LA RIABILITAZIONE DELLA MALATTIA DI PARKINSON

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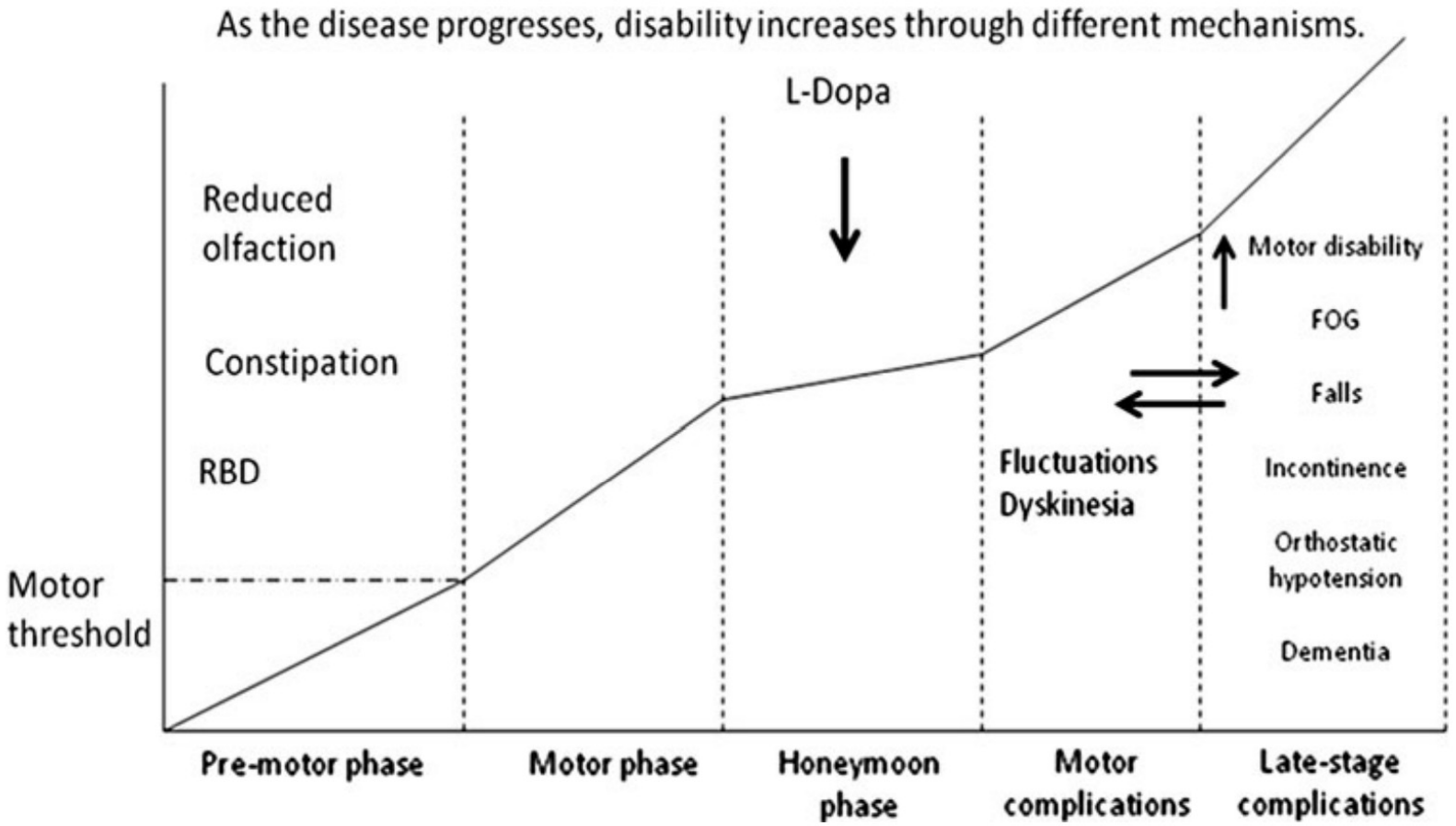
34° Corso di Aggiornamento in Medicina Fisica e Riabilitativa
28-31 maggio 2023

Progression of Parkinson's Disease



J Neurol (2010) 257 (Suppl 2):S288–S291

Progression of Parkinson's Disease

Istituto delle Scienze Neurologiche di Bologna

Hoehn and Yahr (H&Y)

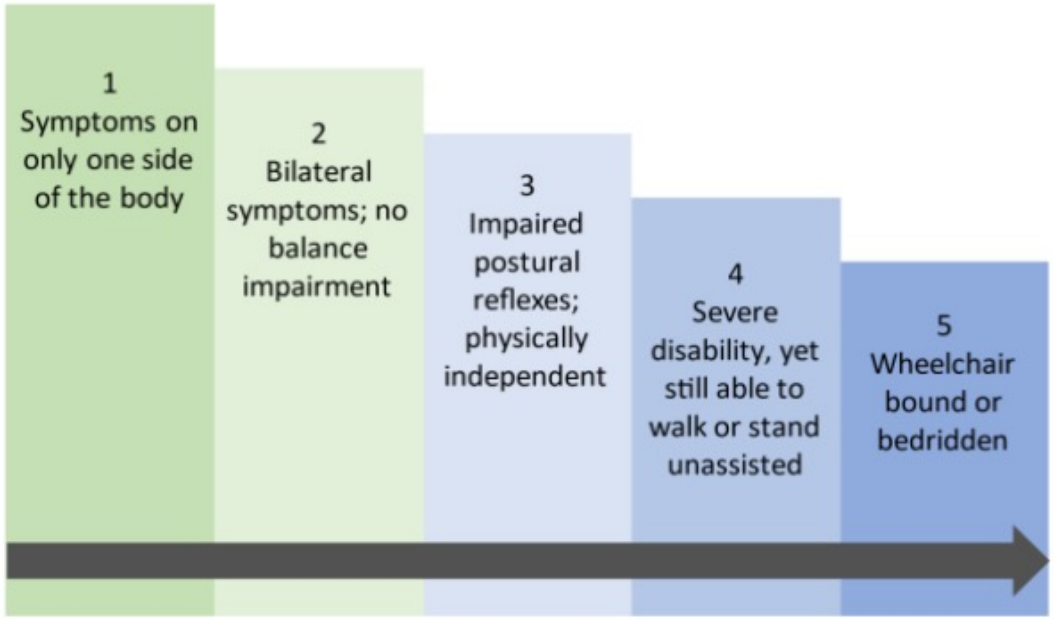
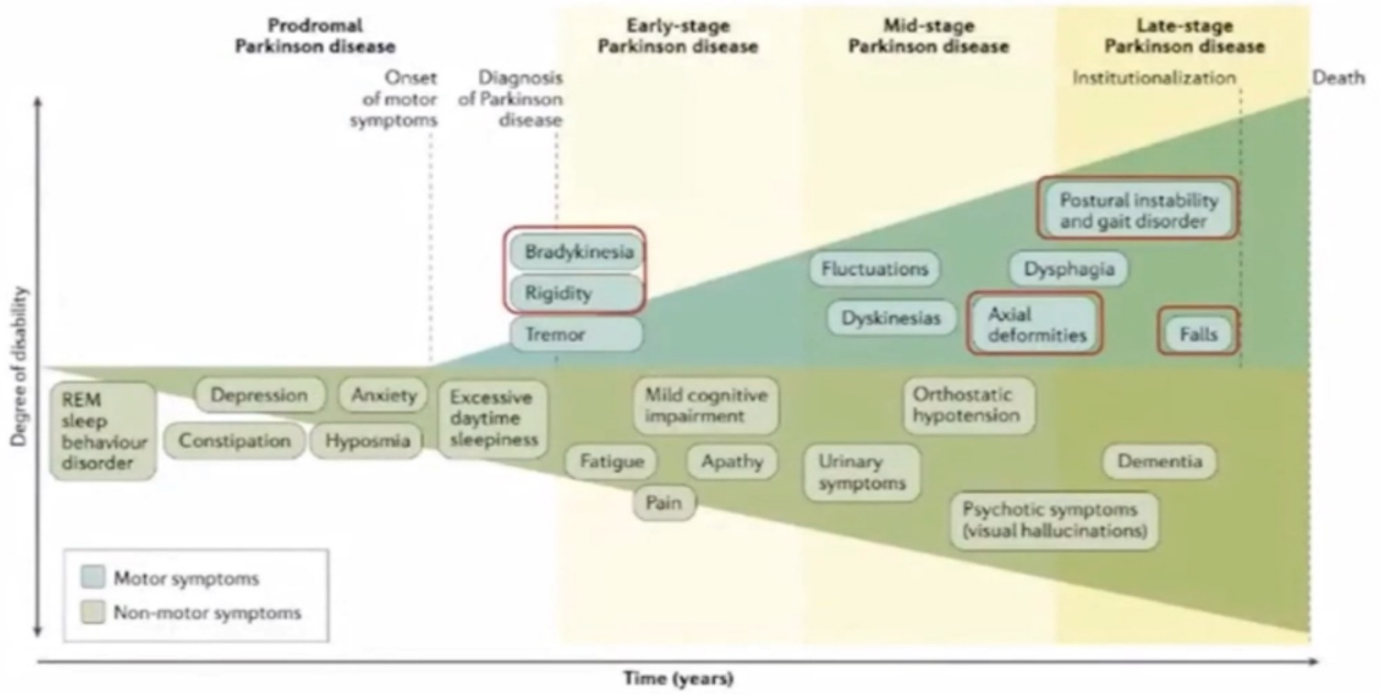


Figure 7. Hoehn and Yahr Scale

Unified Parkinson's Disease Rating Scale (UPDRS or MDS-UPDRS) - Motor section III

The complexities of Parkinson's disease



Fattori che influenzano il decorso:

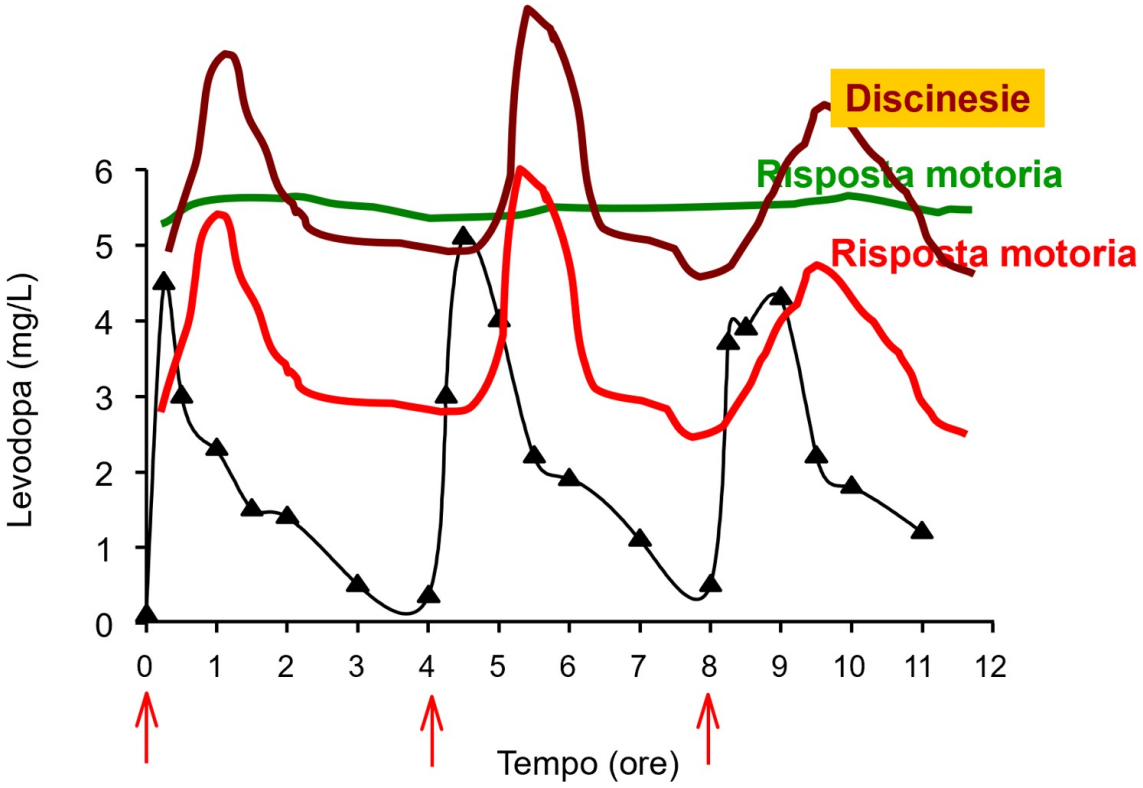
- **ETA' D'ESORDIO**
- **FATTORI GENETICI**
- **FENOTIPO MOTORIO**
- **DISAUTONOMIA**

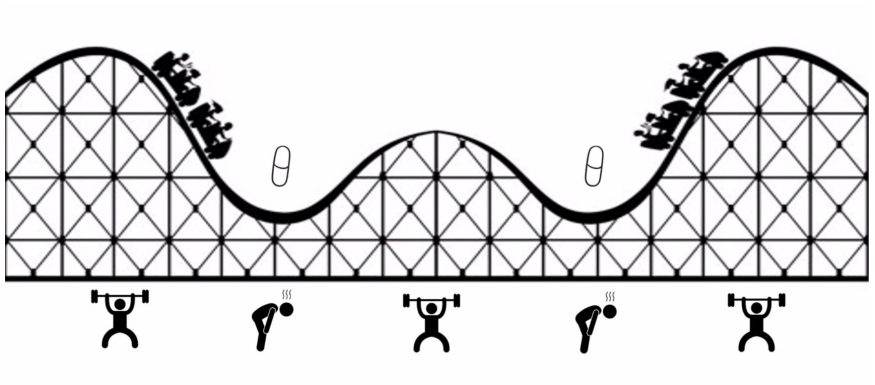
Poewe et al. 2017

L'evoluzione della MP **NON E' UN PROCESSO LINEARE**

La risposta alla terapia con Levodopa

Levodopa: risposta terapeutica ai diversi stadi della malattia





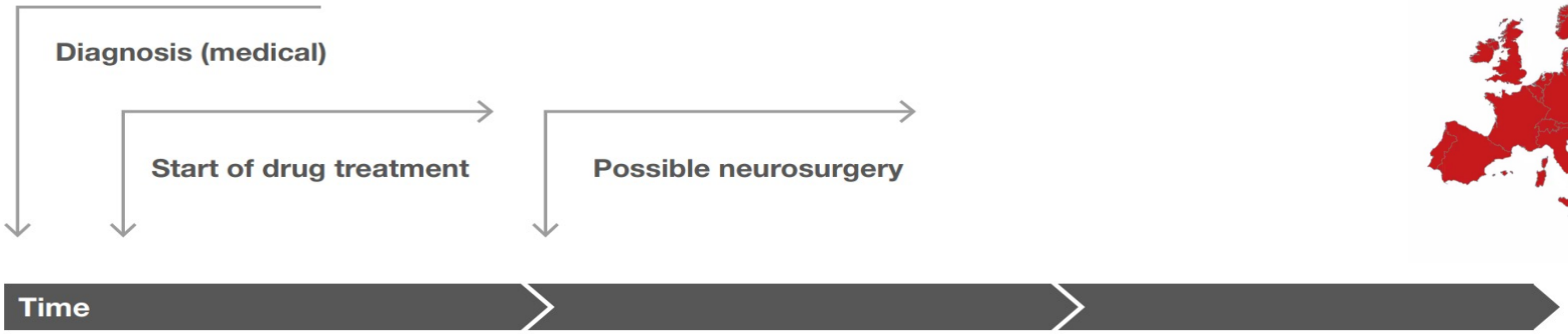
La riabilitazione nella Malattia di Parkinson

European Physiotherapy Guideline for Parkinson's Disease

Developed with twenty European professional associations

ISNB IRCCS Istituto delle Scienze Neurologiche di Bologna

Fig 4.1. Core areas of physiotherapy related to disease progression



Hoehn and Yahr 1

Physiotherapy goals

- Self-management support
- Prevent inactivity
- Prevent fear to move or fall
- Improve physical capacity
- Reduce pain
- Delay onset activity limitations (motor learning, up to HY3)

Hoehn and Yahr 2-4

Additional goals

- Maintain or improve activities, especially:

- Transfers
- Balance
- Manual activities
- Gait

Hoehn and Yahr 5

Additional goals

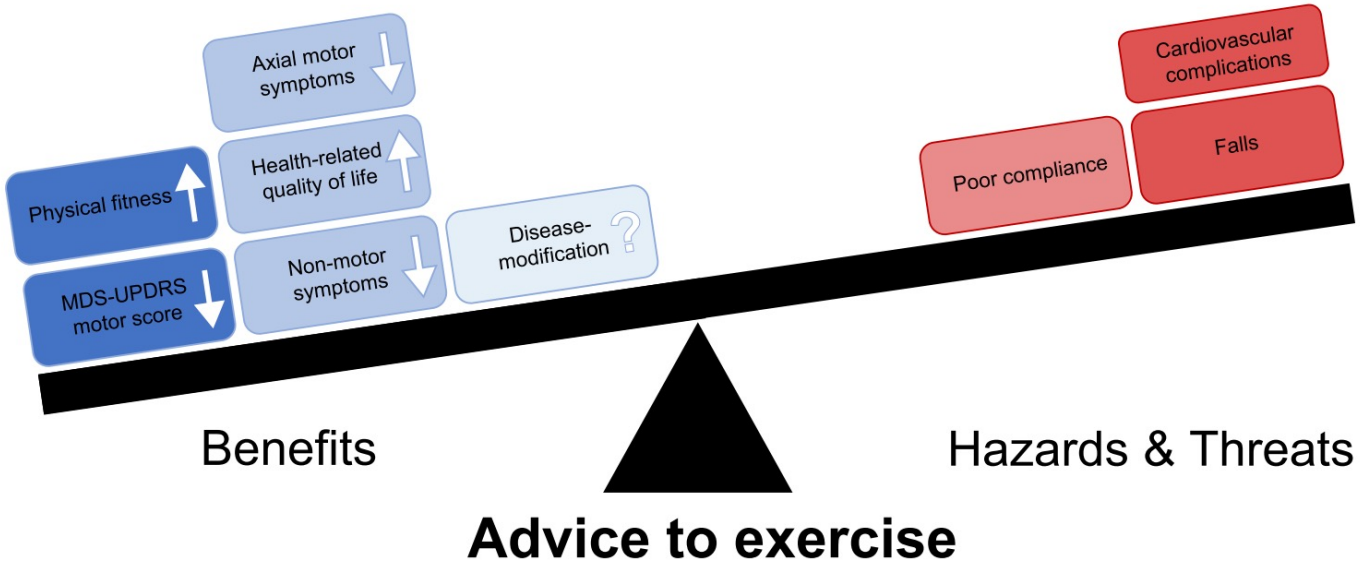
- Maintain vital functions
- Prevent pressure sores
- Prevent contractures
- Support carers/nurses

Exercise in People with Parkinson's Disease

Review > Neurotherapeutics. 2020 Oct;17(4):1418-1433. doi: 10.1007/s13311-020-00904-8.

Current Perspectives on Aerobic Exercise in People with Parkinson's Disease

Sabine Schootemeijer [1], Nicolien M van der Kolk [1], Bastiaan R Bloem [2], Nienke M de Vries [1]



Quando iniziare?

Figure 6.1 Physiotherapy intervention type, goal and focus for pwp by disease stage

Intervention	Goal	Focus	Hoehn and Yahr
			1 2 3 4 5
Exercise • Not physiotherapist-supervised • Conventional physiotherapy • Treadmill training • Tai Chi • Dance	• Improve physical capacity • Prevent secondary complications • Reduce pain • Prevention of fear to move or fall	int vely an exercise diary • Functional mobility: balance, transfers, manual dexterity, gait; focus on large and high speed movements • On state exercising for maximal effects	→

PRIMA POSSIBILE

QUALE ATTIVITA' FISICA?

Cochrane Library
Trusted evidence.
Informed decisions.
Better health.

Cochrane Database of Systematic Reviews

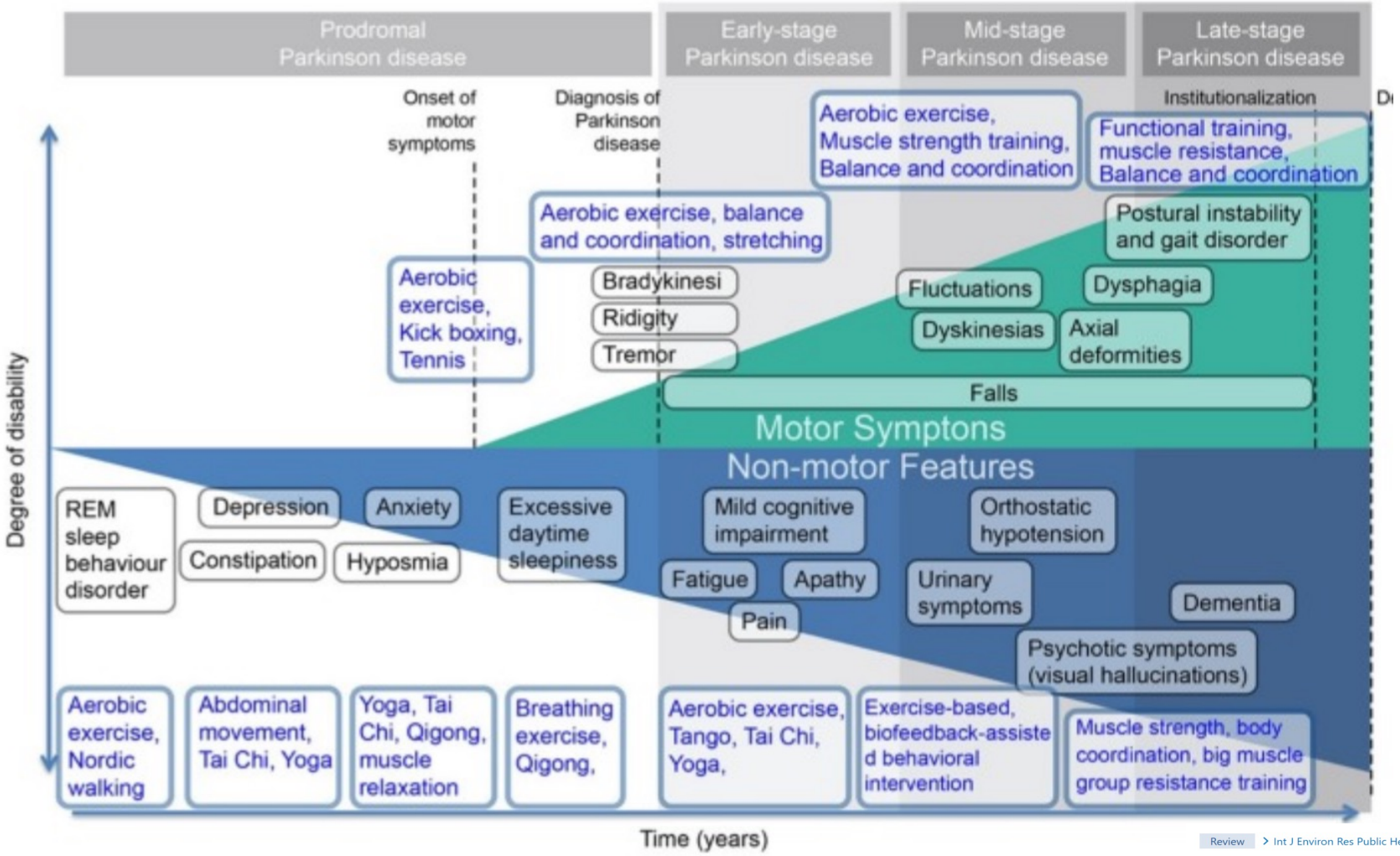
[Intervention Review]

Physical exercise for people with Parkinson's disease: a systematic review and network meta-analysis

Moritz Ernst[1], Ann-Kristin Folkerts[2], Romina Gollan[2], Emma Lieker[2], Julia Caro-Valenzuela[1], Anne Adams[3], Nora Cryns[1], Ina Monsef[1], Antje Dresen[4], Mandy Roheger[5], Carsten Eggers[6,7], Nicole Skoetz[1], Elke Kalbe[2]

Authors' conclusions

We found evidence of beneficial effects on the severity of motor signs and QoL for most types of physical exercise for people with PD included in this review, but little evidence of differences between these interventions. Thus, our review highlights the importance of physical exercise regarding our primary outcomes severity of motor signs and QoL, while the exact exercise type might be secondary. Notably, this conclusion is consistent with the possibility that specific motor symptoms may be treated most effectively by PD-specific programs. Although the evidence is very uncertain about the effect of exercise on the risk of adverse events, the interventions included in our review were described as relatively safe. Larger, well-conducted studies are needed to increase confidence in the evidence. Additional studies recruiting people with advanced disease severity and cognitive impairment might help extend the generalizability of our findings to a broader range of people with PD.



Review > Int J Environ Res Public Health. 2020 Apr 22;17(8):2894. doi: 10.3390/ijerph17082894.

Evidence Supports PA Prescription for Parkinson's Disease: Motor Symptoms and Non-Motor Features: A Scoping Review

Yi-Chen Cheng [1,2], Chun-Hsien Su [1,2]

- **Aerobic exercise:** motor and non-motor symptoms (depression)
- **Treadmill training**: stride length and gait speed, turning
- **Balance training:** balance and gait
- **Progressive resistance training (PRT):** muscle strength, motor function and endurance
- **Dance (Tango):** emotional disorders, cognitive impairment and functional mobility ability
- **Qigong** deficiency of knee extension and heel stride in the process of gait cycle
- **Tai Chi:** balance, cognitive and sleep disorders
- **Yoga:** psychological and balance disorders
- **Robot-assisted gait therapy (RAGT)** bradykinesia, motivation, freezing, rigidity, gait, leg agility and posture
- **Training via computer games (exercise + games = exergames):** cognition therapy and motor training and increase player motivation, enjoyment and efficiency
- **Virtual reality (VR) dual-tasking** training, attention transfer, information processing, sensory integration and motion planning

short-term benefits
(Tomlinson 2013)

PER QUANTO TEMPO?

Review > Nat Rev Neurol. 2017 Nov;13(11):689-703. doi: 10.1038/nrneurol.2017.128. Epub 2017 Oct 13.

Long-term effects of exercise and physical therapy in people with Parkinson disease

Margaret K Mak [1], Irene S Wong-Yu [1], Xia Shen [2], Chloe L Chung [1]

NEUROPLASTICITA' ➡ Effetto disease modifying?

Caratteristiche dell'attività fisica per attivazione Neuroplasticità

- **Intensità** – Alta intensità e frequenza
- **Complessità** - Attivazione su molti canali (motorio, sensoriale e COGNITIVO)
- **Piacere** - Sistema Reward con aumento di rilascio della dopamina
- **Durata e persistenza -** Lunga durata per non perderne i benefici
- **Specificità** - Coinvolgimento di vari domini (motori e non motori)

Journal of Parkinson's Disease 10 (2020) 1293–1299

Meta-Analysis > Neural Plast. 2020 Mar 5;2020:8961493. doi: 10.1155/2020/8961493. eCollection 2020.

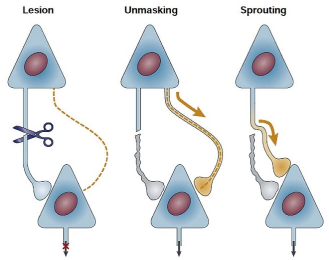
Exercise-Induced Neuroplasticity in Parkinson's Disease: A Metasynthesis of the Literature

Hanna Johansson [1 2], Maria Hagströmer [1 2 3], Wilhelmus J A Grooten [1 2], Erika Franzén [1 2 4]

> J Neurochem. 2003 Apr;85(2):299-305. doi: 10.1046/j.1471-4159.2003.01657.x.

Neuroprotective effects of prior limb use in 6-hydroxydopamine-treated rats: possible role of GDNF

Ann D Cohen [1], Jennifer L Tillerson, Amanda D Smith, Timothy Schallert, Michael J Zigmond



Riabilitazione sintomi non motori

Mancano evidenze

Disautonomia
Pochi studi
benefici dell'esercizio solo su soggetti sani
12 weeks of progressive Resistance Training

Disturbi urinari
Pochi studi
bladder training beneficio su incontinenza urinaria

Disturbi Gastrointestinali
Pochi studi
beneficio del Qigong sulla stipsi

Clin Ther. 2018 January ; 40(1): 8–15. doi:10.1016/j.clinthera.2017.11.004.

Effects of Exercise on Non-Motor Symptoms in Parkinson's Disease

Amy W. Amara, MD, PhD[1] and **Adeel A. Memon, MD**[1]
[1]Department of Neurology, University of Alabama at Birmingham, Birmingham, AL

Riabilitazione sintomi non motori

Non-motor symptoms can create a barrier to engage in exercise → fatigue and apathy

Depressione e ansia
Beneficio dell'esercizio con ripercussioni positive su cammino e cadute

Review > Gait Posture. 2018 Sep;65:57-64. doi: 10.1016/j.gaitpost.2018.06.171. Epub 2018 Jun 28.

Relationships between gait and emotion in Parkinson's disease: A narrative review

Laura Avanzino [1], Giovanna Lagravinese [2], Giovanni Abbruzzese [3], Elisa Pelosin [4]

Sonno
Studi più numerosi
Diversi tipi di esercizio sembrano avere effetti positivi sui disturbi del sonno

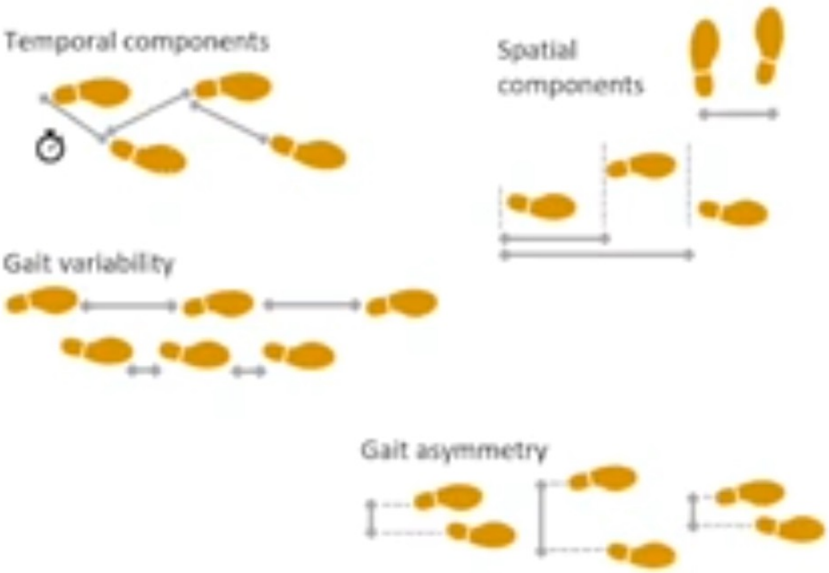
Funzioni cognitive
Numerosi studi e clinical trials
Differenti tipi di esercizio e tecniche riabilitative hanno dimostrato benefici significativi su vari domini

CAMMINO

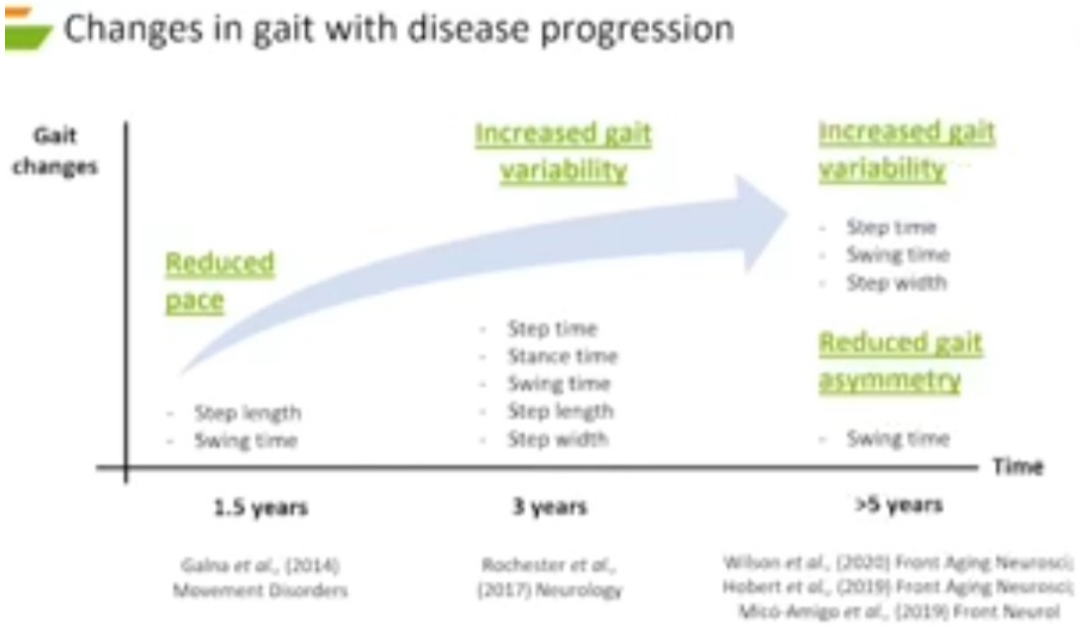
Review > Lancet Neurol. 2019 Jul;18(7):697-708. doi: 10.1016/S1474-4422(19)30044-4. Epub 2019 Apr 8.

Gait impairments in Parkinson's disease

Anat Mirelman [1], Paolo Bonato [2], Richard Camicioli [3], Terry D Ellis [4], Nir Giladi [5], Jamie L Hamilton [6], Chris J Hass [7], Jeffrey M Hausdorff [8], Elisa Pelosin [9], Quincy J Almeida [10]



Reduced gait velocity and step length are associated with **bradykinesia progression**



Physiology (Bethesda). 2016 Mar; 31(2): 95–107.
Published online 2016 Feb 17. doi: 10.1152/physiol.00034.2015

Neural Control of Walking in People with Parkinsonism

D. S. Peterson[1,2] and F. B. Horak[1,2]

PERSISTENTI

- Lentezza cammino
- Asimmetria e Variabilità del passo
- Instabilità posturale

TRANSITORI

Festinazione
Freezing

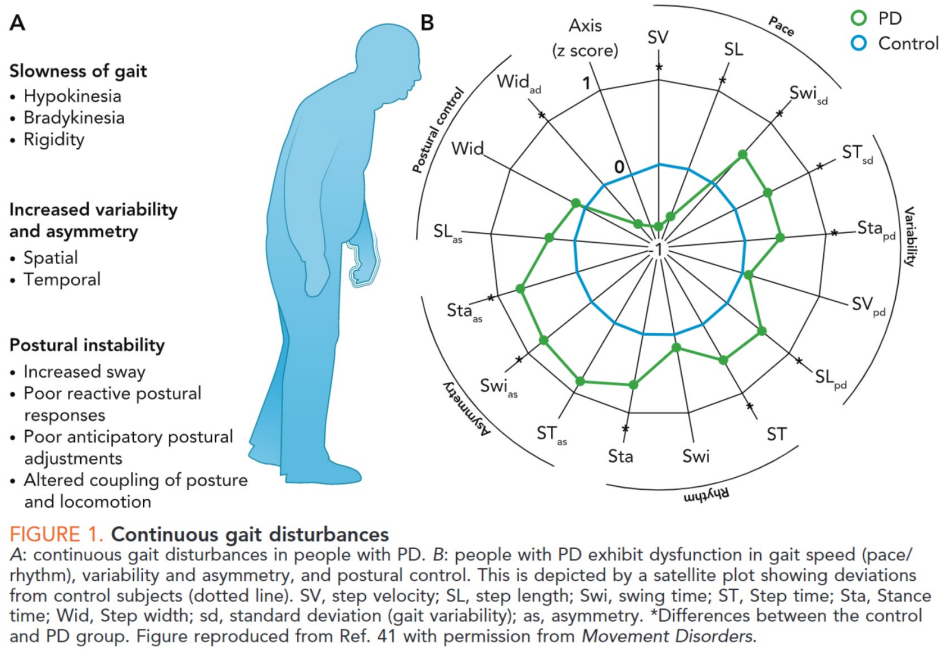


FIGURE 1. **Continuous gait disturbances**
A: continuous gait disturbances in people with PD. *B*: people with PD exhibit dysfunction in gait speed (pace/rhythm), variability and asymmetry, and postural control. This is depicted by a satellite plot showing deviations from control subjects (dotted line). SV, step velocity; SL, step length; Swi, swing time; ST, Step time; Sta, Stance time; Wid, Step width; sd, standard deviation (gait variability); as, asymmetry. *Differences between the control and PD group. Figure reproduced from Ref. 41 with permission from *Movement Disorders*.

Il cammino nelle fasi di Malattia

Early stage

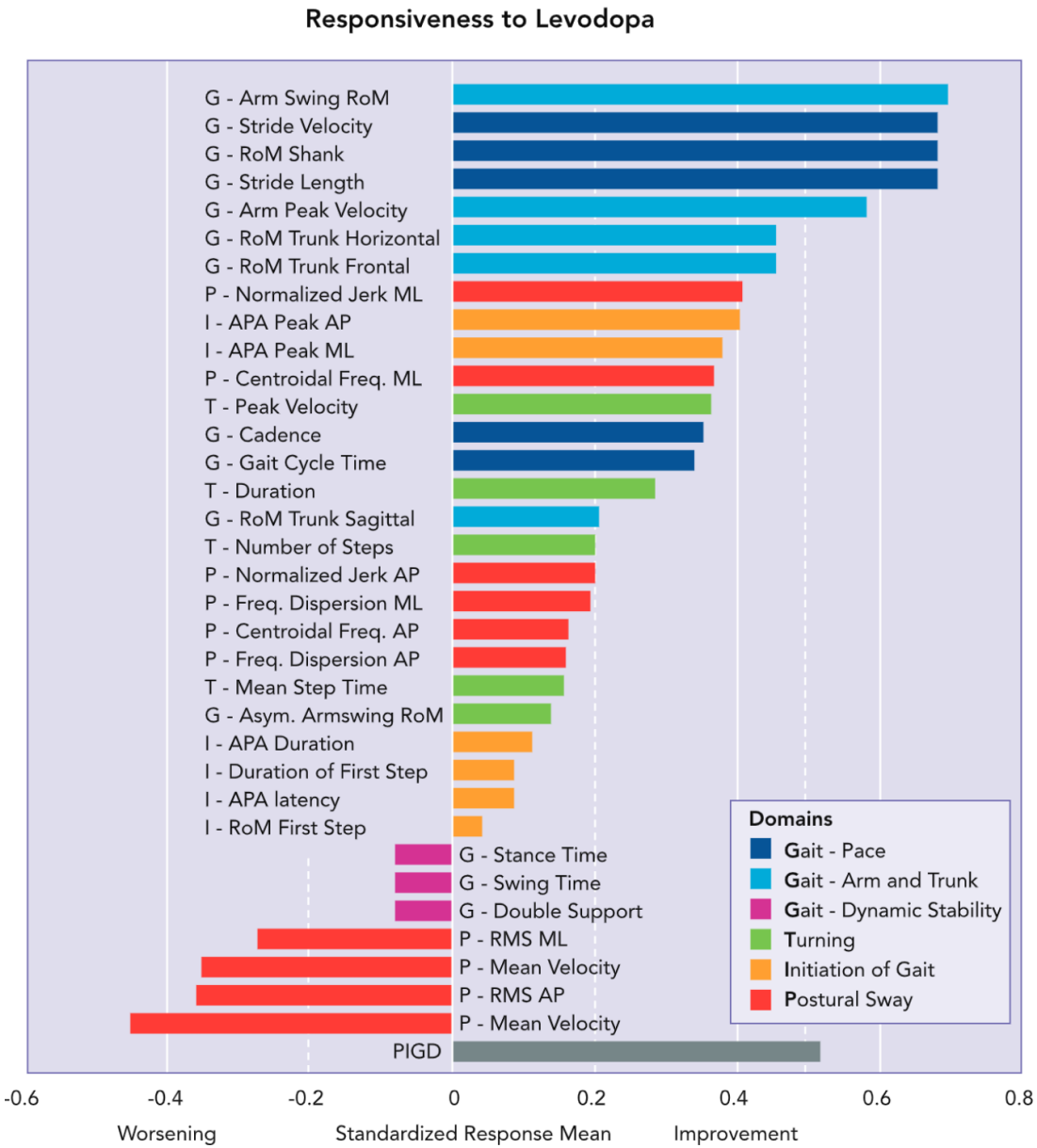
- **Not specific changes**: initial short slows and step length, gait variability
- Specific changes: **asymmetry,** reduced amplitude of arm swing and smoothness of locomotion and increased interlimb asymmetry, reduced angular velocity of turning
- Reduction of step length for initial changes in posture and range of motion

Mild-to-moderate stage

- **Bilaterally**
- Shuffling steps, increased double-limb support (ie, both feet are on the ground) and increased cadence
- The magnitude of arm swing is reduced bilaterally with accompanied reduction of axial rotation
- **Postural changes**
- **Defragmentation of turns**
- Freezing of gait and festination

Advanced stage

- Frequent blocks in motor function (eg, **freezing** of gait)
- Reduced balance and postural control and severe **risk of falling**
- **Motor fluctuations and dyskinesias** negatively impact gait
- Need for **assistance devices or wheelchair use**



Aspetti cammino LD responsivi:

- Velocità
- Lunghezza/altezza del passo
- Recupero pendolarismo degli arti superiori
- Velocità di svolta
- Freezing

Aspetti cammino NON LD responsivi:

- Aspetti temporali (es duble support)
- Postura

Fluttuazioni e discinesie/distonie interferiscono con cammino ed equilibrio

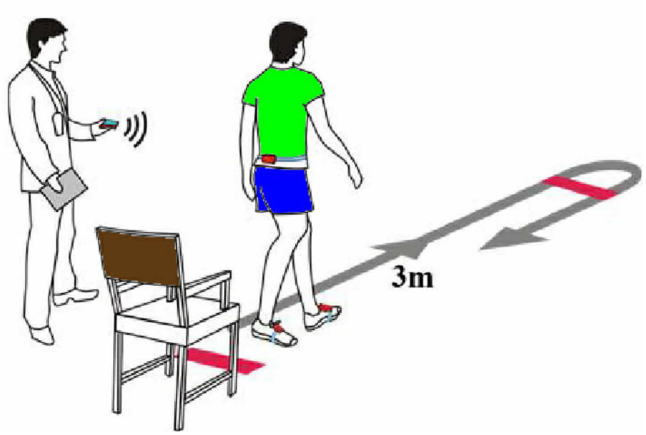
Gait Assessment

- **Anamnesi**
- **Esame obiettivo, MDS UPDRS, Pull test**
- **Scale e test per il cammino (TUG, 10 MWT) o equilibrio (MiniBest, BBS)**
- **Gait Analysis**
- **Sensori indossabili**

Timed Up and Go Test velocità del cammino, transizioni e rischio di caduta

Poche informazioni sulla qualità del movimento

Sensor + Timed Up and Go Test

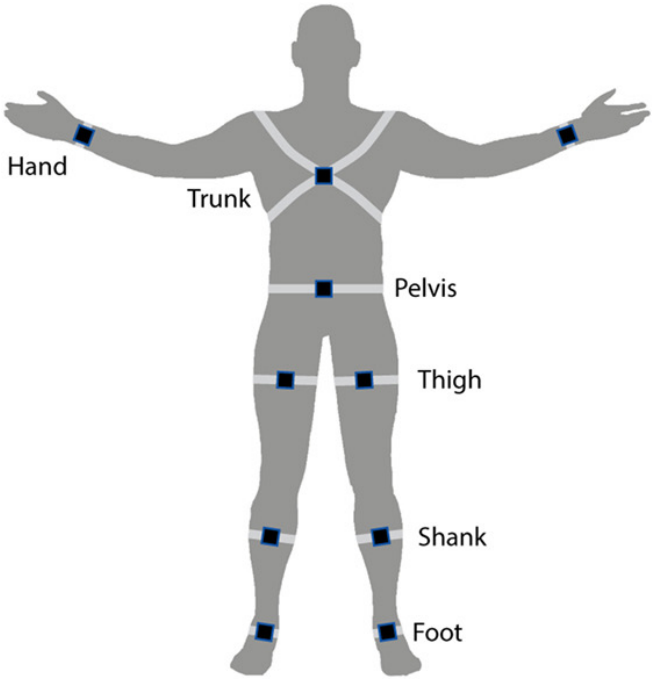


Gait Assessment

› Mov Disord. 2021 Sep;36(9):2144-2155. doi: 10.1002/mds.28631. Epub 2021 May 6.

Detecting Sensitive Mobility Features for Parkinson's Disease Stages Via Machine Learning

Anat Mirelman [1 2], Mor Ben Or Frank [1], Michal Melamed [3], Lena Granovsky [3], Alice Nieuwboer [4], Lynn Rochester [5], Silvia Del Din [5], Laura Avanzino [6 7], Elisa Pelosin [6 7], Bastiaan R Bloem [8], Ugo Della Croce [9], Andrea Cereatti [9 10], Paolo Bonato [11], Richard Camicioli [12], Theresa Ellis [13], Jamie L Hamilton [14], Chris J Hass [15], Quincy J Almeida [16], Maidan Inbal [1 2], Avner Thaler [1 2], Julia Shirvan [17], Jesse M Cedarbaum [18 19], Nir Giladi [1 2], Jeffrey M Hausdorff [1 2 20 21]



Wearable Sensors

Early stage ⇒ sensor located on the **trunk**
Advanced stage ⇒ **arms and limbs**

Home-based measurement provides the "true" picture of the patients' performance.

A casa i pazienti tornano ad applicare le strategie automatiche che hanno sempre usato, e a non mettere in pratica le strategie apprese durante i trattamenti fisioterapici.

Disturbi **TRANSITORI** del cammino

FESTINAZIONE

è un progressivo aumento della velocità di marcia associato a una riduzione dell'ampiezza dei passi.


Journal of Neurology (2019) 266:426–430
https://doi.org/10.1007/s00415-018-9146-7

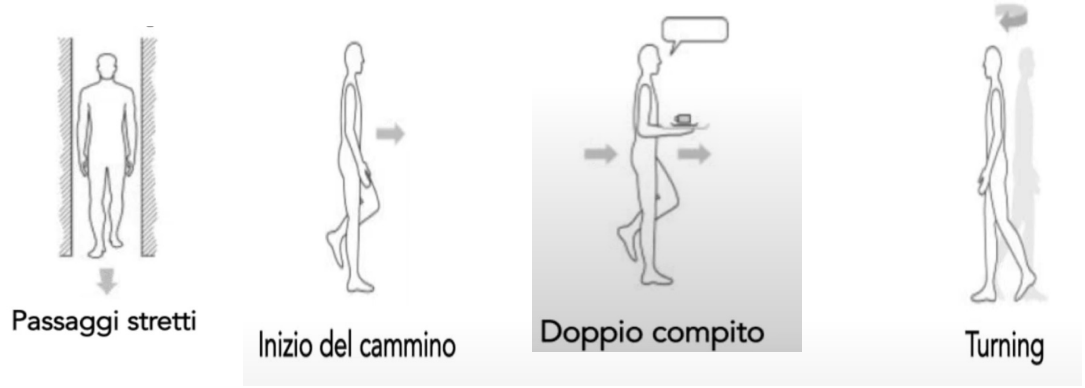
ORIGINAL COMMUNICATION

Gait festination in parkinsonism: introduction of two phenotypes

Jorik Nonnekes[1] · Nir Giladi[2] · Anasuya Guha[3,4] · Urban M. Fietzek[4] · Bastiaan R. Bloem[5] · Evžen Růžička[6]

FREEZING

fenomeno per cui un paziente sente i piedi «incollati al pavimento» e non riesce più a proseguire il cammino, può presentarsi alla partenza (start hesitation), sul tragitto rettilineo, nelle svolte, negli spazi stretti e nell'attraversare le porte e durante i dual task



PM R. 2020 Nov;12(11):1140-1156. doi: 10.1002/pmrj.12337. Epub 2020 May 19.

Physical Therapy for Freezing of Gait and Gait Impairments in Parkinson Disease: A Systematic Review

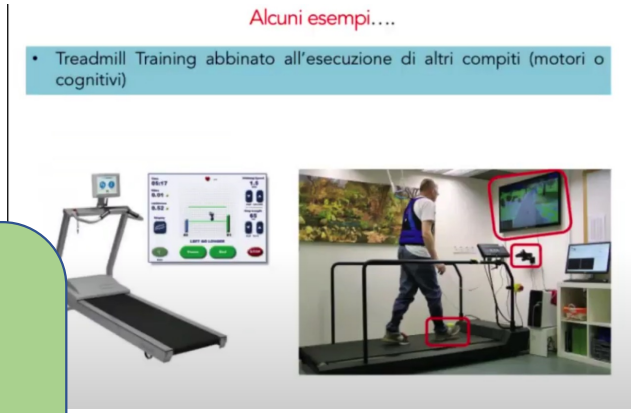
Dionys G Rutz [1], David H Benninger [2]

Conclusions: **Visual and auditory cueing** and the **treadmill training** are effective interventions for FOG and gait impairments in PD patients (evidence level A- according to the European Federation of Neurological Societies).
Tactile cues and other specific therapies targeting FOG are probably effective but need further studies.

Cues reduce the duration of turning and freezing of gait

Emerging technology driven approaches, such as **virtual reality**, **robotics**, **exergaming** (ie, gaming platforms that incorporate physical exercise) show some benefit in improving measures of gait

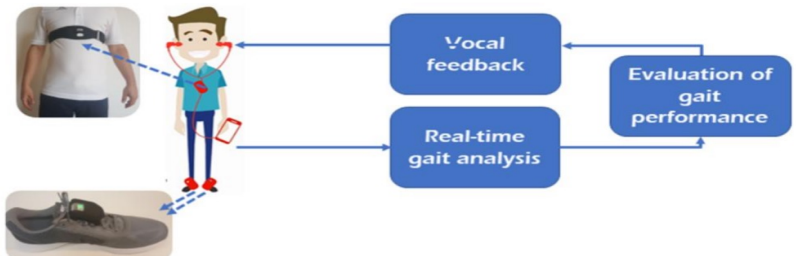
Integrative approaches (**motor imagery, action observation**): motor cognitive interactions improvements in gait



› Sensors (Basel). 2014 Mar 28;14(4):6229-46. doi: 10.3390/s140406229.

A wearable system for gait training in subjects with Parkinson's disease

Filippo Casamassima [1], Alberto Ferrari [2], Bojan Milosevic [3], Pieter Ginis [4], Elisabetta Farella [5], Laura Rocchi [6]



Review › Cochrane Database Syst Rev. 2016 Dec 21;12(12):CD010760. doi: 10.1002/14651858.CD010760.pub2.

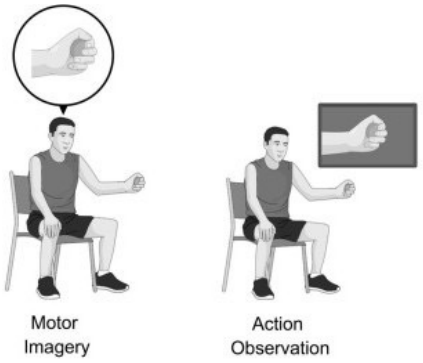
Virtual reality for rehabilitation in Parkinson's disease

Kim Dockx [1], Esther Mj Bekkers [1], Veerle Van den Bergh [1], Pieter Ginis [1], Lynn Rochester [2], Jeffrey M Hausdorff [3], Anat Mirelman [4], Alice Nieuwboer [1]

Review › Parkinsons Dis. 2015;2015:124214. doi: 10.1155/2015/124214. Epub 2015 Oct 1.

Action Observation and Motor Imagery: Innovative Cognitive Tools in the Rehabilitation of Parkinson's Disease

Giovanni Abbruzzese [1], Laura Avanzino [2], Roberta Marchese [1], Elisa Pelosin [1]



Postura

In early stages axial disturbances of PD may not be immediately evident, becoming more visible in the **middle-late stages**

Review > Lancet Neurol. 2011 Jun;10(6):538-49. doi: 10.1016/S1474-4422(11)70067-9. Epub 2011 Apr 22.

Postural deformities in Parkinson's disease

Karen M Doherty [1], Bart P van de Warrenburg, Maria Cecilia Peralta, Laura Silveira-Moriyama, Jean-Philippe Azulay, Oscar S Gershanik, Bastiaan R Bloem

CAMPTOCORMIA

ANTEROCOLLO

SINDROME DI PISA

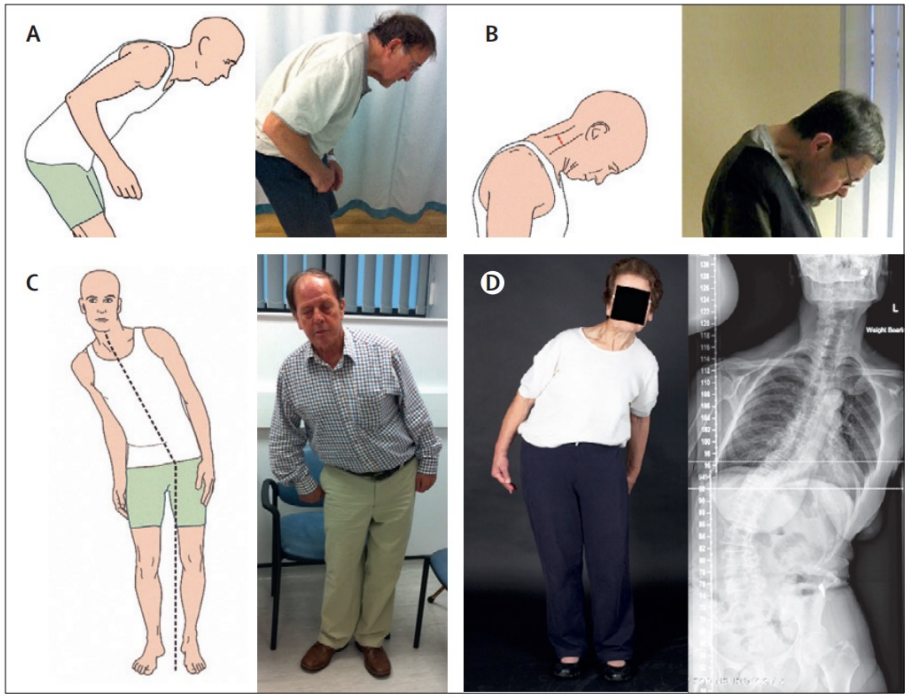


Figure 2: Sagittal plane deformities (A: camptocormia, B: antecollis) and coronal plane deformities (C: Pisa syndrome, D: scoliosis)

Piano sagittale

CAMPTOCORMIA

- Flessione anteriore di 45°
- Esordio dopo 7-8 anni di malattia
- Esordio graduale, raramente subacuto
- Dolore l-s frequente
- Non risposta a LD o DA
- **Tipo Upper**: fulcro toracico
- **Tipo lower**: fulcro lombare
- Valutazione: Goniometro a muro – softwere
- DBS nuclei subtalamici
- **Non evidenze** sull'efficacia a lungo termine di fisioterapia, manipolazioni, massoterapia, ortesi e busti

Figure 3: Camptocormia in the standing, seated, and supine positions

Doherty et al, Lancet Neurol 2011

J Neurol Neurosurg Psychiatry 2016;87:75–85

ANTEROCOLLO

Piano sagittale

- Flessione anteriore capo e collo di 45°
- Frequente in **MSA** (46%) rispetto a MP (6%) – Diagnosi Differenziale
- Limita l'esplorazione visiva > rischio di caduta
- Dolore cervicale
- Irreversibile in pochi mesi
- Più frequente in donne e PIGD
- **Disfagia, disartria, disturbi respiratori e scialorrea**
- Non efficace gesto antagonista (distonia?) – tossina botulinica
- No risposta a LD e DA
- **Non evidenze di beneficio della fisioterapia o utilizzo di collari**

› Parkinsonism Relat Disord. 2021 Jul;88:34-39. doi: 10.1016/j.parkreldis.2021.05.024. Epub 2021 May 29.

Botulinum toxin treatment of dystonic anterocollis: What to inject

Marie-Helene Marion [1], Lucy A Hicklin [2]

- **Durata di malattia: 5.4 anni**
- **Prevalenza: 6%**

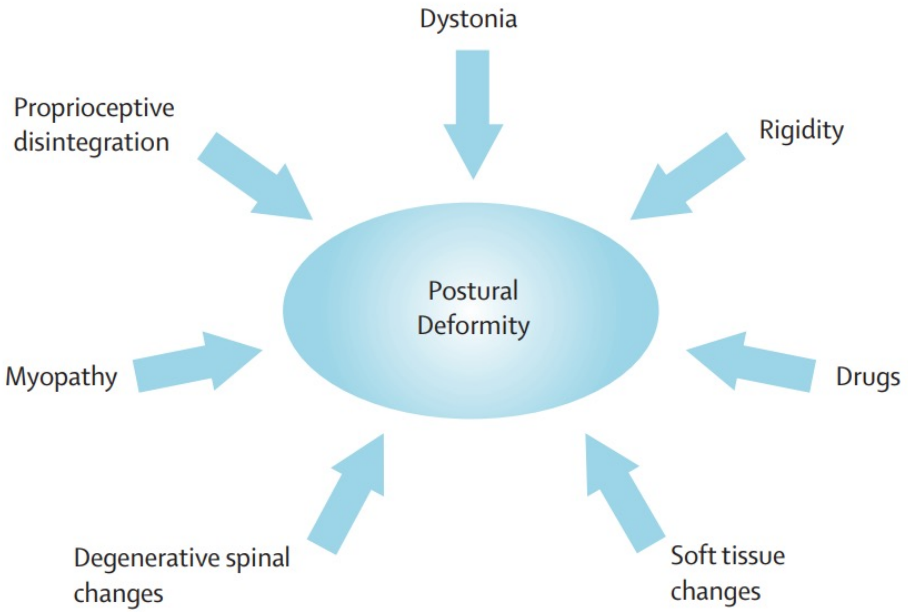
Piano coronale

SINDROME DI PISA

- Flessione laterale del tronco ≥ 10° in stazione eretta, che si accentua in ortostatismo e posizione seduta
- **Scompare inizialmente in posizione supina o appoggiati a superficie verticale**
- Dolore lombare
- DD scoliosi
- Deficit verticalità visus
- **Deficit di percezione della postura**
- Non risposta a LD o DA

Eziologia

Meccanismo Centrale



Meccanismo Periferico

EZIOLOGIA MULTIFATTORIALE

APPROCCIO INTEGRATO

PRECOCE – INTENSIVO (4-5 gg /sett per 2-4 mesi).

Disturbo **POTENZIALMENTE REVERSIBILE**

Identificazione di fattori aggravanti e precipitanti

Strategie di compenso al domicilio

MANTENIMENTO ⇨ BENEFICI TEMPORANEI

- Il trattamento riabilitativo della POSTURA deve integrarsi con gli altri trattamenti efficaci:

TOSSINA BOTULINICA e DBS

Parkinsonism Relat Disord. 2019 May;62:231-235. doi: 10.1016/j.parkreldis.2018.11.003. Epub 2018 Nov 5.

Botulinum toxin for Pisa syndrome: An MRI-, ultrasound- and electromyography-guided pilot study

Carlo Alberto Artusi [1], Sara Bortolani [2], Aristide Merola [3], Maurizio Zibetti [4], Marco Busso [5], Stefania De Mercanti [6], Paolo Arnoffi [7], Simone Martinetto [8], Elena Gaidolfi [9], Andrea Veltri [10], Pierangelo Barbero [11], Leonardo Lopiano [12]

Review. Neurosurg Rev. 2022 Oct;45(5):3083-3092. doi: 10.1007/s10143-022-01830-3. Epub 2022 Jul 5.

Deep brain stimulation for Parkinson's disease-related postural abnormalities: a systematic review and meta-analysis

Philipp Spindler [1], Yasmin Alzoobi [2], Andrea A Kühn [3], Katharina Faust [2], Gerd-Helge Schneider [2], Peter Vajkoczy [2]

- Il trattamento deve essere effettuato in **fase di ON terapia**, anche se la terapia dopaminergica sappiamo essere nulla o modesta per il coinvolgimento di un network non dopaminergico nella patogenesi di tali disturbi.

- L'utilizzo di **ortesi o ausili** deve essere **ponderato e personalizzato perché spesso controproducente** (busti, reggispalle, deambulatori..)

- Kinesiotaping: è utilizzato ma i risultati sono controversi

- Trattamento del **dolore**, spesso associato ai disturbi posturali e a volte trigger nella genesi del disturbo

Riabilitazione della Fase Avanzata

- Risposta subottimale alla terapia farmacologica
  Importanza degli approcci integrative riabilitativi e assistenziali
- Disturbi cognitivi
- Disturbi dell'equilibrio e cammino – CADUTE
- Perdita delle autonomie (ADL e IADL)
- DISFAGIA/DISARTRIA/SCIALORREA
- DISTURBI NON MOTORI
- CARICO CAREGIVERS
- AUSILI
- FREQUENTE OSPEDALIZZAZIONE

PDTA

Intervento al domicilio
Attivazione dei servizi territoriali
Multidisciplinarietà e Interdisciplinarietà

Review > J Pers Med. 2022 May 18;12(5):813. doi: 10.3390/jpm12050813.

Personalized Care in Late-Stage Parkinson's Disease: Challenges and Opportunities

Margherita Fabbri [1], Miguel Coelho [2], Michela Garon [3], Roberta Biundo [4 5 6], Tiago A Mestre [7], Angelo Antonini [3 5], On Behalf Of iCARE-Pd Consortium

Riabilitazione della Fase Avanzata

- Advanced PD patients are able to benefit from physiotherapy in the short term, but older and the cognitively less able patients lose their functional gains after three months without physiotherapy.

- cognitive impairments

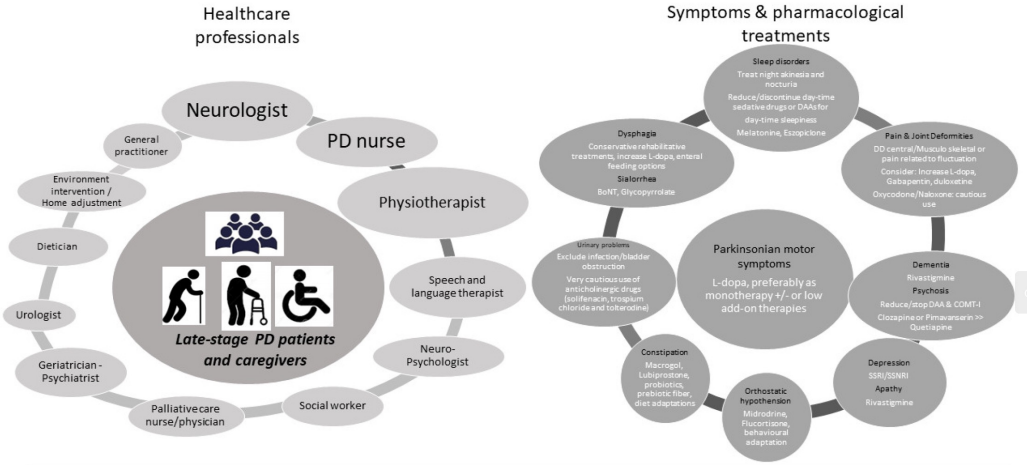
- Older and mentally more able individuals are less inclined to reproduce the treatment strategies autonomously in an unfamiliar environment without the support of regular physiotherapy.

- **Palliative Care**

› Clin Rehabil. 2002 Dec;16(8):886-93. doi: 10.1191/0269215502cr573oa.

Prediction of outcome of physiotherapy in advanced Parkinson's disease

Alice Nieuwboer [1], Willy De Weerdt, René Dom, Kris Bogaerts



Palliative care /Advance Care Planning aim to address NMS and reduce the risk of:
Falls (bone fracture, head trauma), psychosis, joint deformities/pain, aspiration pneumonia, malnutrition, confusion, caregiver burnout

Take home message

- Esercizio sin dall'esordio
- Intensivo e coinvolgimento cognitivo
- Considerare sintomi motori e non motori
- Riabilitazione con dominio specifico su cammino e postura
- Importanza dell'integrazione multidisciplinare e interdisciplinare nella fase avanzata

Istituto delle Scienze Neurologiche di Bologna

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