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Viewpoint

Evidence-Based Analysis of Physical Therapy in Parkinson's Disease with Recommendations for Practice and Research

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Abstract: Physical therapy is often prescribed in Parkinson's disease. To facilitate the uniformity and efficacy of this intervention, we analyzed current evidence and developed practice recommendations. We carried out an evidence-based literature review. The results were supplemented with clinical expertise and patient values and translated into practice recommendations, developed according to international standards for guideline development. A systematic literature search yielded 6 systematic reviews and 23 randomized controlled trials of moderate methodological quality with sufficient data. Six specific core areas for physical therapy were identified: transfers, posture, reaching and grasping, balance, gait, and physical capacity. We extracted four specific treatment recommendations that were based on evidence from more than two controlled trials: cueing strategies to improve gait; cognitive movement strategies to improve transfers; exercises to improve balance; and training of joint mobility and muscle power to improve physical capacity. These practice recommendations provide a basis for current physical therapy in Parkinson's disease in everyday clinical practice, as well as for future research in this field. © 2006 Movement Disorder Society

Key words: practice guideline; physical therapy; Parkinson disease; evidence-based medicine; International Classification of Functioning, Disability, and Health (ICF); activities of daily living

In the course of their disease, most patients with Parkinson's disease (PD) face mounting mobility deficits, including difficulties with transfers, posture, balance, and walking. This frequently leads to loss of independence, (fear of) falls, injuries, and inactivity, resulting in social isolation and an increased risk of osteoporosis or cardiovascular disease.[1,2] Consequently, costs increase[3] and quality of life decreases.[4] These mobility deficits are difficult to treat with drugs or neurosurgery.[5,6]

Physical therapy† is often prescribed next to medical treatment.[7] However, there are presently no guidelines for physical therapy in PD with practical recommenda-

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Members of the Practice Recommendations Development Group are listed in the Appendix.

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†In the Netherlands, physical therapists, Cesar exercise therapists, and Mensendieck exercise therapists can deliver exercise therapy. The term "physical therapy" in this study also includes Cesar and Mensendieck exercise therapies; the term "physical therapist" in this study also includes Cesar and Mensendieck exercise therapists.

TABLE 1. *EBRO classification of study results and recommendations: classification of the study results according to the level of evidence*

A1	Meta-analyses (systematic reviews), which include at least some, randomized clinical trials at quality level A2 that show consistent results between studies
A2	Randomized clinical trials of a good methodological quality (randomized double-blind controlled studies) with sufficient power and consistency
B	Randomized clinical trials of a moderate methodological quality or with insufficient power, or other nonrandomized, cohort or patient–control group study designs that involve intergroup comparisons
C	Patient series
D	Expert opinion

tions graded according to scientific evidence. Prior research was hampered by this lack of uniform treatment recommendations.[8–10] Therefore, we developed evidence-based practice recommendations according to international criteria for guideline development.[11,12] With these recommendations we aim to facilitate the uniformity and efficacy of physical therapy in PD. Furthermore, practice recommendations provide referring physicians insight into the possibilities and limitations of physical therapy in PD, thereby promoting the quality of referrals. Finally, the recommendations can provide a firm basis for future research in this field.

Here, we describe the systematic analysis of evidence and the key recommendations. For detailed recommendations on referral indications and treatment options, we refer to a comprehensive description that is available online: http://www.cebp.nl or http://www.kngf.nl.

EVIDENCE-BASED LITERATURE REVIEW

Search Strategy and Selection Criteria

First, a systematic literature search for guidelines, systematic reviews, trials, and expert opinions was performed in the electronic databases of Medline, Cinahl, Embase, and the Cochrane Library in May 2002. As insights may evolve over time, expert opinions were only included when published after May 1997. Randomized controlled trials (RCTs), controlled clinical trials (CCTs), and pre-experimental studies were identified using combinations of the following medical subject heading (MeSH) headings and free texts: Parkinson's disease, physical therapy, physical therapy techniques, exercise movement techniques, exercise, exercise therapy, physiotherapy, and training. To identify clinical measurements for baseline assessment and treatment evaluation purposes, combinations of the following [MeSH] headings and free texts were used: Parkinson disease, sensitivity and specificity, exercise test, physical examination, outcome assessment, and treatment outcome. Furthermore, cross-references and expert recommended references were evaluated. To be selected, publications had to address physical therapy in PD and be published in English, Dutch, or German. Trials were only selected if sufficient data were reported.

Levels of Evidence

The selected literature was critically appraised by assessing the quality of the study design. When evidence was not available in published studies, recommendations were formulated based on consensus among group members. Evidence was graded according to EBRO recommendations (Table 1). EBRO is an initiative of the Dutch Cochrane Center and the Dutch Institute for Healthcare Improvement (CBO, http://www.cbo.nl), a member of the Guidelines International Network (GIN). Consensus was gained by means of informative meetings, Delphi rounds, Web-based discussions, and consensus-meetings. Finally, practice recommendations were graded based on their levels of evidence (Table 2).

Identified Literature

The literature searches yielded six systematic reviews[8–10,13–15] and 23 controlled (level B) studies with sufficient data on the effectiveness of physical therapy in PD.[16–39] One of these studies was covered in two publications.[29,30] Another six controlled studies could not be included due to insufficient data.[40–45]

EXTRACTING PRACTICE RECOMMENDATIONS

On the basis of the systematic literature search, practice recommendations were deduced according to international standards for guideline development.[11,12] A national Practice Recommendations Development Group of 9 expert physical therapists and 1 expert neurologist, as well as a Steering Committee that guarded the development process, were installed in December 2001.

TABLE 2. *EBRO classification of study results and recommendations: classification of the recommendations according to the level of evidence*

Level	
1	Supported by one systematic review at quality level A1 or at least two independent trials at quality level A2
2	Supported by at least two independent trials at quality level B
3	Supported by one trial at quality level A2 or B, or research at quality level C
4	Based on the expert opinion (e.g., of working group members)

Clinical Expertise and Patient Values

An independent, international Review Panel of 16 professionals with specific expertise in movement disorders (e.g., neurologist, general practitioner, physical therapist, and occupational therapist) reviewed a draft of the practice recommendations. Finally, a Patient Panel of the Dutch Parkinson's Disease Association reviewed a draft of the practice recommendations. The key question was "Would your physical therapist be able to optimally treat you and the problems you experience due to your Parkinson's disease, if he had a copy of this manuscript?". The Practice Recommendations Development Group discussed the collected drawbacks and strengths of the recommendations until consensus was reached. Finally, the literature search was updated in October 2003. Newly found evidence was graded according to the EBRO criteria and, after consensus was reached, incorporated into the recommendations.

PRACTICE RECOMMENDATIONS

Core Areas

Physical therapy is unlikely to influence the disease process itself but can improve daily functioning by teaching and training PD patients in the use of (compensatory) movement strategies. Furthermore, physical therapy may influence secondary health problems, e.g., (risk of) decreased strength or endurance.

Six specific core areas for physical therapy in PD were identified (in random order): (1) Transfers (e.g., turning in bed or rising from a chair), (2) Posture (including neck and back problems), (3) Reaching and grasping, (4) Balance and falls (including fear of falling), (5) Gait, (6) Physical capacity and (in)activity.

History Taking and Physical Examination

The practice recommendations contain a quick reference card for history taking and physical examination. During history taking, the physical therapist should systematically assess health problems on all levels of the International Classification of Functioning, Disability and Health (ICF). The outcome of the history taking and physical assessment determines the core area(s) for treatment. Finally, the therapist should examine the patient's expectations regarding treatment, particularly whether these are realistic. On the basis of the results of the history taking and physical examination, the therapist determines whether physical therapy is indicated and, if so, draws a treatment plan. The Practice Recommendations Development Group has identified three phases in the course of the disease: early, middle, late (Fig. 1). These phases are based on the model of Kamsma.[46] Each phase is characterized by specific physical therapy goals and interventions within the six core areas. In the successive phases, the goals and interventions of the foregoing phase(s) might remain valid.

Clinical Measurements

We selected clinical measurements (both quantitative and qualitative) for baseline assessment and treatment evaluation purposes. In physical therapy, the most suitable instruments are linked to the ICF domain of level of limitations (in activities).[47,48] Instruments were selected based on ICF level, feasibility, and clinimetric properties: reliability; validity; and responsiveness.

Three instruments are recommended for use in all patients: a patient preference disability questionnaire (to identify patient-specific complaints) for baseline assessment and treatment evaluation purposes[49,50]; a structured falls history questionnaire for baseline assessment purposes[51]; and the global perceived effect for treatment evaluation purposes. Although the selection of these three instruments was based on consensus within the Practice Recommendations Development Group, other instruments may also be appropriate as a systematic approach to determine best examination tools was not undertaken.

PD patients with more than one fall in the previous year are likely to fall again within the next 3 months. This falling can lead to fractures or other physical injury and to (more) fear to move, resulting in decreased activities and an increased liability to renewed falls. Most falls in PD occur during transfers, such as rising from a chair, and during (freezing of) gait.[51,52] Therefore, fall circumstances should be adequately screened to guarantee that interventions are tailored to the patient's specific fall circumstances.

Repeated clinical evaluations should always be performed while the patient is in a comparable clinical state (e.g., always at the same time after medication intake, or standardized for *on* and *off* periods). Depending on the patient-specific treatment goals and the patient's motivation, treatment should be finished when the goals are reached, or when the therapist concludes that physical therapy no longer has additional value (e.g., the goals are unreachable, or the patient can achieve the goals unsupervised).

Key Recommendations for Physical Therapy Intervention

Of all practice recommendations provided, four were based on evidence from two or more controlled trials (Tables 3–5) and, therefore, reach "level 2" recommendation (Table 2): (I) Application of cueing strategies to

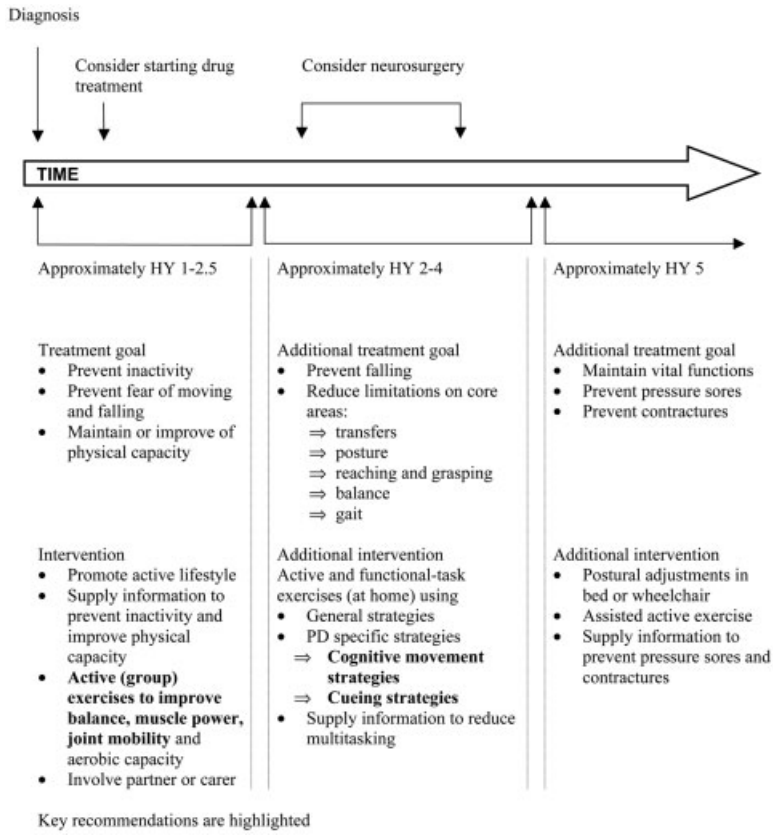

FIG. 1. Phases in the course of Parkinson's disease (PD): goals and possible interventions for physical therapy in Parkinson's disease

improve gait; (II) Application of cognitive movement strategies to improve transfers; (III) Specific exercises to improve balance; (IV) Training of joint mobility and muscle power to improve physical capacity.

I. Cueing strategies

It is plausible that, in patients with PD, gait is improved by applying visual or auditory cues, which have been trained during active gait training.[31,37] Cues are stimuli from the environment or generated by the patient, which the patient uses, consciously or not, to facilitate (automatic and repetitive) movements. It is not yet clear exactly how cues improve movement. Perhaps they provide an external rhythm that can compensate for the improperly supplied internal rhythm of the basal ganglia, correct the motor set deficiency, or (in case of visual cues) generate optical flow that activates a cerebellar visual–motor pathway.[15] Not all patients benefit equally from using cues.

A distinction is made between rhythmical cues and "one–off" cues. Rhythmical cues are given as a continuous, serial set of stimuli, which can serve as a control mechanism to pace walking. The frequency of rhythmical cues is based on the patient's comfortable walking speed as measured with the Ten-meter Walk Test.[53] One–off cues are used as a focusing point to maintain balance, and for initiating activities of daily life (ADL; e.g., start walking after a period of freezing, or rising from a chair).

Cues can be divided into four groups: Auditory cues,[21,27,30,31,37,54–56] e.g., the use of a walkman with rhythmic music, a metronome, or counting (by the patient, partner, or caretaker); Visual cues,[27,30,31,55,57–60] e.g., stepping over stripes on the floor or over the grip of an inverted walking stick, or focusing on an object (e.g., a clock) in the environment; Tactile cues,[27,30] e.g., tapping on the hip or the leg; Cognitive cues,[21,60] e.g., a mental image of the appropriate step length.

II. Cognitive movement strategies

It is plausible that, in patients with PD, applying cognitive movement strategies improves the performance of transfers.[26,31] In this strategy, complex automated movements are transformed into a series of submovements that have to be executed in a fixed order. All elements consist of relatively simple movement components. The course of the movement is thereby reorganized in such a way that the activity can be performed

TABLE 3. *Identified level B studies (EBRO criteria) on the effectiveness of physical therapy in Parkinson's disease used for the key recommendations: RCT of PT versus no intervention*

Reference, year of publication	No.[a] (E,C)	Design Hoehn & Yahr	Experimental intervention	Duration	No. of sessions	Group effect
Bergen et al. (16), 2002	8 (4,4)	Parallel H&Y 2	Exercises to improve physical capacity	16 weeks (22 hr)	48	VO2-max Leg strength
Comella et al. (18), 1994	18	Cross-over H&Y 2 to 3	Exercises for ROM, gait, balance, dexterity, and physical capacity (proprioceptive neuromuscular facilitation); Additional: OT	4 weeks (12 hr)	12	UPDRS: total, ADL, motor
Gauthier et al. (21), 1987	64 (33,31)	Parallel H&Y 2 to 4	Exercises for ROM, dexterity, ADL, balance, posture, and gait (visual and auditory cues); Education; Additional: OT, dietician, SW, psychologist	5 weeks (20 hr)	10	ADL (BI)
Patti et al. (34), 1996	20 (12,8)	Parallel H&Y 2 to 3	Active and passive exercises for ROM, balance, gait (e.g. auditory cues), and antirigidity. Additional: OT for self-care; Speech therapy for swallowing	4 weeks		ADL (BI, FIM) Gait: speed, step length UPDRS: total
Schenkman et al. (35), 1998	51 (27,24)	Parallel H&Y 2 to 3	Active exercises for (axial) ROM and coordinated movement incorporated in ADL	10 weeks (22.5 to 30 hr)	30	Functional axial rotation Functional reach (balance)
Toole et al. (38), 2000	11 (6,5)	Parallel H&Y 1 to 4	Active exercises for strength of knee (fitness equipment) and ankle (resistive elastic bands), and balance (pro- and retropulsion tests, balance on foam)	10 (30 hr)	30	Leg strength Balance (sway)

[a]Dropouts included.

RCT, randomized controlled trial; PT, physical therapy; E, experimental group; C, control group; VO2-max, maximum oxygen consumption; ROM, range of motion; ADL, activities of daily life; OT, occupational therapy, SW, social work; H&Y, Hoehn & Yahr; UPDRS, Unified Parkinson's Disease Rating Scale; BI, Barthel Index; FIM, Functional Independence Measure.

consciously. The fundamental problem of disturbed internal control (in particular the inability of the basal ganglia to automatically program sequential movements) is thus bypassed. Before execution, the movement should be prepared mentally. The newly learned movement sequence does not become automated, but performance remains under conscious control and can be guided by the application of cues for initiation.[29,30]

TABLE 4. *Identified level B studies (EBRO criteria) on the effectiveness of physical therapy in Parkinson's disease used for the key recommendations: NRCT of PT versus no intervention*

Reference, year of publication	No. (E,C)	Design, Hoehn & Yahr	Experimental intervention	Duration	No. of sessions	Group effect
Bridgewater and Sharpe (17), 1997	26 (13,13)	Parallel H&Y 1 to 3	Exercises for strength trunk muscles (respiration, posture) in different positions (prone, back, and on hands and knees)	12 weeks (14 hr)	24	Rotational strength trunk ADL (NUDS, HAP)
Formisano et al. (20), 1992	33 (16,17)	Parallel H&Y 2 to 3	Passive exercises for ROM, active exercises for posture, balance, coordination, gait, dexterity, and respiration	17 weeks (51 hr)	51	Gait: speed ADL (NUDS)
Nieuwboer et al. (31), 2001	33	Within-subject H&Y 2 to 3	Active home-based exercises strategies for transfers (cognitive movement strategies) and gait (visual and auditory cues)	6 weeks (9 hr)	18	ADL (PAS) Gait: step length

NRCT, nonrandomized controlled trial; PT, physical therapy; E, experimental group; C, control group; ROM, range of motion; ADL, activities of daily life; H&Y, Hoehn & Yahr; NUDS, Northwestern University Disability Scale; HAP, Human Activity Profile; PAS, Parkinson Activity Scale.

TABLE 5. *Identified level B studies (EBRO criteria) on the effectiveness of physical therapy in Parkinson's disease used for the key recommendations: RCT of PT versus placebo-controlled*

Reference, year publication	No.[a] (E,C)	Design, Hoehn & Yahr	Experimental intervention	Control intervention	Duration	No. of sessions	Group effect
Hirsch et al. (24), 2003	15 (6,9)	Parallel E: H&Y 1.9±0.6 C: H&Y 1.8±0.3	Active exercises for ankle and knee strength (fitness equipment, resistive elastic bands), and balance (pro- and retropulsion tests, balance and weight-shifting on foam)	Exercises for balance (see E)	10 weeks (22.5 hr)	30	Balance Leg strength Instrumental ADL (e.g., housekeeping)
Hurwitz (25), 1989	30 (15,15)	Parallel H&Y 1 to 3	Exercises for ROM, mobility, and self-care	Weekly assessment, no exercise	32 weeks (16 hr)	32	Memory, eating, incontinence
Kamsma et al. (26), 1995	38 (25,13)	Parallel H&Y 2 to 4	Exercises (cognitive movement strategies) for gait and transfers (e.g. rising from a chair, bed mobility)	Exercises for physical capacity and ROM	1 year (8 + 2–9 hr)	1st: 8 2nd: 2–9	ADL, physical functioning, coping; UPDRS (bed, chair mobility)
Marchese et al. (27), 2000	20 (10,10)	Parallel H&Y 1.5 to 3	Exercises for (axial) ROM, posture, and gait (visual and auditory cues)	Equal, without cues	6 weeks (18 hr)	18	UPDRS: motor
Mohr et al. (29), 1996 Muller et al. (30), 1997	41(20,21)	Parallel H&Y 1.5 to 4	Group exercises (external cues and cognitive movement strategies) for gait, transfers, and relaxation	Group exercises for respiration; Disease specific information	10 weeks (30 hr)	20	UPDRS: motor (e.g., rising from chair) Gait: initiation, postural stability Dexterity
Stallibrass et al. (36), 2002	93 (32,31/30)	Parallel H&Y unknown	Alexander technique	Manual contact to the skin and personal attention (C1); none (C2)	12 weeks (16 hr)	24	ADL (SPDDS) (versus C2) Depression (BDI) (versus C2)
Thaut et al. (37), 1996	26 (15,11/11)	Parallel H&Y mean 2.5	Gait training with weekly increased rhythm (auditory cues)	Self-paced gait training (C1); none (C2)	3 weeks (10.5 hr)	21	Gait: speed; stride length (versus C2) Cadence (versus C1)

[a]Dropouts included.

RCT, randomized controlled trial; PT, physical therapy; E, experimental group; C, control group; ROM, range of motion; ADL, activities of daily life; OT, occupational therapy, SW, social work; H&Y, Hoehn & Yahr; UPDRS, Unified Parkinson's Disease Rating Scale; BDI, Beck Depression Inventory; SPDDS, Self-assessment Parkinson's Disease Disability Scale.

III. Balance

It is plausible that balance training (where patients are taught to use visual and vestibular feedback), combined with lower limb strength training, is effective in improving balance in patients with PD, and more effective than balance exercises alone.[24,38]

IV. Physical capacity

It is plausible that an exercise program aimed at improving range of motion combined with activity-related (e.g., gait or balance) exercises, improves ADL functioning.[18,20,27,32,33] Furthermore, it is plausible that, in PD, a strength-training program increases muscle power.[17,24,36]

Additional Recommendations

A broad range of level 3 and level 4 recommendations is provided, including specific recommendations (tailored to the core areas) and more general recommendations. The patient-specific treatment goals determine which recommendations are best addressed. Examples of general recommendations are as follows: involve the partner or caretaker; recognize *on* and *off* periods; preferentially select functional exercises; avoid dual tasking; and evaluate treatment outcome every 4 weeks, to decide whether the intervention needs to be continued, adjusted, or terminated.

Format

The practice recommendations manuscript has been transformed into a formal guideline for physiotherapy in Parkinson's disease.[61] The guideline informs neurologists about the indication for referral to physical therapy, and informs therapists about possibilities and limitations of physical therapy in PD.

This guideline consists of brief practice recommendations (nine pages), a detailed review of the evidence (34 pages, excluding references and supplements), and four quick reference cards concisely describing the history taking, physical examination, instruments for baseline assessment and treatment evaluation purposes, and the disease-specific treatment strategies. Furthermore, a pa-

tient information leaflet is provided. The manuscript will be scrutinized within 5 years, and updated if necessary.

Formal Approval

The practice recommendations were formally approved and disseminated by the Royal Dutch Society for Physical Therapy as their official guideline. The full practice recommendations are available in Dutch and English (http://www.kngf.nl and http://www.cebp.nl). The Association of Physiotherapists in Parkinson's Disease Europe (APPDE, http://appde.unn.ac.uk) endorses the practice recommendations and supports their international implementation and evaluation.

Field Test

The practice recommendations were field tested for 4 months by 70 physical therapists who were not involved in the development process. In this field test, therapists thoroughly studied the practice recommendations and subsequently applied it in ongoing or newly started treatments of PD patients. Therapists completed a questionnaire on the overall comprehensibility of the practice recommendations, on the applicability in everyday clinical practice, on the feasibility of the recommended measuring instruments, and on any discrepancies between the recommendations and everyday clinical practice. Physical therapists could also provide additional comments to improve the practice recommendations. Simultaneously, a draft of the practice recommendations was evaluated in a feasibility study.[62] The Practice Recommendations Development Group discussed the collected drawbacks and strengths of the recommendations until consensus was reached.

Update of Latest Evidence

For our guideline (published in 2004), literature published until October 2003 was reviewed. We have repeated the literature search for all studies published until June 2006. Several papers have appeared since the publication of the guideline.[63–81] An analysis of these studies demonstrates that the level of evidence of the recommendations provided in our guideline is not altered by the results of these studies.

CONCLUSION AND FUTURE DIRECTIONS

Evidence-Based Health Care

There are indications that physical therapy might be effective in PD.[82] However, the evidence is inconclusive. This finding is due to the small number of patients enrolled in the studies, the methodological flaws in many studies, and the possibility of publication bias. Three systematic reviews[8–10] had reasonable quality; the others had moderate[13,14] or poor[15] quality. Furthermore, the specific physical therapy interventions that were evaluated in different studies varied widely. This finding is not surprising, because evidence-based practice guidelines were unavailable until now. An important step was made by expert physical therapists in the UK who developed a guideline of physical therapy in PD.[83] Although this guideline provides an extensive overview of the field, it was not systematically developed according to international standards for guideline development. For example, referring physicians and patients were not involved in the development process. The current practice recommendations were systematically developed according to accepted international criteria,[11,12] and are reproducible. By integrating the best available research evidence with clinical expertise and patient values, we have developed clinical practice recommendations that facilitate evidence-based health care for physical therapy in PD. These recommendations provide a firm basis for current physical therapy practice in PD, as well as for future research in this field. Our suggestion is that future research should further address the use of cues and movement strategies. For instance, we need to known for which subgroups of PD patients cues and movement strategies are most effective. In addition, we need to further clarify how cues and movement strategies might prevent freezing and falls in PD. Another research topic is the safety problems (e.g., falls) caused by executing dual tasks in relation to physiotherapy interventions. For instance, can the performance of dual tasks be trained and, if so, how? Pain and fatigue are also issues of common clinical concern. Evidence concerning physiotherapy interventions dealing with these issues is limited and should be enlarged. Finally, there is a need to evaluate how physiotherapy guidelines can be implemented effectively into everyday clinical practice. Do Parkinson patients benefit from implementation of the guideline? Future research requires appropriate methods to optimize the scientific value. An important methodological issue that needs to be addressed is the use of appropriate outcome measures with particular relevance to patients, their carers, physiotherapists, and physicians. Furthermore, prospective intervention studies should include a sufficient number of participants, and these patients need to be followed for at least 6 months to determine the duration of any improvement.

Implementation of Practice Recommendations

We have developed a multifaceted implementation strategy: creation of regional networks of expert physical therapists with specific training in PD (ParkNet), who are

offered continuous education, improved communication with referring physicians, and a PD-specific electronic patient record; quick reference referral cards are provided for referring physicians (e.g., neurologists or geriatricians). Currently, a large cluster RCT (ParkNet Trial) is performed in the Netherlands to evaluate the implementation of these practice recommendations.[84]

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APPENDIX

The following are members of the Practice Recommendations Development Group. B.R. Bloem, PhD (neurologist, RUNMC); C.J.T. de Goede, MSc (physical therapist, human movement scientist, VU University Medical Center); Ms. M. van Haaren (physical therapist, Rehabilitation Centre Breda); H.J.M. Hendriks, PhD (physical therapist, health scientist, clinical epidemiologist, Dutch Institute of Allied Health Care, Centre for Evidence Based Physiotherapy); Ms. M. Jaspers (Mensendieck exercise therapist, Fysio Ludinge); Y.P.T. Kamsma, PhD (physical therapist, human movement scientist, Center for Human Movement Sciences); Ms. S.H.J. Keus, MSc (physical therapist, human movement scientist, LUMC); M. Munneke, PhD (physical therapist, human movement scientist, clinical epidemiologist, RUNMC); Ms. J. Westra (physical therapist, Nursing home Maartenshof); and B.Y. de Wolff, MSc (Cesar exercise therapist, Medical Center De Vecht).

Members of the Review Panel (Expert Professionals) are as follows. Ms. A. Coerts (speech therapist, Spaarne Hospital); Ms. Y. van den Elzen-Pijnenburg (occupational therapist, RUNMC); AN Goudswaard, PhD (general practitioner, Dutch College of General Practitioners); J.J. van Hilten, PhD (neurologist, LUMC); Ms. D. Jones, PhD (physical therapist, Northumbria University, UK); R. Koopmans, PhD (nursing home physician, RUNMC); G. Kuijpers, MD (rehabilitation physician, Rehabilitation Centre Breda); G. Kwakkel, PhD (physical therapist, human movement scientist, VU University Medical Centre); Ms. A. Nieuwboer, PhD (physical therapist, Catholic University Leuven, Belgium); Ms. L. Rochester, PhD (physical therapist, Northumbria University, UK); K.P.M. van Spaendonck, PhD (neuro-psychologist, RUNMC); Ms. M.M. Samson, PhD (geriatrician, UMC Utrecht); J.D. Speelman, PhD (neurologist, AMC); F. Vreeling, PhD (neurologist, Maastricht University); and Ms. S. Vernooy and Ms. C. van der Bruggen-De Vries (Cesar exercise therapists, Scheper Hospital).

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