



Congresso Regionale
SIN SICILIA

Segretario:
Placido Bramanti

LE CURE PALLIATIVE
IN NEUROLOGIA

**NUOVI PERCORSI
RIABILITATIVI NELLA
MALATTIA DI PARKINSON**

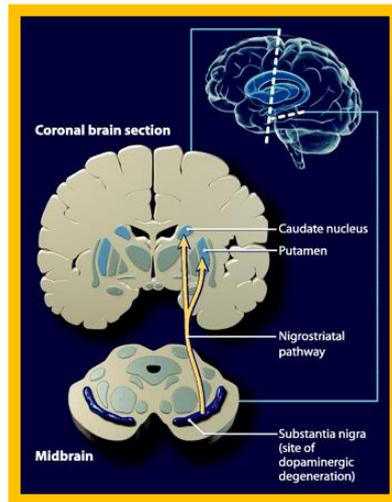
Vincenzo Cimino

Centro Disordini del Movimento
IRCCS Centro Neurolesi “Bonino-Pulejo”
- Messina -



Malattia di Parkinson

Non è solo un disordine del sistema motorio conseguente alla degenerazione nigrostriatale. È **una malattia multisistemica** dovuta alla degenerazione di numerosi sistemi neurotrasmettitoriali del sistema nervoso centrale



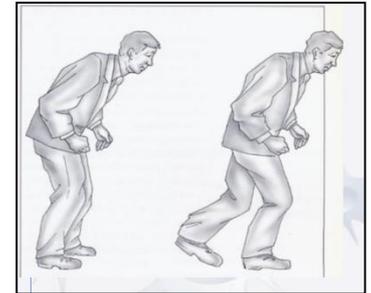
- Stadi 1-2 preclinici: tronco-encefalo e strutture olfattive
- Stadi 3-4 sintomatici: sostanza nera e mesencefalo
- Stadi 5-6 finali: corteccia



CONTROLLO DEL MOVIMENTO

3 tipi di movimento:

- ✓ **VOLONTARIO** (volontari, intenzionali)
- ✓ **RIFLESSO** (risposte rapide, stereotipate, involontarie)
- ✓ **RITMICO** (sequenze di movimenti ripetitivi, automatici)



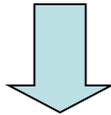
PROGRAMMA MOTORE → insieme di istruzioni elementari per l'esecuzione di un movimento (mm da usare, relazione temporale tra i diversi eventi...)

PIANO MOTORE → livello più elevato: insieme di operazioni che attivano una serie di programmi motori per la riuscita di un movimento complesso.

Bradicinesia (*Denny-Brown, 1968*)

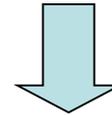
Disturbo caratterizzato da un progressivo rallentamento del movimento generato da un deficit nelle operazioni di *pianificazione* e *programmazione* degli atti motori in particolare quelli ben appresi

Anomalie esecuzione
programma motorio



- Riduzione del parametro **ampiezza** (micrografia, marcia a piccoli passi)
- Riduzione parametro **velocità** (rallentamento)

Anomale operazioni di
pianificazione motoria



- Inizio di un piano motorio (**freezing**)
- Cambiamento di programmi all'interno di un piano motorio (**freezing**)
- Conclusione del piano motorio (difficoltà a fermarsi)

Alterazioni della marcia

*Lenta, difficoltosa nell'avvio e nelle variazioni di direzione, spesso con necessità di diversi tentativi e "congelamento" del pz specie davanti a strettoie (**freezing**),*

ORIGINAL ARTICLE

Freezing of Gait and Activity Limitations in People With Parkinson's Disease

Dawn M. Tan, M Physio, Jennifer L. McGinley, PhD, Mary E. Danoudis, M Physio, Robert Iansek, MD, PhD, Meg E. Morris, PhD

CONCLUSIONS

FOG occurs throughout the time course of idiopathic PD and is associated with increased levels of activity limitation even after adjusting for disease severity. It is recommended that clinicians consider screening FOG in patients at all stages of the disease using FOG-specific tools tailored to the needs of people with PD.

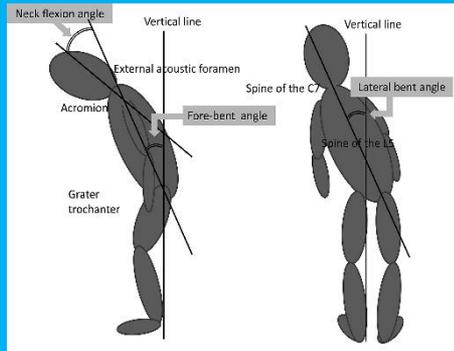
[Arch Phys Med Rehabil.](#) 2011 Jul;92(7):1159-65.

- ✓ Causa di significativa disabilità con alto impatto sulla qualità della vita e sulle attività quotidiane (ADL).
- ✓ Collegato alla bradicinesia, e più precisamente all'esecuzione anormale di compiti complessi come gesti ripetitivi, simultanei, automatici e sequenziali.

L'INSTABILITA' POSTURALE

Pisa syndrome in Parkinson disease

An observational multicenter Italian study



ABSTRACT

Objective: To estimate the prevalence of Pisa syndrome (PS) in patients with Parkinson disease (PD) and to assess the association between PS and demographic and clinical variables.

Methods: In this multicenter cross-sectional study, consecutive outpatients with PD attending 21 movement disorders Italian tertiary centers were enrolled and underwent standardized clinical evaluation. PS was defined as trunk lateral deviation $\geq 10^\circ$. Patients with PD were compared according to the presence of PS for several demographic and clinical variables.

Results: Among 1,631 enrolled patients with PD, PS was detected in 143 patients (8.8%, 95% confidence interval 7.4%–10.3%). Patients with PS were older, had lower body mass index, longer disease duration, higher disease stages, and poorer quality of life. Falls were more frequent in the PS group as well as occurrence of “veering gait” (i.e., the progressive deviation toward one side when patient walked forward and backward with eyes closed). Patients with PS received higher daily levodopa equivalent daily dose and were more likely to be treated with combination of levodopa and dopamine agonists. Osteoporosis and arthrosis were significantly the most frequent associated medical conditions in patients with PS. Multiple explanatory variable logistic regression models confirmed the association of PS with the following variables: Hoehn and Yahr stage, ongoing combined treatment with levodopa and dopamine agonist, associated medical conditions, and presence of veering gait.

Conclusions: Our results suggest that PS is a relatively frequent and often disabling complication in PD, especially in the advanced disease stages. The association is dependent on a number of potentially relevant demographic and clinical variables. *Neurology*® 2015;85:1-11

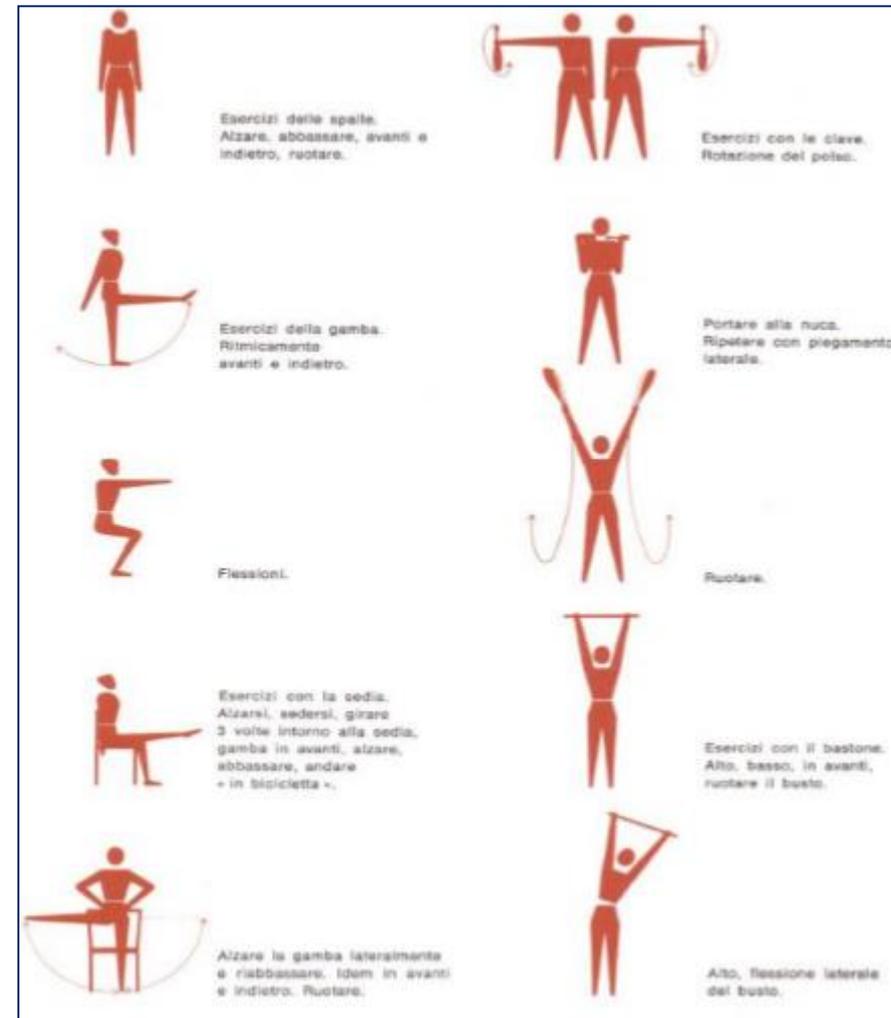
Aspetti disabilitanti della instabilità posturale

- **Cadute** e danni associati (Es. frattura del femore)
- **FOF (Paura di Cadere)**
- Limitazione della deambulazione
- Riduzione della mobilità
- Perdita di indipendenza funzionale
- Isolamento sociale

Malattia Parkinson Riabilitazione 1970

Terapia Farmacologica: levodopa dalla fine degli anni '60.

- Esercizi e fisioterapia sempre raccomandati nella cura della malattia.
- Dagli anni '90 crescente consapevolezza delle potenzialità dell'esercizio fisico.
- Ma solo il 3-29% dei pazienti consulta un terapista (Deane et al, 2002).
- Oggi percentuale più elevata: Maggiore consapevolezza.



Retoricamente!

È efficace la riabilitazione nel PD?

Neurology[®]
THE MOST WIDELY READ AND HIGHLY
CITED PEER-REVIEWED NEUROLOGY JOURNAL

The Official Journal of the
American Academy of Neurology

review

se Interventions for People with

Physical therapy and Parkinson's disease: controlled clinical trial

In a randomized, single-blind, crossover study, we evaluated physical disability in moderately advanced Parkinson's disease (PD) patients after 4 weeks of normal physical activity and 4 weeks of an intensive physical rehabilitation program. We used a timed motor task and a standard assessment of PD severity (the Unified Parkinson's Disease Rating Scale [UPDRS] with subscales for mentation, activities of daily living [ADL], and motor function) completed by an investigator blinded to the physical rehabilitation status of the patient. Following physical rehabilitation, there was significant

improvement in the UPDRS ADL and motor scores, but no change in mentation score. **During the 6 months following physical rehabilitation, patients did not regularly exercise, and the UPDRS scores returned to baseline.**

We conclude that physical disability in moderately advanced PD objectively improves with a regular physical rehabilitation program, but this improvement is not sustained when normal activity is resumed.

Cynthia L Comella et al, Neurology, March 1994

people with PD and a large body of empirical evidence has emerged in recent years. The objective is to systematically review randomized controlled trials (RCTs) reporting on the effectiveness of exercise interventions on outcomes (physical, psychological or social functioning, or quality of life) for people with PD. RCTs meeting the inclusion criteria were identified by systematic searching of electronic databases. Key data were extracted by two independent researchers. A mixed methods approach was undertaken using narrative, vote counting, and random effects meta-analysis methods. Fourteen RCTs

was insufficient evidence support or refute the value of exercise in reducing falls or depression. This review found evidence of the potential benefits of exercise for people with PD, although further good quality research is needed. Questions remain around the optimal content of exercise interventions (dosing, component exercises) at different stages of the disease. © 2008 Movement Disorder Society

Key words: Parkinson's disease; exercise; systematic review; meta-analysis.



Malattia Parkinson Riabilitazione

L'importanza della riabilitazione nella malattia di Parkinson è generalmente riconosciuta come è emerso dal convegno World Parkinson Congress che si è tenuto a Montreal nel mese di ottobre 2013.

La riabilitazione nella malattia di Parkinson, può essere considerata un ambito **altamente specializzato**.

Evidenze di studi internazionali indicano quali sono gli elementi particolari da inserire in un percorso riabilitativo per il Parkinson:

- cammino su **treadmill** (ovvero tappeto ruotante)
- uso di stimoli visivi o uditivi ("**cues**") che non fanno parte della riabilitazione generica.

Treadmill training for patients with Parkinson's disease (Review)



Mehrholz J, Friis R, Kugler J, Twork S, Storch A, Pohl M

ABSTRACT

Background: Treadmill training is used in rehabilitation and is described as improving gait parameters of patients with Parkinson's disease.

Objectives: To assess the effectiveness of treadmill training in improving the gait function of patients with Parkinson's disease and the acceptability and safety of this type of therapy.

Search methods: We searched the Cochrane Movement Disorders Group Specialised Register (see Review Group details for more information) (last searched March 2009), Cochrane Central Register of Controlled Trials (*The Cochrane Library* 2009, Issue 2), MEDLINE (1950 to March 2009), and EMBASE (1980 to March 2009). We also handsearched relevant conference proceedings, searched trials and research registers, and checked reference lists (**last searched March 2009**). We contacted trialists, experts and researchers in the field and manufacturers of commercial devices.

Selection criteria: We included randomised controlled trials comparing treadmill training with no treadmill training in patients with Parkinson's disease.

Data collection and analysis: Two review authors independently selected trials for inclusion, assessed trial quality and extracted data. We contacted the trialists for additional information. We analysed the results as standardised mean differences (SMDs) and mean differences (MDs) for continuous variables and relative risk differences (RD) for dichotomous variables.

Main results: We included eight trials (203 participants) in this review. Treadmill training improved gait speed (SMD **0.50; 95% confidence interval (CI) 0.17 to 0.84; P = 0.003; I² = 0%**) (fixed-effect model), stride length (SMD 0.42; 95% CI 0.00 to 0.84; P = 0.05; I² = 0%), walking distance (MD = 358 metres; 95% CI 289 to 426; P < 0.0001; I² = 30%), but cadence did not improve (MD 1.06; 95% CI -

4.32 to 6.44; P = 0.70; I² = 0%) at the end of study. Treadmill training did not increase the risk of patients dropping out (RD -0.07; 95% CI -0.18 to 0.05; P = 0.26; I² = 51%) (random-effects model). Adverse events were not reported.

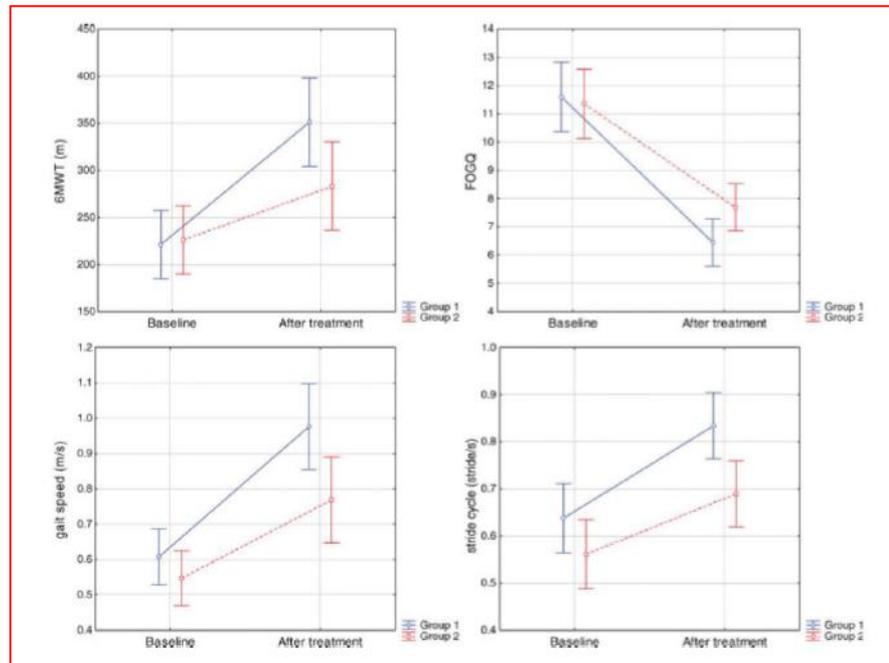
Authors' conclusions: Patients with Parkinson's disease who receive treadmill training are more likely to improve their impaired gait hypokinesia. However, the results must be interpreted with caution because there were variations between the trials in patient characteristics, the duration and amount of training, and types of treatment. Additionally, it is not known how long these improvements may last.

The Cochrane Library 2010, Issue 1

Rehabilitation Treatment of Gait in Patients with Parkinson's Disease with Freezing: A Comparison Between Two Physical Therapy Protocols Using Visual and Auditory Cues with or Without Treadmill Training



Giuseppe Frazzitta, MD,^{1*} Roberto Maestri, MD,² Davide Uccellini, MD,³
Gabriella Bertotti, MD,¹ and Paola Abelli, MD¹



- Miglioramento significativamente maggiore nei pazienti che usavano il Treadmill per quanto riguarda il cammino (**netto aumento della distanza percorsa in 6 minuti e della lunghezza dei passi**), del **freezing**, della rigidità, della camptocormia e dell'equilibrio.
- Se il paziente non continua a praticare esercizio fisico, dopo 1 anno i benefici vengono persi, ma le loro condizioni cliniche generali sono comunque nettamente migliori rispetto ad un gruppo di pazienti che invece ha assunto solo farmaci e non hanno effettuato il trattamento riabilitativo.
- I pazienti sottoposti a terapia riabilitativa intensiva assumevano mediamente un **dosaggio inferiore di levodopa rispetto ai controlli dopo 12 mesi**.

Short- and Long-Term Efficacy of Intensive Rehabilitation Treatment on Balance and Gait in Parkinsonian Patients: A Preliminary Study with a 1-Year Followup

Giuseppe Frazzitta,^{1,2} Gabriella Bertotti,³ Davide Uccellini,⁴ Natalia Boveri,³
R. Rovescala,³ Gianni Pezzoli,⁵ and Roberto Maestri⁶

Parkinson's disease (PD) is a neurodegenerative disease in which gait and balance disturbances are relevant symptoms that respond poorly to pharmacological treatment. The aim of this study was to investigate whether a 4-week inpatient multidisciplinary intensive rehabilitation treatment (MIRT) is effective in improving balance and gait and whether improvements persist at a one-year followup. We studied 20 PD inpatients (stage 3 Hoehn-Yahr) who underwent a MIRT. Outcome measures were UPDRS items for balance (30), falls (13), and walk (29), Berg Balance Scale, six-minute walking test, Timed Up and Go Test, and Comfortable-Fast gait speeds. Patients were evaluated at admission, at the end of the 4-week treatment, and at a 1-year followup. Pharmacological therapy was unchanged during MIRT and follow-up. All outcome measures improved significantly at the end of treatment. At 1-year follow-up control, UPDRS walk and Comfortable-Fast gait speeds still maintained better values with respect to admission ($P = 0.009$, $P = 0.03$, and $P = 0.02$, resp.), while the remaining scales did not differ significantly. Our results demonstrate that the MIRT was effective in improving balance and gait and that the improvement in gait performances was partially maintained also after 1 year.

Our findings indicate that balance and gait disturbances can be effectively countered by a multidisciplinary intensive inpatient treatment. The promotion of physical activity should be considered a valid option to maintain a good motor performance and autonomy in daily activity and to delay the increase in drug dosage with related adverse effects, although this needs to be tested in future well-controlled trials.

In-Patient Multidisciplinary Rehabilitation for Parkinson's Disease: A Randomized Controlled Trial

Marco Monticone, MD, PhD,^{1*} Emilia Ambrosini, PhD,^{1,2} Alessandro Laurini, MD,¹ Barbara Rocca, Psy,¹ and Calogero Foti, MD³

¹*Physical Medicine and Rehabilitation Unit, Scientific Institute of Lissone, Institute of Care and Research, Salvatore Maugeri Foundation IRCCS, Lissone (Monza Brianza), Italy*

²*Neuroengineering and Medical Robotics Laboratory, Department of Electronics, Information and Bioengineering, Politecnico di Milano, Milan, Italy*

³*Department of Physical Medicine and Rehabilitation, University of Rome 'Tor Vergata', Rome, Italy*

Movement Disorders, Vol. 30, No. 8, 2015

ABSTRACT: Purpose: This study was undertaken to evaluate the effects of an inpatient 2-month multidisciplinary rehabilitative program of task-oriented exercises, cognitive-behavioral training, and occupational therapy on motor impairment, activities of daily living, and quality of life (QoL) in subjects with long-duration Parkinson's disease (PD).

Methods: Subjects were randomly selected for an experimental (multidisciplinary rehabilitative care) and a control group (general physiotherapy) and were assessed before treatment, after 8 weeks (post-treatment), and 12 months after the end of treatment. Medications were not adjusted during training. Outcome measures were the Movement Disorder Society Unified Parkinson's Disease Rating Scale, Part III (primary outcome), the Berg Balance Scale, the Functional Independence Measure, and the 39-Parkinson's Disease Questionnaire. A linear mixed model for repeated measures was used for each outcome.

Results: Seventy subjects with PD (46 females; mean age, 74 ± 7 years; mean disease duration, 15 ± 3 years,

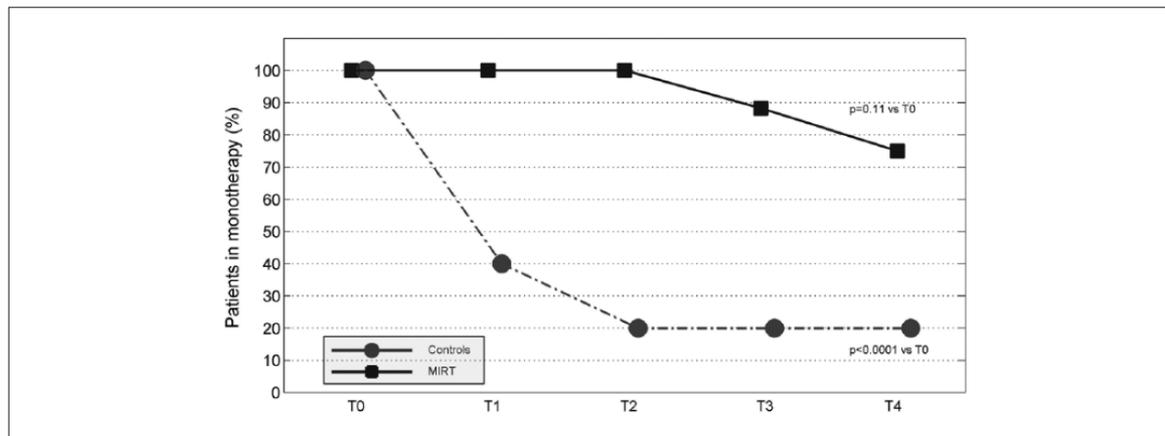
modified Hoehn & Yahr stage, 2.5-4) were randomized, 64 completed the study (experimental = 32; control = 32). A significant effect of time, group, and time by group interaction were noted for all outcomes. The primary outcome showed a between-group difference in favor of the experimental group of 25 points after training, which was maintained at follow-up. After training, the Berg Balance Scale score of the experimental group was greater than 43.5, a value previously identified as a cutoff between fallers and nonfallers for subjects with PD.

Conclusion: Our findings suggest that multidisciplinary rehabilitative care is useful in changing the course of motor impairment, balance, activities of daily living, and QoL. The effects lasted for at least 1 y after the intervention. © 2015 International Parkinson and Movement Disorder Society

Key Words: Parkinson's disease; multidisciplinary care; rehabilitation; task-oriented exercises; randomized controlled trial

Intensive Rehabilitation Treatment in Early Parkinson's Disease: A Randomized Pilot Study With a 2-Year Follow-up

Giuseppe Frazzitta, MD^{1,2}, Roberto Maestri³, Gabriella Bertotti³, Giulio Riboldazzi, MD⁴, Natalia Boveri³, Michele Perini, MD⁵, Davide Uccellini, MD⁶, Marinella Turla, MD⁷, Cristoforo Comi, MD⁸, Gianni Pezzoli, MD⁹, and M. Felice Ghilardi, MD¹⁰



Our results suggest that MIRT, **in the early stage of disease**, can not only slow down disease progression, but it can also lead to a better motor performance. This conclusion is also in agreement with the *current guidelines, which encourage patients with PD to begin exercise training programs with a high training intensity, “beyond what they may self-select,” with a multidisciplinary approach.*

Malattia Parkinson Riabilitazione

OBIETTIVI RIABILITATIVI

1. Contenimento del danno primario (sintomo)
2. Prevenzione o riduzione dei danni secondari alla ridotta motilità
3. Vicariare le funzioni compromesse, identificando modalità e strategie alternative.
4. Aumento della plasticità del tessuto nervoso del cervello favorendo il rinforzo cognitivo dell'apprendimento (**motor learning**).

Percorso riabilitativo intensivo specializzato

In base all'esperienza acquisita e alla letteratura scientifica è stato messo a punto un percorso riabilitativo intensivo che prevede, in regime di ricovero ospedaliero 3 sedute giornaliere ciascuna di circa 60 minuti, 6 giorni la settimana per 4 settimane.

Prima seduta

Lavoro individuale con un fisioterapista che lo induce a prendere coscienza dei suoi problemi per quanto riguarda

- la postura
- l'equilibrio
- la funzionalità articolare
- strategie

Percorso riabilitativo intensivo specializzato

Seconda seduta

Lavoro con apparecchiature di tipo avanzato e/o facilitanti (tra cui, ovviamente, il tapis roulant assieme ai “cues) scelte per facilitare il ri-apprendimento della corretta sequenza di sequenze motorie, tra cui le fasi del ciclo del passo, sino ad una **rieducazione cognitiva**.

Terza seduta

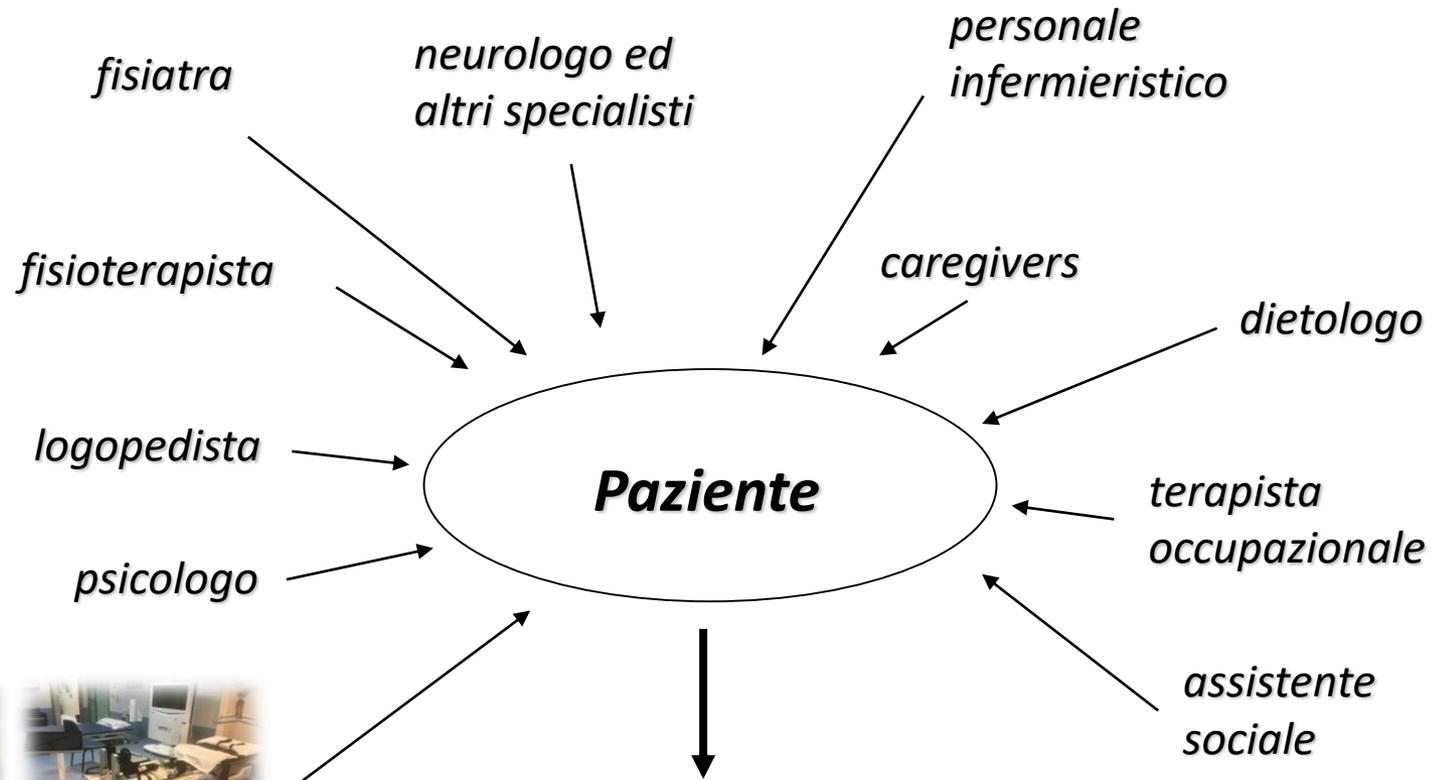
Esercizi di tipo occupazionale finalizzati a migliorare l'autonomia nelle attività del vivere quotidiano: scrivere, girarsi nel letto, alzarsi da una poltrona, uso di utensili, ecc. (oppure **musicoterapia**)

*Questo protocollo si è rilevato essere particolarmente efficace nel rallentare l'evoluzione della malattia e nel ridurre la necessità di aumentare il dosaggio farmacologico.

QUANDO?

Idealmente bisogna iniziare la fisioterapia **nelle prime fasi della malattia**, perché è più facile prevenire che correggere.

COME?



**PRESA IN CARICO
GLOBALE E
PERSONALIZZATA**

RIABILITAZIONE EFFICACE



Può la riabilitazione robotizzata consentire un intervento terapeutico con tali caratteristiche?

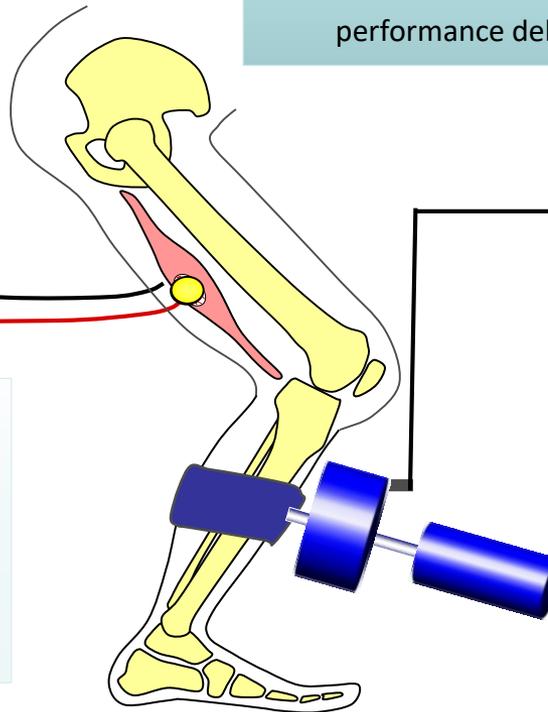
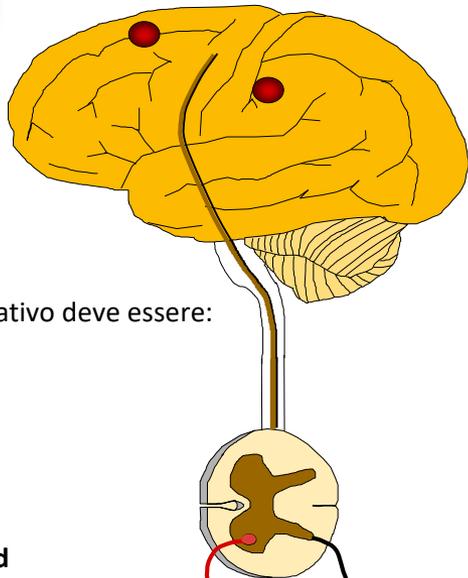
- ◆ coadiuvare il terapista nel somministrare, con precisione, **intensità** e **ripetibilità** (fino a 1000 passi in una sessione di 30 min vs 50-100 tradizionale nei paz gravi), la terapia motoria più adeguata che riproduce il fisiologico cammino (con minore carico del FT)
- ◆ valutare le funzionalità motorie e seguire nel tempo la performance del paziente

L'intervento riabilitativo deve essere:

- **Precoce**
- **Intensivo**
- **Ripetitivo**
- **Attivo**
- **Task-Oriented**

→ Un robot è una macchina in grado di rimpiazzare/aiutare un operatore per lo svolgimento di alcune funzioni.....

... ma ciò è possibile solo se possiede un sistema sensoriale in grado di determinare un autoregolazione (**active feed-back**).



ROBOT



Le tre leggi della robotica

Prima Legge: “Un robot non può recar danno a un essere umano né può permettere che a causa del proprio mancato intervento un essere umano riceva danno”.

Seconda legge: “Un robot deve obbedire agli ordini impartiti dagli esseri umani purché tali ordini non contravvengano alla prima legge”.

Terza legge: “Un robot deve proteggere la propria esistenza purché questo non contrasti con la prima e la seconda legge”.



2.2 Three laws of neurorobotics

According to the aforementioned desirable features of a neurorobot, we have re-formulated the three laws of robotics into three laws for robotics in neurorehabilitation:

- (1) A robot for neurorehabilitation may not injure a patient or allow a patient to come to harm.
- (2) A robot must obey the orders given it by therapists, except where such orders would conflict with the First Law.
- (3) A robot must adapt its behavior to patients' abilities in a transparent manner as long as this does not conflict with the First or Second Law.



Format Abstract ▾

Send to ▾

[J Med Biol Eng](#), 2016;36:1-11. Epub 2016 Feb 9.

The Three Laws of Neurorobotics: A Review on What Neurorehabilitation Robots Should Do for Patients and Clinicians.

[Iosa M¹](#), [Morone G¹](#), [Chenubini A²](#), [Paolucci S¹](#).

[Author information](#)

Abstract

Most studies and reviews on robots for neurorehabilitation focus on their effectiveness. These studies often report inconsistent results. This and many other reasons limit the credit given to these robots by therapists and patients. Further, neurorehabilitation is often still based on therapists' expertise, with competition among different schools of thought, generating substantial uncertainty about what exactly a neurorehabilitation robot should do. Little attention has been given to ethics. This review adopts a new approach, inspired by Asimov's three laws of robotics and based on the most recent studies in neurorobotics, for proposing new guidelines for designing and using robots for neurorehabilitation. We propose three laws of neurorobotics based on the ethical need for safe and effective robots, the redefinition of their role as therapist helpers, and the need for clear and transparent human-machine interfaces. These laws may allow engineers and clinicians to work closely together on a new generation of neurobots.

KEYWORDS: Ethics; Medical robots; Neuroscience; Rehabilitation; Robotic training

PMID: 27069459 PMID: PMC4781450 DOI: 10.1007/s40846-016-0115-2

[Free PMC Article](#)



RESEARCH

Clinical Research Articles

Robotic Gait Training vs. Conventional Gait Training in Parkinson's Disease: A Randomized Clinical Trial

Stefano Carda, MD, PhD, Cristoforo Comi, MD, PhD, Carlo Cisari, MD^{1,3}

Abstract

Background. The use of robots over the standard treadmill in early-stage PD (Hoehn-Yahr 1-2) in the Lokomat for 3 d/wk for 12 weeks after the end of treatment and the results. **Results.** Of 334 screened patients, 190 were included. At baseline, the 2 groups did not differ for any outcome measure (treadmill walking speed, 95% CI = 417.23-499.96, $p = 0.15$). Robotic gait training with the Lokomat significantly improved PD. Both approaches are safe, with results maintained for up to 6 months.

ORIGINAL ARTICLE

Robotic-assisted gait training in Parkinson's disease: a three-month follow-up randomized clinical trial

Anna Furnari^a, Rocco Salvatore Calabrò^b, Maria Cristina De Cola^b, Michelangelo Bartolo^a, Alberto Castelli^a, Alessia Mapelli^a, Giampiero Buttacchio^a, Elena Farini^a, Placido Bramanti^a and Roberto Casale^a

^aNeurorehabilitation Unit, HABILITA Care & Research Rehabilitation Hospitals, Zingonia di Ciserano (Bergamo), Zingonia, Italy; ^bIRCCS Centro Neurolesi "Bonino-Pulejo", Messina, Italy

ABSTRACT

Purpose: The aim of this study was to evaluate the efficacy of a robotic-assisted gait training (RAGT), together with a conventional exercise program (CEP), to improve PD ambulation, as compared to standard gait training. **Methods:** Thirty-eight patients with mild PD stage (H&Y 2-2.5) were randomly assigned to an experimental group (EG) or a control group. The 19 patients in EG received 30 min RAGT (using Lokomat device), whereas the 19 controls received a conventional gait training; both groups received 30 min of CEP. Participants were evaluated before (T0), immediately after (T1), and 12 weeks after the end of treatment (T2), by using 10-MWT, Tinetti Test and the motor score of the UPDRS-III. **Results:** We found that Tinetti Walking (TW) ($X^2(3) = 31.75$; $p < 0.001$), Tinetti Balance ($X^2(3) = 74.07$; $p < 0.001$), UPDRS-III ($X^2(3) = 6.87$; $p < 0.001$) and GDS ($X^2(3) = 28.83$; $p < 0.001$) scores were affected by the type of the rehabilitative treatment. At T2, we found a significant difference between the two groups for TW ($t = 2.62$; $p < 0.02$, $d = 0.85$). Concerning all the study outcomes, a significant improvement was observed from T0 to T1 in both groups. However, the functional motor gain at T2 was maintained only in the EG. **Conclusions:** RAGT may significantly improve walking ability, motor function and for a maximum period of three months. Thus, our findings support the importance of a RAGT as a valid rehabilitative tool for PD.

ARTICLE HISTORY

Received 14 October 2016
Revised 29 December 2016
Accepted 26 January 2017
Published online 10 February 2017

KEYWORDS

Neurodegenerative brain disorder; gait disorders; lower extremity rehabilitation; device-based therapy

reducing FOG and improving gait. Videotaped scoring of FOG has the potential advantage of providing additional data to complement FOG self-report.



Rhythmic auditory stimulation in gait training for Parkinson's disease patients

Finalità

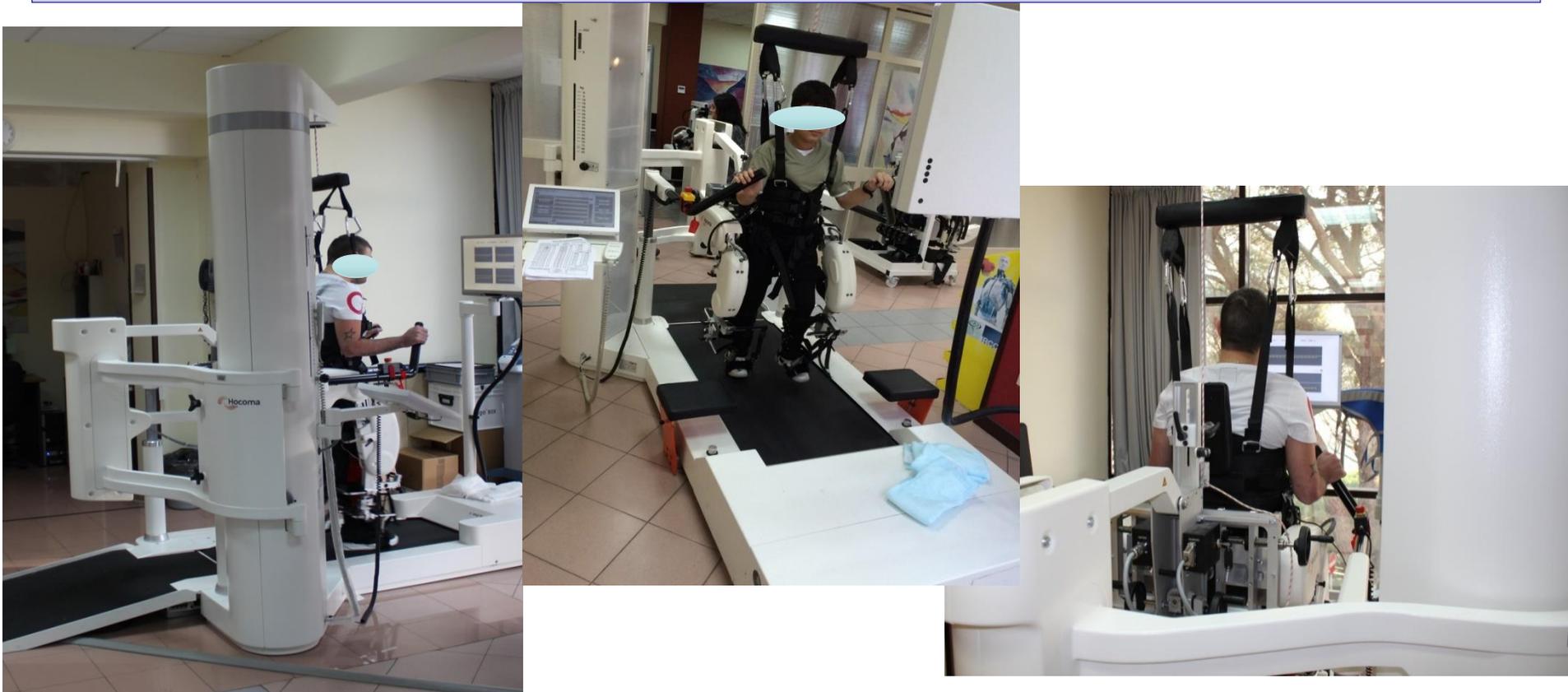


Bengtsson, 2003).

LOKOMAT

Sistema robotizzato che consente di riprodurre uno schema motorio assimilabile alla normale deambulazione, costituito da un **treadmill**, un sistema computerizzato di **sgravio del peso corporeo** ed un esoscheletro robotizzato composto da **ortesi meccanizzate** per gli arti inferiori.

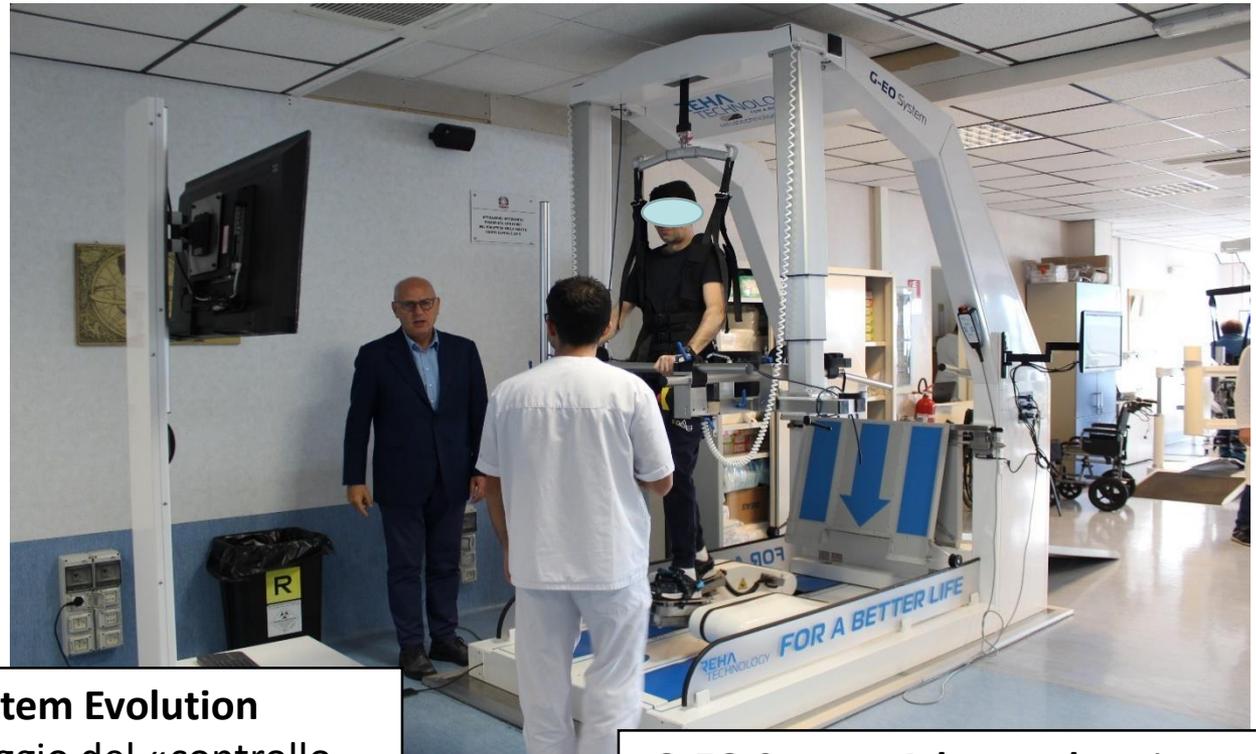
Il device consente la personalizzazione di parametri quali velocità, ROM articolare, forza guida, BWS e fornisce un feedback visivo (con realtà virtuale aumentata nel PRO) per valutare la performance motoria



GEO - SYSTEM

G-EO System Basic

si contraddistingue per il design funzionale e la facilità d'uso. Consente ai terapisti di offrire le più avanzate terapie del cammino robot-assistito, simulando il cammino nel piano con varie possibilità d'impostazione.



G-EO System Evolution

offre il vantaggio del «controllo intelligente», che consente alla macchina di reagire attivamente e in tempo reale alle capacità del paziente.

G-EO System Advanced aggiunge una serie più complessa di schemi del passo alla sola simulazione del cammino sul piano, come ad esempio i movimenti per salire e scendere le scale.

VIRTUAL REALITY

Il fine della **realtà virtuale** è simulare un ambiente reale per mezzo di tecnologie elettroniche, sino a dare a chi la sperimenta l'impressione di trovarsi realmente immerso in quell'ambiente



La VR è in grado di generare verso il proprio SNC un feedback aumentato **“augmented feedback”** attraverso l’esecuzione di esercizi in ambiente virtuale che consentono di sviluppare la consapevolezza dei risultati dei movimenti effettuati **“knowledge of results”** e la consapevolezza della qualità dei movimenti stessi **“knowledge of performance”**; in tal modo il SNC può attivare un cruciale meccanismo di apprendimento fisiologico chiamato **“reinforcement learning”**



BTS NIRVANA E RIABILITAZIONE

BTS NIRVANA è un sistema terapeutico che facilita la riabilitazione **motoria** e **cognitiva** di pazienti affetti da patologie neurologiche attraverso un totale coinvolgimento sensoriale (feedback visivo ed uditivo aumentato).

*Training “Semi-immersivo-interattivo”,
guidato dal terapeuta.*



COME? Il paziente interagisce con scenari virtuali e stimoli audio-visivi **mediante il movimento**, determinando così un totale coinvolgimento sensoriale.

NIRVANA E PARKINSON

What About the Role of Virtual Reality in Parkinson Disease's Cognitive Rehabilitation? Preliminary Findings From a Randomized Clinical Trial

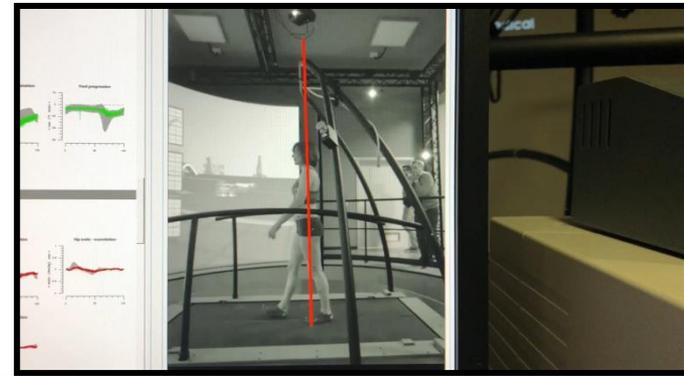
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Rosaria De Luca, MSc¹, and Rocco Salvatore Calabrò, RS, MD, PhD¹**

Background: The purpose of this study is to evaluate the effects of a virtual reality training with BTS Nirvana (BTS-N) system in the cognitive and behavioral recovery in patients with Parkinson disease (PD). The BTS-N is a semi-immersive therapy system used for motor and cognitive rehabilitation of patients with neurological diseases, by creating virtual scenarios with which the patient may interact. Methods: We enrolled 20 patients with PD undergoing neurorehabilitation. All the patients were randomized into 2 groups: experimental group performing semi-immersive virtual reality training with BTS-N and control group undergoing traditional cognitive training. Each participant was evaluated before and immediately after the end of the training. Each cognitive training consisted of 3 sessions a week, each lasting 60 minutes, for 8 weeks, for a total of 24 sessions in each group. Results: Experimental group showed a greater improvement in cognitive functioning, with regard to executive and visuospatial abilities, as compared with the control group. Conclusion: **Our findings suggest that rehabilitation through a new virtual reality instrument could be a valuable tool in improving cognitive and behavioral outcomes of patients with PD.**

Computer Assisted Rehabilitation Environment (CAREN)

Surround sound system & Visual projection



Motion-Capture system



6 DOF Motion Platform

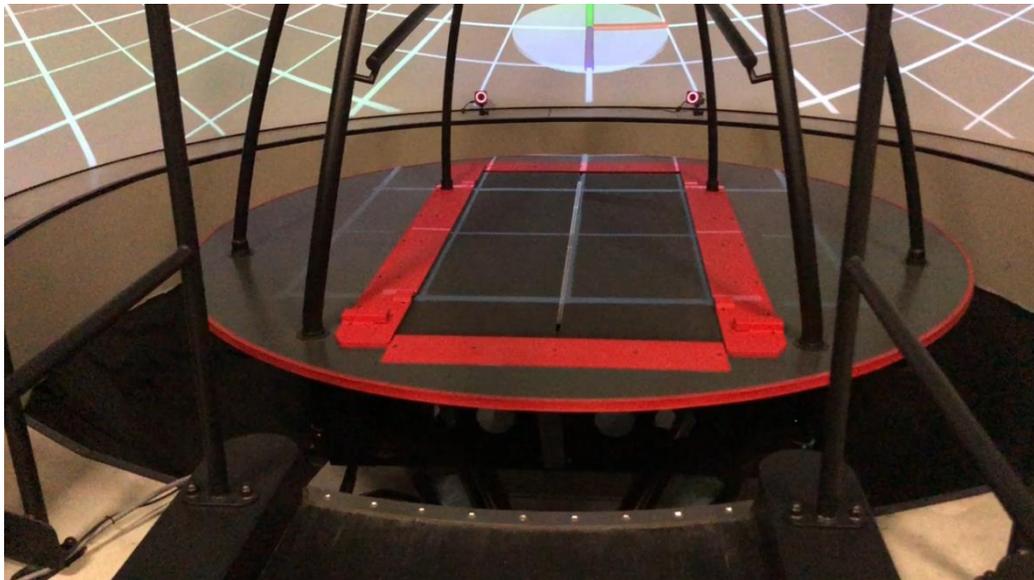


Instrumented Dual-belt Treadmill

Il **CAREN** è un simulatore a cupola dotato di schermo (fino 360°), in grado di visualizzare diverse “**realtà virtuali**” per il recupero delle performance motorie e cognitive in pz neurologici ed ortopedici.

CAREN

Pedana



La base di movimento 6 DOF può somministrare delle perturbazioni ai soggetti (durante la camminata) sulla pedana lungo gli assi X, Y e Z, e applicare delle rotazioni intorno a questi assi.

CAREN

Tapis



La pedana strumentata con doppio nastro permette una velocità di camminata fino a 5 m/s. Tutta la superficie di ciascun nastro è anche una piattaforma di forza ad alta precisione, in grado di misurare il centro di pressione, i momenti e le forze in tutte le direzioni.

CAREN

Sicurezza



Pulsanti di arresto di emergenza sulla console e sulla pedana

Imbragatura di sicurezza di varie misure

Sensori di arresto se il paziente arretra troppo sulla pedana

CAREN

CREAZIONE SCENARI

 SketchUp



OLVIDO

CAREN

INDICAZIONI

Il CAREN grazie all'unicità e complessità del sistema, consente la riabilitazione e il potenziamento di numerose patologie e condizioni cliniche:

- riabilitazione neurologica di pazienti con deficit dell'equilibrio e dell'andatura (stroke, traumi cranici, sclerosi multipla e **malattia di Parkinson**; lesioni spinali incomplete, atassie, miopatie)
- Riabilitazione e potenziamento dopo traumi sportivi (>lesioni al ginocchio)
- Potenziamento muscolare e cardiovascolare in medicina dello sport
- Riabilitazione post-chirurgia ortopedica (protesi di anca e ginocchio)
- riabilitazione all'utilizzo di protesi negli amputati
- riabilitazione neuropsicologica (> neglect)
- riabilitazione psichiatrica (attacchi di panico, fobie e disturbo da stress post-traumatico)
- Ricerca clinica (studio del movimento, dell'equilibrio, efficacia dei trattamenti riabilitativi)



CAREN

Kalron et al. *Journal of NeuroEngineering and Rehabilitation* (2016) 13:13
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Journal of NeuroEngineering
and Rehabilitation

RESEARCH

Open Access



The effect of balance training on postural control in people with multiple sclerosis using the CAREN virtual reality system: a pilot randomized controlled trial

Alon Kalron^{1*}, Ilia Fonkatz², Lior Frid², Hani Baransi³ and Anat Achiron^{2,4}

Abstract

Background: Multiple sclerosis (MS) is a multi-focal progressive disorder of the central nervous system often resulting in diverse clinical manifestations. Imbalance appears in most people with multiple sclerosis (PwMS). A popular balance training tool is virtual reality (VR) with several advantages including increased compliance and user satisfaction. Therefore, the aim of this pilot RCT (Trial registration number, date: ISRCTN14425615, 21/01/2016) was to examine the efficacy of a 6-week VR balance training program using the computer assisted rehabilitation environment (CAREN) system (Motek Medical BV, Amsterdam, Netherlands) on balance measures in PwMS. Results were compared with those of a conventional balance exercise group. Secondary aims included the impact of this program on the fear of falling.

Methods: Thirty-two PwMS were equally randomized into the VR intervention group or the control group. Each group received balance training sessions for 6 consecutive weeks, two sessions per week, 30 min sessions. Clinical balance tests and instrumented posturography outcome measures were collected upon initiation of the intervention programs and at termination.

Results: Final analysis included 30 patients (19 females, 11 males; mean age, (S.D.)=45.2 (11.6) years; mean EDSS (S.D.)=4.1 (1.3), mean disease duration (S.D.)=11.0 (8.9) years). Both groups showed a main effect of time on the center of pressure (CoP) path length with eyes open ($F=5.278, P=.024$), sway rate with eyes open ($F=5.852, P=.035$), Functional Reach Test ($F=20.841, P=.001$), Four Square Step Test ($F=9.011, P=.031$) and the Fear of Falls self-reported questionnaire ($F=17.815, P=.023$). In addition, significant differences in favor of the VR program were observed for the group x time interactions of the Functional Reach Test ($F=10.173, P=.009$) and fear of falling ($F=6.710, P=.021$).

Conclusions: We demonstrated that balance training based on the CAREN device is an effective method of balance training for PwMS.

Keywords: Multiple sclerosis, Balance, Postural control, Virtual reality, CAREN

Weight Shift of Persons With Vestibular Dysfunction Using a Virtual Reality Simulation Environment

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... vestibular pathology requiring physical weight shift for subjects receiving vestibular CAREN). A 6-session CAREN, 6-session control (0 traditional sessions) therapy group. ... controls performing similar tasks on the ... in gait speed ($p = 0.014$) and weight ... control population.

... , Dear Reini, Eric Reini and

MSA

TAHE HOME MESSAGE

1. Attualmente non è possibile considerare la riabilitazione della Malattia di Parkinson come un programma di esercizi generici
2. Presa in carico multidisciplinare in regime di intensività
3. Precocità di intervento
4. Tread mil e cues presupposti fondamentali per ottenere un significativo miglioramento delle capacità motorie
5. L'utilizzo di tecnologia avanzata che tenga conto e agisca sui meccanismi fisiopatologici di base può *agevolare* significativamente i percorsi riabilitativi e il raggiungimento dei target riabilitativi, oltre al mantenimento nel tempo degli stessi



L'intuizione è "la madre" di tutti i successi