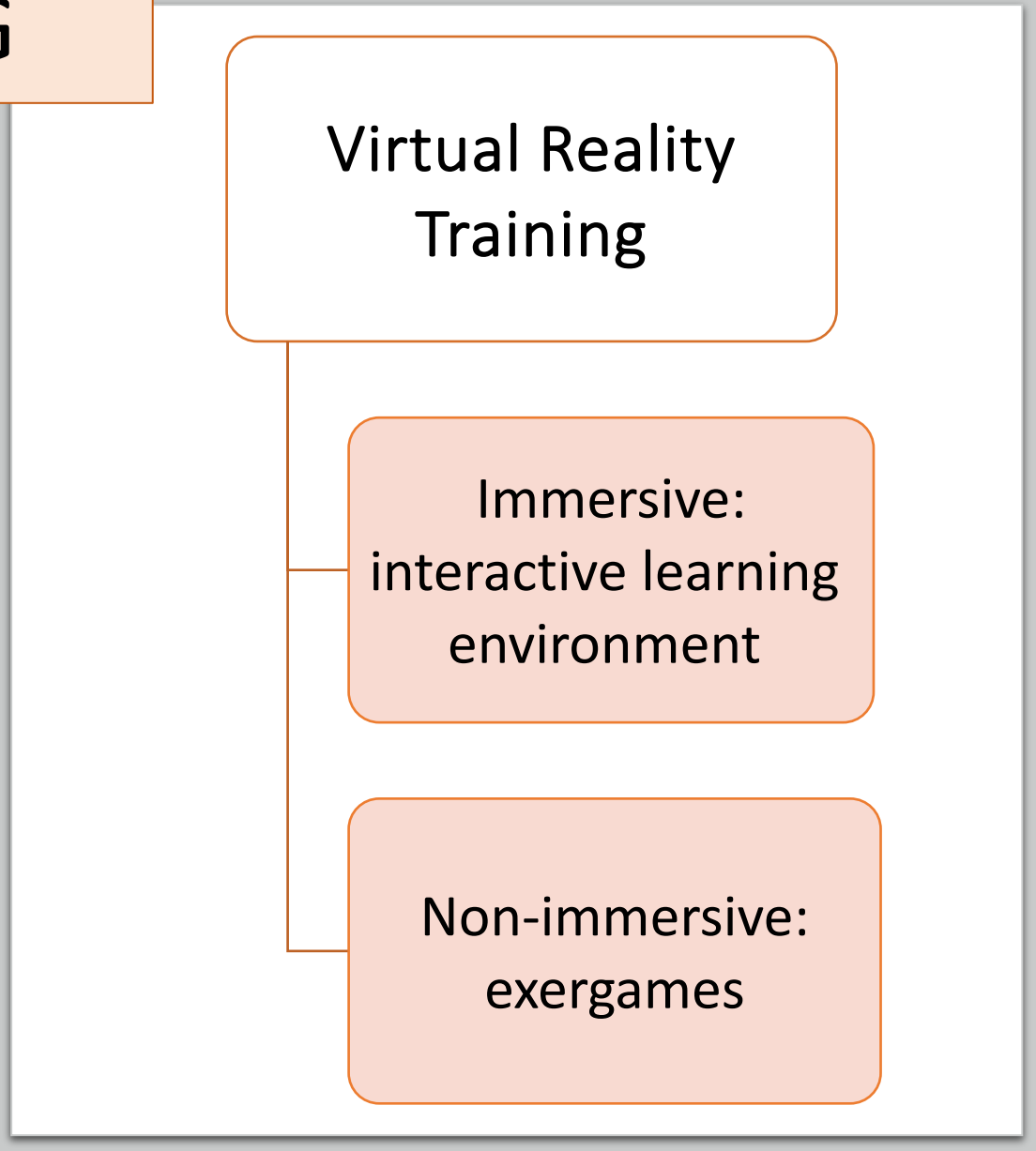
Non ambulatory stroke survivors in early rehabilitation phase

↑ comfortable walking speed	↑ walking distance	↑ walking ability	↑ sitting and standing balance	↑ performance in ADL

(Selves et al., 2020; KNGF, 2004; Winstein et al., 2016)

VIRTUAL REALITY TRAINING

- Use of computerized technology to allow patients to engage in specific task practice within a computer-generated visual environment in a naturalistic fashion
- Highly repetitive training + great variability = ↑ motivation and ↓ perception of exertion
- More effective to train gait and balance than conventional training
- Positive outcomes (e.g. walking speed) can be seen regardless of the rehabilitation phase



(de Rooij et al., 2016; Selves et al., 2020; KNGF, 2004; Winstein et al., 2016)

CIRCUIT CLASS TRAINING

- Intensive, repetitive, and task-oriented training which is focused on repetitive practice of functional tasks
- For stroke survivors with FAC score of > 3 and should be maintained in the chronic phase (> 6 months post-stroke)
- Allow social interaction between patients
- A session: Strengthening, balance, and steady-state training
- Improves walking distance and speed, walking capacity, physical activity and fitness level in the early, late rehabilitation, and chronic phase

(Selves et al., 2020; KNGF, 2004; Winstein et al., 2016)

SELF REHABILITATION

- Intensive practice of a wide variety of functional mobility tasks (e.g., walking, rising from a chair, turning, stepping over an obstacle)
- For stroke survivors with FAC score of ≥ 3
- Implemented in the early and late rehabilitation phases
- Should be introduced to the patient in the early phase, in order to prepare him for discharge, and it should be supervised at a distance by a therapist
- Effectively improve performance of ADL

(Selves et al., 2020; KNGF, 2004)

TRADITIONAL PHYSIOTHERAPEUTIC APPROACHES

Neurodevelopmental technique (NDT)/Bobath

VS

Motor Relearning Programme (MRP)

No difference in leg function, balance, walking and stair climbing

NDT/Bobath

VS

Body-weight supported treadmill training

NDT / Bobath to be inferior in improving walking speed and walking category

(Eng & Tang, 2007; Winstein et al., 2016)

TRADITIONAL PHYSIOTHERAPEUTIC APPROACHES

NDT/Bobath **VS** Other approaches of gait training

NDT/ Bobath to be equivalent or inferior in improving walking ability

Brunnstrum and Proprioceptive Neuromuscular Facilitation (PNF) **VS** Other approaches of gait training

No trials showed these approaches are superior to the respective comparison of gait training

Meta-analysis of 4 studies showed larger effect on improving gait speed in alternative interventions (e.g., treadmill and functional training) compared to Bobath/NDT

(Lang & Tang, 2007; Langhammer & Stanghelle, 2010; Winstein et al., 2016)

TRADITIONAL PHYSIOTHERAPEUTIC APPROACHES

Poor efficacy of the

Does not challenge the central nervous system

Insufficient to make a clinically significant difference in a patient's recovery trajectory after stroke

Ideal rehabilitation involves repetitive and intensive practice, which is continually incremented in difficulty according to the tolerance of the patient

(Eng & Tang, 2007; Langhammer & Stanghelle, 2010; Winstein et al., 2016)

CONCLUSION

- This combination of rehabilitation strategies appear to be more effective than over ground gait training alone
- It is time to move beyond traditional low-intensity/low-demanding rehabilitation to the intensive, repetitive, high intensity rehabilitation → to maximize the walking potential
- Changing the practice of rehabilitation requires a system-level changes (e.g. access to resources and staff), therapists' knowledge/beliefs, along with innovative methods
- It is well worth considering and immediate action is imperative owing to the prediction of increasing prevalence of stroke in nationwide

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THANKS!