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Occupational Therapy for Stroke Patients
A Systematic Review

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Background and Purpose—Occupational therapy (OT) is an important aspect of stroke rehabilitation. The objective of this study was to determine from the available literature whether OT interventions improve outcome for stroke patients.

Methods—An extensive search in MEDLINE, CINAHL, EMBASE, AMED, and SCISEARCH was performed. Studies with controlled and uncontrolled designs were included. Seven intervention categories were distinguished and separately analyzed. If a quantitative approach (meta-analysis) of data analysis was not appropriate, a qualitative approach (best-evidence synthesis), based on the type of design, methodological quality, and significant findings of outcome and/or process measures, was performed.

Results—Thirty-two studies were included in this review, of which 18 were randomized controlled trials. Ten randomized controlled trials had a high methodological quality. For the comprehensive OT intervention, the pooled standardized mean difference for primary activities of daily living (ADL) (0.46; CI, 0.04 to 0.88), extended ADL (0.32; CI, 0.00 to 0.64), and social participation (0.33; CI, 0.03 to 0.62) favored treatment. For the training of skills intervention, some evidence for improvement in primary ADL was found. Insufficient evidence was found to indicate that the provision of splints is effective in decreasing muscle tone.

Conclusions—This review identified small but significant effect sizes for the efficacy of comprehensive OT on primary ADL, extended ADL, and social participation. These results correspond to the outcome of a systematic review of intensified rehabilitation for stroke patients. The amount of evidence with respect to specific interventions, however, is limited. More research is needed to enable evidence-based OT for stroke patients. **(*Stroke*. 2003;34:676-687.)**

Key Words: meta-analysis ■ occupational therapy ■ stroke

One year after the onset of the first stroke, physical independence (for 66% of the stroke survivors) and occupation (for 75% of the stroke survivors) are the most affected domains of handicap.[1] This necessitates the multidisciplinary rehabilitation of stroke patients, which is aimed at decreasing the consequences of the illness in daily functioning. Occupational therapy (OT) aims at facilitating task performance by improving relevant performing skills or developing and teaching compensatory strategies to overcome lost performance skills.[2] Training of self-care activities, training of leisure activities, and advice and instruction regarding assistive devices are the 3 most frequently chosen interventions for stroke patients.[3] In addition, the occupational therapist educates and shares information with the family and primary caregiver about the patient's ability to perform and about how to provide proper assistance.[4]

The efficacy of occupational therapy has been addressed in several rehabilitation reviews.[5–10] However, these reviews are narrative,[7–9] describe only a few of the available relevant studies,[6,8,10] or discuss specific topics such as the treatment of hemiplegia or the treatment of cognitive impairments like unilateral neglect.[5,10] One letter to the editor[11] presented some results of a meta-analysis in comprehensive OT on activities of daily living (ADL). The efficacy of various OT interventions has yet to have been systematically summarized. Therefore, the aim of our systematic review was to determine whether OT interventions improve outcome for stroke patients.

See Editorial Comment, page 686

Materials and Methods

An extensive search was conducted through the following resources: MEDLINE (1966 through June 2002), CINAHL (1982 through June 2002), EMBASE (1988 through March 2001), SCISEARCH (1974 through March 2001), AMED (1985 through April 2001), Cochrane Controlled Trials Register (June 2002), the Rehabilitation and Related Therapies Field (Cochrane Collaboration), the specialized trial register of the Cochrane Collaborations Stroke Group, and 2

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Dutch libraries of medical and rehabilitation literature (the Dutch National Institute Allied Health Professions and Netherlands Institute for Health Services Research).

The broad computerized search strategy was built on (1) search strategy for stroke (Stroke Group of the Cochrane Collaboration), (2) search strategy for OT interventions, (3) search strategy for controlled trials (Cochrane Collaboration), and (4) search strategy for designs other than controlled designs (ODs). The full search strategy is available on request from the corresponding author. Additionally, the reference lists of all identified studies were scanned, and corresponding authors of articles eligible for inclusion were contacted by mail to identify further studies. Inclusion of articles, which was based on the title and abstract, was performed by 2 independent reviewers (E.M.J.S., C.H.M.E.). In case of uncertainty, the full article was read. Disagreements were resolved by discussion.[12] The applied inclusion criteria were the following: (1) efficacy studies with either a controlled design or an OD such as pre/post tests and time series; (2) studies evaluating OT interventions in clinically diagnosed adult stroke patients; (3) studies on primary outcome measures, including primary ADL, extended ADL, or social participation or secondary process measures, which are measures considered to be indicators of successful treatment (arm or hand function, muscle tone, or cognitive functions such as memory and attention); and (4) full-length articles.

OT interventions either were regarded as comprehensive OT (when all 6 specific intervention categories were part of the evaluated OT treatment) or were classified into 6 specific intervention categories: (1) training of sensory-motor functions; (2) training of cognitive functions; (3) training of skills such as dressing, cooking a meal, or performing domestic activities; (4) advice and instruction in the use of assistive devices; (5) provision of splints and slings; and (6) education of family and primary caregivers. This classification is based on the International Classification of Functioning, Disability and Health.[13] A group of 4 occupational therapists (including E.M.J.S. and E.H.C.C.) and a reviewer (C.H.M.E.) reached consensus about this classification. They assessed whether the interventions evaluated in each study were regarded as OT and, if so, classified them into 1 of the intervention categories. The criteria applied were that the intervention would most likely be part of an OT treatment plan and that the treatment was aimed at enhancing occupational performance. Disagreements were resolved by discussion.

The methodological quality of all studies was independently assessed by 2 reviewers (E.M.J.S., E.H.C.C.). Disagreements were resolved by discussion. If no consensus was met, a third reviewer (C.H.M.E.) made the final decision. For randomized controlled trials (RCTs) and case-control trials (CCTs), a list of methodological criteria recommended by Van Tulder et al[12] was used. This list, containing all criteria proposed by Jadad et al[14] and Verhagen et al,[15] consists of 11 criteria for internal validity, 6 descriptive criteria, and 2 statistical criteria (Appendix 1). One modification was made regarding the specification of the eligibility criterion: The condition of interest (the impairment or disability that indicated referral to OT) was added as an eligibility criterion, as proposed by Wells et al.[16] All criteria were scored as "yes", "no," or "unclear." Studies were considered to be of high quality if at least 6 criteria for internal validity, 3 descriptive criteria, and 1 statistical criterion were scored positively.

To rate the methodological quality of the ODs, the list of Van Tulder et al[12] was adapted with regard to some items (Appendix 1). The final list consisted of 7 criteria for internal validity, 4 descriptive criteria, and 2 statistical criteria. Studies were considered to be of sufficient quality if at least 4 internal validity criteria, 2 descriptive criteria, and 1 statistical criterion were met.

Analysis of the results was performed separately for each intervention category. For continuous variables, a standardized mean difference (Hedges' g) was calculated. Means and SD were converted from medians and interquartile ranges, if necessary.[17] For dichotomous variables, odds ratios with corresponding 95% confidence intervals were computed. In cases of missing data, the first authors of the specific studies were not contacted to obtain additional information. In crossover trials without a washout period between

Best-evidence synthesis

Strong evidence:	provided by consistent, statistically significant findings in outcome measures in at least two high quality RCTs*
Moderate evidence:	provided by consistent, statistically significant findings in outcome measures in at least one high quality RCT and at least one low quality RCT or high quality CCT*
Limited evidence:	provided by statistically significant findings in outcome measures in at least one high quality RCT*
or:	provided by consistent, statistically significant findings in outcome measures in at least two high quality CCTs* (in the absence of high quality RCTs)
Indicative findings:	provided by statistically significant findings in outcome and/or process measures in at least one high quality CCT or low quality RCT* (in the absence of high quality RCTs)
or:	provided by consistent, statistically significant findings in outcome and/or process measures in at least two ODs with sufficient quality (in absence of RCTs and CCTs)*
No or insufficient evidence:	in the case that results of eligible studies do not meet the criteria for one of the above stated levels of evidence
or:	in the case of conflicting (statistically significant positive and statistically significant negative) results among RCTs and CCTs
or:	in the case of no eligible studies

Best-evidence synthesis. *If the number of studies that show evidence is <50% of the total number of studies found within the same category of methodological quality and study design (RCTs, CCTs, or ODs), we will state no evidence.

intervention phases, data after the first phase was not further analyzed. The primary analysis was focused on comparisons of an OT intervention with a no treatment control group. However, if studies compared the effect of more than the 2 intervention groups, 2 reviewers (E.M.J.S., C.H.M.E.) decided by consensus how these comparisons would be classified. In particular, if 2 interventions were compared, the predominant contrast needed to be the OT treatment provided.

For each intervention category, a decision was made as to whether to apply a quantitative (eg, meta-analysis) or qualitative (eg, best-evidence synthesis) approach for the analysis of data. The qualitative approach was considered appropriate if the included studies within 1 intervention category were clinically diverse and/or statistically heterogenous. Clinical diversity among studies was assessed by 2 reviewers (E.M.J.S., C.H.M.E.), taking into account the classification of patients (severity of the disease), interventions (duration, frequency and setting), and outcome measures (dimensions of outcome measures). Disagreements were resolved by discussion. Statistical heterogeneity was determined by the sign test. If meta-analysis was appropriate, the pooled standardized mean difference (Hedge's g effect size) was computed from a random effects model. In cases of too much diversity and/or heterogeneity, a best-evidence synthesis was applied. The best-evidence synthesis is based on that proposed by Van Tulder et al[18] and adapted for the purpose of this review by attributing the appropriate level of evidence to the efficacy of OT, taking into account the design of the studies, methodological quality, type of outcome measures, and statistical significance of the findings (the Figure). To reanalyze the results, a sensitivity analysis was performed by excluding low-quality studies.

Results

The search strategy resulted in a list of 4183 citations. After a selection based on title and abstract, 210 full articles were obtained. Sixty-two publications concerned the efficacy of OT in stroke patients, of which 36 articles, presenting 32 studies, fulfilled all inclusion criteria. Data from 5 studies were presented in >1 article.[19–28] One publication presented 2 studies.[23] Twenty-six publications presenting 25 studies evaluating the efficacy of OT were excluded because a single-subject design was used, healthy persons or patients with diseases other than stroke participated in the study, or the outcome measures were beyond the scope of our review (Appendix 2).

The methodological quality was assessed in 18 RCTs, 6 CCTs, and 8 ODs (Appendix 1). Ten RCTs had a high methodological quality. All CCTs scored low in methodological quality. One of the ODs had sufficient methodological quality. The raters disagreed on 17% of the items. Specifically, the items "allocation concealment" and "intention-to-treat analysis" were scored differently. All disagreements were resolved after discussion.

For each intervention category, results of studies that contribute to the outcome of the meta-analysis or the best-evidence synthesis are presented.

Comprehensive OT

Seven studies—6 RCTs[19,21,25,29–31] (Table 1) and 1 CCT[32]—were identified. Five RCTs[19,21,25,29,30] had a high methodological quality. Two studies[19,31] compared 2 treatment groups (1 for ADL problems, 1 for leisure problems) with a nontreated control group.

Outcome Measures

Primary ADL was measured in 5 RCTs with the Barthel Index.[21,25,29–31] One high-quality RCT[30] presented no SD and was excluded from the meta-analysis (Table 2). The pooled standardized mean difference (Hedge's g effect size) for the remaining RCTs was 0.31 (CI, 0.03 to 0.60). For extended ADL, measured with the Nottingham Extended ADL Scale, the pooled effect size of 0.20 (CI, −0.02 to 0.42) was calculated. The sensitivity analysis excluding low-quality RCTs showed changes of the pooled effect sizes of 0.46 (CI, 0.04 to 0.88) and 0.32 (CI, 0.00 to 0.64), respectively. Social participation was measured in all RCTs. Two studies[29,30] presented inappropriate data and were excluded from pooling. The effect size for the remaining RCTs was 0.18 (CI, −0.03 to 0.40). When only the high-quality studies were pooled, the effect size changed to 0.33 (CI, 0.03 to 0.62). No process measures were assessed.

Thus, the pooled high-quality studies show small[33] but significant effect sizes on primary ADL, extended ADL, and social participation. A trend favoring comprehensive OT remains when the low-quality studies are incorporated into the meta-analysis.

Training of Sensory-Motor Functions

Three diverse high-methodological-quality RCTs[27,34,35] (Table 1), 1 CCT,[36] and 1 OD[37] focused on the training of sensory-motor functions intervention. The outcome measures primary ADL, extended ADL, and social participation[27,35] showed nonsignificant results (Table 2). Two RCTs[27,34] reported nonsignificant results for the arm and hand function process measure (Table 3).

Thus, no evidence has been found for the efficacy of training of sensory-motor function on primary ADL, extended ADL, social participation, and arm and hand function.

Training of Cognitive Functions

Four low-methodological-quality studies (1 RCT [Table 1], 2 CCTs, 1 OD) evaluated the efficacy of training of visual scanning and visual-spatial ability.[23,24,38,39] The RCT[24] measured the primary ADL outcome measure and showed nonsignificant results; however, the study presented positive significant results on the visual scanning and visual-spatial ability process measures.

Thus, no evidence is found for the efficacy of visual perception training on primary ADL. There are indicative findings that visual scanning and visual-spatial ability improve after treatment.

Training of Skills

Eight studies[40–47] (3 RCTs [Table 1], 1 CCT, 4 ODs) evaluating training of skills and activities focused on strategy training (eg, learn to compensate for impairments) to overcome limitations in the performance of activities resulting from cognitive dysfunctions. Additionally, 1 RCT[48] (Table 1), excluded from further analysis because of missing data, evaluated a particular dressing practice. One RCT[40] had a high methodological quality.

Outcome Measures

The high-quality RCT[40] presented significant results on primary ADL, whereas the low-quality RCT[47] showed significant results on extended ADL (Table 2).

Process Measures

Two studies[40,46] evaluated arm-hand function. The high-quality RCT[40] reported nonsignificant results. Cognitive functions were evaluated in all studies. The low-quality RCT[43] showed an increase in cognitive functions such as memory, verbal function, and visual-spatial ability (Table 3).

Thus, limited evidence is found for the efficacy of strategy training on primary ADL. No evidence is found for extended ADL, cognitive functions, and arm-hand function.

One low-quality RCT[49] compared training of cognitive functions with strategy training and presented no significant difference between treatments on Barthel Index, extended ADL, cognitive functions, and arm-hand function.

Advice and Instruction Regarding Assistive Devices

One high-quality RCT[50] (Table 1) evaluated whether encouragement of wheelchair propulsion would lead to better functional ability and well-being. No significant results were found. Thus, there is no evidence that training of wheelchair propulsion in acute stroke increases functional ability and well-being.

Provision of Splints

Five studies (2 RCTs[51,52] [Table 1], 2 CCTs,[53,54] 1 OD[55]) evaluated splinting on the muscle tone[51–55] process measures. All studies were of low methodological quality. None of the studies presented significant results of these measures (Table 3). Thus, there is insufficient evidence that splinting is effective for decreasing muscle tone.

Education of Family or Primary Caregiver

No OT studies focusing on this intervention were identified.

TABLE 1. Characteristics of Included RCTs

First Author (ref)	No. of Participants	Methods	Inclusion Criteria	Intervention	Outcome Measures	Duration of Intervention
Comprehensive OT						
Corr[29]	110	RCT	Discharged alive from stroke unit following acute stroke	I: individual OT treatment* R: no treatment Home service	Barthel Index NEADL Pearlman's quality of life scale	No information available
Drummond[19]	65	RCT	Independent living, discharged alive from stroke unit following acute stroke	I1: OT for leisure activities I2: conventional OT, ADL R: no additional input Home service	NEADL; leisure and mobility domain Nottingham health profile	I: 30 min 1× wk for 3 mo then: 30 min 1× 2 wks for 3 mo
Gilbertson[21]	138	RCT	CVA, referral to OT, severe cognitive and communication problems excluded	I: individual client centered OT treatment* at home R: inpatient multidisciplinary rehabilitation + follow-up	Barthel Index NEADL London Handicap Scale	I: 10 × 30–45 min, 6 wks R: 1 home visit predischarge
Logan[30]	111	RCT	First stroke, referral to social service OT	I: enhanced OT service* R: routine OT Home service	Barthel Index NEADL General Health Questionnaire	I: 6 visits R: 2.5 visit
Parker[31]	466	RCT	Independent living stroke patients, no dementia, stroke ≥6 mo first visit clinic	I1: OT for leisure activities I2: OT for ADL R: no treatment Home service	Barthel Index NEADL Nottingham Leisure Questions London Handicap Scale	I: 10 × 30 min
Walker[25]	185	RCT	<1 mo clinically diagnosed stroke, no hospital admission	I: individual OT treatment* at home R: no OT treatment, normal home service available	Barthel Index NEADL London Handicap Scale	I: on average 5.8 × 52 min
Training of sensory-motor function						
Feys[34]	100	RCT	First stroke, admission to hospital, motor deficit, sit independently	I: sitting in rocking chair, actively rocking with hemiplegic site R: sitting in rocking chair, hemiplegic site in rest Inpatients	Barthel Index Action Research Arm Test	30 min, 5 d for 6 wks
Jongbloed[35]	90	RCT	First CVA, admitted to hospital <12 weeks after onset, hemiplegia	I: OT treatment functional approach R: OT treatment sensory-motor Inpatients	Barthel Index Meal preparation test	40 min 5 d/wk, 8 wks
Kwakkel[27]	101	RCT	Primary first stroke in middle cerebral artery	I: OT arm-rehabilitation group R: immobilization of hemiplegic site Inpatients	Barthel Index Sickness impact profile Action Research Arm test	30 min 5 d/wk, 20 wks
Training of cognitive functions						
Carter[24]	33	RCT	Admission to hospital with acute stroke	I: cognitive skill remediation training R: no treatment	Barthel Index Cognitive skills (visual scanning + spatial time)	30–40 min 3 d/wk, 3–4 wks
Training of skills						
Donkervoort[40]	113	RCT	Left hemisphere stroke >4 wks <2 y, apraxia, age >24 <95, no brain damage	I: apraxia strategy training R: conventional OT Inpatients	Barthel Index ADL observation Functional motor test Apraxia test	I: 15 h in 25 session R: 19 h in 27 sessions

TABLE 1. Continued

First Author (ref)	No. of Participants	Methods	Inclusion Criteria	Intervention	Outcome Measures	Duration of Intervention
Söderback[43]	67	RCT	Acute acquired stroke, age >17 <65, in need of regular rehabilitation program	I1: Intellectual function training I2: Intellectual housework training I3: I1+I2+R R: no treatment Inpatients†	Intellectual function assessment Intellectual housework assessment	I1: 37 × 1 h I2: 16 × 2.5 h I3: 14 × 1 h, 8 × 2.5 h
Walker[48]	30	RCT crossover	Stroke, discharged from hospital, no dementia	I: dressing practice R: no treatment Home service	Nottingham dressing assessment Rivermead ADL Nottingham health profile	8 visits in 3 mo
Weinberg[47]	57	RCT	> 4 weeks after first stroke, no organic mental syndrome	I: strategy training R: no treatment Inpatients	Copying task	I: 1 h, 5 d, 4 wks
Training of cognitive functions versus training of skills						
Edmans[49]	80	RCT	Stroke, perceptual deficit + assessable and treatable	I1: transfer of training approach I2: functional approach Inpatients	Barthel Index Edmans ADL Rivermead perceptual assessment Rivermead motor assessment	2.5 h for 6 wks Additional to OT treatment
Advice/instruction regarding assistive devices						
Barrett[50]	40	RCT	Acute stroke, wheelchair dependent at start, no severe neglect or aphasia	I1: Encouraged wheelchair propulsion R: discouraged wheelchair propulsion	Barthel Index NEADL General health questionnaire	I: 1e week daily practice, 7 wks 1 session R: no treatment
Provision of splints						
Langlois[51]	9	RCT	Stroke <12 mo, spastic hemiplegia, stable condition	I1: 6 h finger spreader splint I2: 12 h finger spreader splint I3: 22 h finger spreader splint	Spasticity: torque motion analyzer	Each day, 4 wks
Rose[52]	30	RCT	Stroke <6 mo, spastic wrist flexor	I1: statistic dorsal splint I2: statistic volar splint R: no splint	Spasticity: angle point of stretch reflex	2 h

RCT indicates randomized clinical trial; CCT, controlled clinical trial; I, intervention group; R, reference group; OT, occupational therapy; NEADL, Nottingham Extended Activities of Daily Living scale; ADL, activities of daily living.

*Occupational therapy treatment; teaching new skills, facilitating independence in ADL and return of function, enabling use of equipment, counseling of patient and caretaker.

†All groups received regular rehabilitation program.

Discussion

This systematic review explored the efficacy of several OT interventions for stroke. Seven intervention categories were separately analyzed for the primary outcome measures of primary ADL, extended ADL, and social participation and the secondary process measures of arm and hand function, muscle tone, and cognitive functions. This review established for comprehensive OT small but significant effect sizes on primary ADL, extended ADL, and social participation. The magnitudes of these effect sizes correspond to the results of a systematic review of intensified rehabilitation for stroke patients. Kwakkel et al[56] presented a small significant effect size on ADL. Within the specific intervention categories, quantitative pooling of data was not appropriate for analyzing results. Instead, we applied a qualitative best-evidence synthesis. For the training of skills category, limited evidence for improving primary ADL was found. The training of cognitive functions category revealed indicative findings for efficacy in visual perception skills. Insufficient evidence was found to indicate that the provision of splints is effective in decreasing muscle tone.

The results of comprehensive OT on ADL support the conclusions presented by Langhorne et al.[11] In their letter to the editor regarding the results of a meta-analysis of comprehensive OT, data on extended and primary ADL scores were pooled and showed a positive significant effect size favoring OT. However, in our view, primary ADL (eg, self-care and basic mobility skills) and extended ADL (eg, domestic and leisure skills) are 2 distinct dimensions of functional ability. Therefore, they were

TABLE 2. Effects of OT on Primary ADL (Barthel Index), Extended ADL, and Social Participation

Reference (n)	Method Quality	Barthel Index Mean (SD) Baseline	Barthel Index SMD* [CI]	EADL Mean (SD) Baseline	EADL SMD* [CI]	Participation Mean (SD) Baseline	Participation SMD* [CI]
Comprehensive OT							
Corr[29] (110)	High	I: 15 (13.3) R: 14 (7.4)	0.19† [−0.23;0.60]	NR	NS	NR	0.82‡ [0.34;1.98]
Drummond[19] (44), ADL group	High	. . .	. . .	NR	Mobility: −0.24 [−0.85;0.38]	I: 39.6 (18.4) R: 30.9 (25.6)	−0.08 [−0.69; 0.53]
Drummond[19] (44), Leisure group	High	. . .	. . .	NR	Leisure: 0.57 [−0.05;1.19]	I: 29.5 (24.9) R: 30.9 (25.6)	0.86 [0.22; 1.49]
Gilbertson[21] (138)	High	I: 17 (2,2) R: 18 (2,2)	0.30† [-0.04;0.64]	NR	0.23† [−0.12;0.57]	NR	0.18† [−0.16;0.52]
Logan[30] (111)	High	NR	NS	NR	NE, $P<0.01$	NR	NS
Parker[31] (310), Leisure group	Low	I: 18 (3.0) R: 18 (3.0)	0.00† [−0.22;0.22]	NR	0.01 [−0.24;0.26]	NR	0.06 [−0.19;0.31]
Parker[31] (313), ADL group	Low	I: 18 (3.0) R: 18 (3.0)	0.27† [0.05;0.49]	NR	0.09 [−0.16;0.34]	NR	−0.04 [−0.29;0.20]
Walker[25] (185)	High	I: 18 (3.7) R: 18 (3.7)	0.86† [0.54;1.18]	I: 10 (6.7) R: 11 (9.6)	0.57† [0.26;0.88]	NR	0.44† [0.13;0.75]
Pooled effect size high quality studies			0.46 [0.04;0.88]		0.32 [0.00;0.64]		0.33 [0.03;0.62]
Training of sensory-motor function							
Jongbloed[35] (90)	High	NR	NS	NR	NS	. . .	. . .
Kwakkel[27] (70)	High	I: 5.0 (2.0) R: 5.5 (2.0)	0.18† [−0.29;0.65]	I: 26.5 (6.1) R: 26.8 (6.8)	0.34 [−0.14;0.81]	I: 38.6 (10.9) R: 41.2 (11.7)	0.27 [−0.20;0.74]
Training of cognitive functions							
Carter[24] (33)	Low	NR	0.60 [−0.10;1,30]	. . .	. . .	. . .	. . .
Training of skills							
Donkervoort[40] (113)	High	I: 10.7 (4.9) R: 11.2 (5.0)	0.46 [0.05;0.87]	I: 2.2 (0.5) R: 2.3 (0.4)	0.34 [−0.09;0.78]	. . .	. . .
Weinberg[47] (57)	Low	. . .	. . .	I: 39.3(18.1) R: 31.6 (10.9)	2.29 [1.26;3.32]	. . .	. . .
Training of cognitive functions vs training of skills							
Edmans[49] (80)	Low	I: 9.0 (2.1) R: 9.0 (2.1)	0.32† [−0.12;0.76]	I: 28.5 (9.1) R: 29.0 (8.4)	0.35† [−0.09;0.79]	. . .	. . .
Advice/instruction regarding assistive devices							
Barrett[50] (40)	High	I: 7.4 (1.9) R: 7.0 (2.5)	0.35 [−0.27;0.98]	NR	0.11 [−0.51;0.73]	NR	0.37 [−0.25;1.00]

ADL indicates activities of daily living; ADL group, activities of daily living training given; leisure group, leisure training given; SMD, standardized mean difference; *measurement after ending therapy; [CI], 95% confidence interval; I, intervention group; R, reference group; RCT, randomized clinical trial; CCT, controlled clinical trial; NR, not reported; NE, not estimable; NS, not significant; †effect size calculated with median and converted SD from interquartile range; ‡odds ratio; . . . , not assessed.

analyzed separately in this systematic review. The effect sizes for both primary and extended ADL show a small significant effect size for OT treatment, which is encouraging.

One third of the identified studies had a high methodological quality. The 10 high-quality RCTs covered mainly 2 intervention categories, namely comprehensive OT and training of sensory-motor functions. Consequently, evidence for the efficacy of some categories of OT interventions such as training of cognitive functions (0 high-quality trials), training of skills (1 high-quality RCT), advice and instruction regarding assistive devices (1 high-quality RCT), and provision of splints (0 high-quality trials) is lacking. Furthermore, no OT studies were identified for the widely applied intervention category of instruction of family or primary caregiver. Thus, there is an urgent need for more high-methodological-quality efficacy trials evaluating these categories of OT interventions.

Surprisingly, 8 of 9 studies in the training of skills intervention category evaluated strategy training to reduce the conse-

TABLE 3. Effects of OT in Stroke on Arm-Hand Function, Tonus, and Cognitive Functions

Reference (n)	Method Quality	Arm-Hand Function		Tonus		Cognitive Function	
		Mean (SD) Baseline	SMD* [CI]	Mean (SD) Baseline	SMD* [CI]	Mean (SD) Baseline	SMD* [CI]
Training of sensory-motor function							
Feys[34] (100)	High	NR	NS	...	...	...	...
Kwakkel[27] (70)	High	I: 0.0 (0.5) R: 0.5 (0.0)	0.45† [−0.02;0.93]	...	...	...	...
Training of cognitive functions							
Carter[24] (33)	Low	...	...	...	...	NR	1.81 [1.00;2.63]
Training of skills							
Donkervoort[40] (113)	High	I: 6.5 (3.9) R: 5.3 (3.5)	0.18 [−0.23;0.58]	...	...	I: 57.3 (21.2) R: 62.0 (17.9)	0.19 [−0.22;0.60]
Söderback[43] (67)	Low	...	...	...	...	NR	NE, P=0.09
Training of cognitive functions versus training of skills							
Edmans[49] (80)	Low	I: 1.0 (0.7) R: 1.0 (1.4)	NS	...	...	I: 100.5 (51.3) R: 99.9 (34.5)	−0.11† [−0.55;0.33]
Splints							
Langlois[51] (9)	Low	...	...	I: 0.6 (0.5) R: 0.5 (0.3)	0.92 [−0.80;2,65]	...	...
Rose[52] (30)	low	...	...	NR	NS	...	...

SMD indicates standardized mean difference; *measurement after ending therapy; [CI], 95% confidence interval; I, intervention group; R, reference group; †effect size calculated with median and converted SD from interquartile range; RCT, randomized clinical trial; CCT, controlled clinical trial; NR, not reported; NE, not estimable; NS, not significant; . . ., not assessed.

quences of cognitive impairments such as visual-spatial neglect and apraxia in the performance of ADL. It reflects the interest of occupational therapists in a functional approach to the treatment of stroke patients with cognitive impairments. However, the efficacy of strategy training as part of OT is based on only 1 high-quality RCT. So, although strategy training is advocated in the literature[57,58] as a preferable approach, the evidence for the efficacy of this approach is very limited.

A major problem in summarizing the efficacy of OT is the variability in interventions applied between OT settings and between countries. OT is part of the multidisciplinary rehabilitation of stroke patients and functions in collaboration with all the other involved healthcare professions. It is likely that within settings and countries different choices are made regarding treatment approaches. To deal with this diversity, a pragmatic classification of OT interventions was made in collaboration with 3 internationally oriented occupational therapists. Furthermore, because of the variety, we considered the use of a qualitative best-evidence synthesis to analyze the results highly appropriate.

The qualitative levels-of-evidence approach was used to analyze the results of diverse and heterogenous studies if a quantitative meta-analysis was not appropriate. This approach has been criticized because conclusions of reviews using this approach are essentially based on arbitrary criteria.[59] However, in the present review, both qualitative and quantitative approaches of analysis can be compared. If we apply the best-evidence synthesis to the pooled outcomes in our review, the result would be no evidence for the efficacy of comprehensive OT on primary and extended ADL because <50% of the included studies presented statistically significant effect sizes. Results of the best-evidence synthesis regarding social participation would confirm the results of the meta-analysis. So, this comparison of qualitative and quantitative approaches shows that our best-evidence synthesis seems to be a strict one. Furthermore, meta-analysis may be flawed by the need to convert data recorded as median scores and interquartile ranges into means and SD. Additionally, in our review, several studies did not report the data necessary for computing the standardized mean differences and were excluded from pooling procedures. Therefore, both approaches of analysis have limitations, but the use of a levels-of-evidence approach seems justified when pooling is not appropriate or severely hampered.

In conclusion, the positive results for comprehensive OT on primary ADL, extended ADL, and social participation endorse the importance of OT as part of the multidisciplinary rehabilitation of stroke patients. The amount of evidence with respect to specific interventions, however, is lacking. More research is needed to enable evidence-based OT for stroke patients.

Appendix 1: Fulfilled Items of Methodological Quality Plus Quality Criteria for Randomized Controlled Trials, Case-Control Trials, and Controlled Designs

First Author	Design	Internal Validity	Descriptive	Statistic	MQ
Comprehensive OT					
Corr[29]	RCT	b1, b2, j, l, n, p	a, c, d, m2	o, q	+
Drummond[19]	RCT	b1, b2, i, j, l, n, p	a, d, m1, m2	o, q	+
Gilbertson[21]	RCT	b1, b2, i, j, l, n, p	a, m1, m2	o, q	+
Logan[30]	RCT	b1, b2, i, j, n, p	a, m1, m2	o, q	+
Parker[31]	RCT	b1, b2, i, j, l, n, p	d, m2	o, q	−
Walker[25]	RCT	b1, b2, g, i, j, l, n, p	a, c, m2	o, q	+
Gibson[32]	OD	j, p	a, d, m1	o, q	−
Training of sensory-motor function					
Feys[34]	RCT	b1, h, i, j, l, n	a, d, k, m1, m2	o	+
Jongbloed[35]	RCT	b1, f, h, i, j, n	a, c, d, m1	o	+
Kwakkel[27]	RCT	b1, f, g, i, j, l, n, p	a, c, d, k, m1, m2	o, q	+
Turton[36]	CCT	p	a, m1	o	−
Whitall[37]	OD	g, j, l, n	a, d, m1	o	+
Training of cognitive functions					
Carter[24]	RCT	b1, i, j, n	c, d, m1	o	−
Gordon[38]	CCT	−	a, d, m1	q	−
Young [39]	CCT	f, i, n	a, c, d, m1	o, q	−
Carter[23]	OD	j	d, m1	o, q	−
Training of skills					
Donkervoort[40]	RCT	b1, b2, f, i, j, l, n, p	a, d, m1	o, q	+
Söderback[43]	RCT	b1	a, d, m1	o	−
Walker[48]	RCT	b1, i, j, n	a, c, d, m1, m2	o, q	−
Weinberg[47]	RCT	b1, j, p	c, m1	o, q	−
Tham [44]	CCT	g, l, n, p	a, c, d, m1	o, q	−
Goldenberg [41]	OD	i, j, p	a, d, m1	o	−
Goldenberg [42]	OD	j, l, n	a, d, m1	o	−
Thomas [45]	OD	g, j, n	d, m1	o, q	−
Van Heugten [46]	OD	i, j, n	a, d, m1	o, q	−
Training of cognitive function versus training of skills					
Edmans[49]	RCT	b1, g, i, j, l, n, p	a, m1	o, q	−
Advice/instruction regarding assistive devices					
Barrett[50]	RCT	b1, b2, i, j, l, n, p	a, c, d, k, m1, m2	q	+
Provision of splints					
Langlois[51]	RCT	b1, f, n	a, d, m1	o	−
Rose[52]	RCT	b1, g, n, p	a, d, m1	−	−
McPherson [53]	CCT	i, n, p	a, c, d, m1	o	−
Poole[54]	CCT	f, i, j, n, p	a, d, m1	o, q	−
Gracies [55]	OD	n	a, d, k, m1	o, q	−

MQ indicates methodological quality; +, high methodological quality; −, low methodological quality.

a indicates eligibility criteria; b1, method of randomization; b2, treatment allocation concealed; c, groups similar at baseline; d, index and control interventions described; e, care provider blinded; f, co-interventions avoided/comparable?; g, compliance acceptable; h, patient blinded; I, outcome assessor blinded; j, outcome measures relevant; k, adverse effects described; l, withdrawal/dropout rate described and acceptable; m1, short-term follow-up measurement; m2, long-term follow-up measurement; n, timing outcome assessment comparable; o, sample size for each group; p, intention-to-treat analysis; q, point estimates and measures of variability presented. Criteria b1, b2, c, e, and h were not scored for ODs.

Appendix 2: Excluded Studies With the Reason for Exclusion

Reference	Design and/or Other Reason for Exclusion
Borst and Pete[1]	Single subject design
Cermak et al[2]	Single subject design
Dirette and Hinojosa[3]	Single subject design, outcome measures not included in review
Edmans and Lincoln[4]	Single subject design
Johnson and Schkade[5]	Single subject design
Paul[6]	Single subject design
Paul[7]	Single subject design
Schreiber et al[8]	Single subject design
Söderback et al[9]	Single subject design
Stern[10]	Single subject design
Tham et al[11]	Single subject design
Wagenaar et al[12]	Single subject design
Wu et al[13]	Single subject design
Charait[14]	Outcome measure not included in review
Giudice[15]	Participants with CVA and other diseases, outcome measures not included in review
Hass et al[16]	Outcome measures not included in review
Jongbloed,[17] Jongbloed and Morgan[18]	Outcome measures not included in review
Kaplan[19]	Participants with CVA and other diseases, outcome measure not included in review
Lavelle and Tomlin[20]	Outcome measures not included in review
Mathiowetz et al[21]	Outcome measures not included in review
McPherson et al[22]	Participants with CVA and other diseases
Platz et al[23]	Participants with CVA and other diseases
Poole[24]	Participants with CVA and apraxia, CVA without apraxia and well healthy persons
Schemm and Gitlin[25]	Outcome measures not included in review
Trombly and Quintana[26]	Outcome measures not included in review

1. Borst, MJ, Pete CQ. Overcoming topographical orientation deficits in an elderly woman with a right cerebrovascular accident. *Am J Occup Ther*. 1992;47:551–554.
2. Cermak SA, Trombly CA, Hausser J, Tiernan AM. Effects of lateralized tasks on unilateral neglect after right cerebral vascular accident. *Occup Ther J Res*. 1991;11:271–291.
3. Dirette D, Hinojosa J. Effects of continuous passive motion on the edematous hands of two persons with flaccid hemiplegia. *Am J Occup Ther*. 1994;48;403–409.
4. Edmans JA, Lincoln NB. Treatment of visual perceptual deficits after stroke: single case studies on four patients with right hemiplegia. *Br J Occup Ther*. 1991;54:139–144.
5. Johnson JA, Schkade JK. Effects of an occupation-based intervention on mobility problems following a cerebrovascular accident. *J Appl Gerontol*. 2001;20:91–110.
6. Paul S. Effects of computer assisted visual scanning training in the treatment of visual neglect: three case studies. *Phys Occup Ther Geriatr*. 1996;14:33–44.
7. Paul S. The effects of video assisted feedback on a scanning kitchen task in individuals with left visual neglect. *Can J Occup Ther*. 1997;64:63–69.
8. Schreiber J, Sober L, Banta L, Glassbrenner L, Haman J, Mistry N, et al. Application of motor learning principles with stroke survivors. *Occup Ther Health Care*. 2000;13:23–44.
9. Söderback I, Bengtsson I, Ginsburg E, Ekholm. Video feedback in occupational therapy: its effect in patients with neglect syndrome. *Arch Phys Med Rehabil*. 1992;73:1140–1146.
10. Stern HI. A preliminary study using a daily living task to assess upper limb function: a single case study of upper limb hemiparesis. *Br J Occup Ther*. 1994;57:294–296.
11. Tham K, Ginsburg E, Fisher AG, Tegnér R. Training to improve awareness of disabilities in clients with unilateral neglect. *Am J Occup Ther*. 2001;55:46–54.
12. Wagenaar RC, Van Wieringen PC, Netelenbos JB, Meijer OG, Kuik DJ. The transfer of scanning training effects in visual inattention after stroke: five single-case studies. *Disabil Rehabil*. 1992;14:51–60.
13. Wu SH, Huang HT, Lin CF, Chen MH. Effects of a program on symmetrical posture in patients with hemiplegia: a single-subject design. *Am J Occup Ther*. 1996;50:17–23.
14. Charait SE. A comparison of volar and dorsal splinting of the hemiplegic hand. *Am J Occup Ther*. 1968;22:319–321.
15. Giudice ML. Effects of continuous passive motion and elevation on hand edema. *Am J Occup Ther*. 1990;44:914–921.
16. Hass U, FredenKarlsson I, Persson J. Assistive technologies in stroke rehabilitation from a user perspective. *Scand J Caring Sci*. 1996;10:75–80.
17. Jongbloed L, Morgan D. An investigation of involvement in leisure activities after a stroke. *Am J Occup Ther*. 1991;45:420–427.
18. Jongbloed L. Evaluating the efficacy of OT intervention related to leisure activities. *Can J Rehabil*. 1993;7:19–20.
19. Kaplan N. Effect of splinting on reflex inhibition and sensorimotor stimulation in treatment of spasticity. *Arch Phys Med Rehabil*. 1962;43:565–569.
20. Lavelle P, Tomlin GS. Occupational therapy goal achievement for persons with post acute cerebrovascular accident in an on-campus student clinic. *Am J Occup Ther*. 2001;55:36–42.
21. Mathiowetz V, Bolding DJ, Trombly CA. Immediate effects of positioning devices on the normal and spastic hand measured by electromyography. *Am J Occup Ther*. 1983;37:247–254.

22. McPherson JJ, Kreimeyer D, Aalderks M, Gallagher T. A comparison of dorsal and volar resting hand splints in the reduction of hypertonus. *Am J Occup Ther*. 1982;36:664–670.
23. Platz T, Winter T, Müller N, Pinkowski C, Eickhof C, Mauritz KH. Arm ability training for stroke and traumatic brain injury patients with mild arm paresis: a single blind, randomized, controlled trial. *Arch Phys Med Rehabil*. 2001;82:961–968.
24. Poole JL. Effect of apraxia on the ability to learn one-handed shoe tying. *Occup Ther J Res*. 1998;18:99–104.
25. Schemm RL, Gitlin LN. How occupational therapists teach older patients to use bathing and dressing devices in rehabilitation. *Am J Occup Ther*. 1998;52:276–282.
26. Trombly C, Quintana LA. The effects of exercise on finger extension of CVA patients. *Am J Occup Ther*. 1983;37:195–202.

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References

1. Sturm JW, Dewey HM, Donnan GA, Macdonell RAL, McNeil JJ, Thrift AG. Handicap after stroke: how does it relate to disability, perception of recovery, and stroke subtype. *Stroke*. 2002;33:762–768.
2. Gillen G, Burkhardt A, eds. *Stroke Rehabilitation: A Function Based Approach*. St Louis, Mo: Mosby Co; 1998.
3. Driessen MJ, Dekker J, Lankhorst GJ, Van der Zee J. Occupational therapy for patients with chronic diseases: CVA, rheumatoid arthritis and progressive diseases of the central nervous system. *Disabil Rehabil*. 1997;19:198–204.
4. Tomlinson JL. Helping the family support the patient. In: Gillen G, Burkhardt A, eds. *Stroke Rehabilitation: A Function Based Approach*. St Louis, Mo: Mosby Co; 1998:512–518.
5. Cicerone KD, Dahlberg C, Kalmar K, Langenbahn DM, Malec JF, Bergquist TF, et al. Evidence based cognitive rehabilitation: Recommendations for clinical practice. *Arch Phys Med Rehabil*. 2000;81:1596–1615.
6. De Pedro-Cuesta J, Widen-Holmqvist L, Bach-y-Rita P. Evaluation of stroke rehabilitation by randomized controlled studies: a review. *Acta Neurol Scand*. 1992;86:433–439.
7. Dombovy ML, Sandok BA, Basford JR. Rehabilitation for stroke: a review. *Stroke*. 1986;17:363–369.
8. Lind K. A synthesis of studies on stroke rehabilitation. *J Chron Dis*. 1982;35:133–249.
9. Rice-Oxley M, Turner-Stokes L. Effectiveness of brain injury rehabilitation. *Clin Rehabil*. 1999;13(suppl):7–24.
10. Wagenaar RC, Meijer OG. Effects of stroke rehabilitation, 1: a critical review of the literature. *J Rehabil Sci*. 1991;4:61–73.
11. Langhorne P, Legg L. Therapy for stroke patients living at home. *Lancet*. 1999;354:1730–1731.
12. Tulder van MW, Assendelft WJJ, Koes BW, Bouter LM. Method guidelines for systematic reviews in the Cochrane Collaboration Back Review Group for Spinal Disorders. *Spine*. 1997;22:2323–2330.
13. *International Classification of Functioning, Disability and Health*. Geneva, Switzerland: World Health Organization; 2001.
14. Jadad AR, Moore RA, Tugwell P. Assessing the quality of randomized controlled trials. *Int J Technol Assess Health Care*. 1996;12:195–208.
15. Verhagen AP, Vet de HCW, Bie de RA, Kessels AG, Boers M, Bouter LM, et al. The Delphi list: a criteria list for quality assessment of randomised clinical trials for conducting systematic reviews developed by Delphi consensus. *J Clin Epidemiol*. 1998;51:1235–1241.
16. Wells GA, Shea B, O'Connell D, Peterson J, Welch V, Tugwell P, The Newcastle-Ottawa Scale (NOS) for assessing the quality of non-randomised studies in meta-analyses. Third Symposium on Systematic Reviews. Available at: www.lri.ca. Accessed 2000.
17. The MathWorks. http://www.mathworks.com/access/helpdesk/help/toolbox/stats/iqr.shtml. Accessed March 19, 2002.
18. Tulder van MW, Cherkin DC, Berman B, Lao L, Koes BW. *Acupuncture for Low Back Pain*. Oxford, UK: Cochrane Library, issue 1, 2003. Oxford: Update Software.
19. Drummond AER, Walker MF. A randomized controlled trial of leisure rehabilitation after stroke. *Clin Rehabil*. 1995;9:283–290.
20. Drummond A, Walker M. Generalisation of the effects of leisure rehabilitation for stroke patients. *Br J Occup Ther*. 1996;59:330–334.
21. Gilbertson L, Langhorne P, Walker A, Allen A, Murray GD. Domiciliary occupational therapy for patients with stroke discharged from hospital: randomised controlled trial. *BMJ*. 2000;320:603–606.
22. Gilbertson L, Langhorne P. Home-based occupational therapy: stroke patients' satisfaction with occupational performance and service provision. *Br J Occup Ther*. 2000;63:464–468.
23. Carter LT, Oliveira DO, Duponte J, Lynch SV. The relationship of cognitive skills performance to activities of daily living in stroke patients. *Am J Occup Ther*. 1988;42:449–455.
24. Carter LT, Howard BE, O'Neil WA. Effectiveness of cognitive skill remediation in acute stroke patients. *Am J Occup Ther*. 1983;37:320–326.
25. Walker MF, Gladman JRF, Lincoln NB, Siemonsma P, Whiteley T. Occupational therapy for stroke patients not admitted to hospital: a randomised controlled trial. *Lancet*. 1999;354:278–280.
26. Walker MF, Hawkins K, Gladman JR, Lincoln NB. Randomised controlled trial of occupational therapy at home: results at 1 year. *J Neurol Neurosurg Psychiatry*. 2001;70:267.
27. Kwakkel G, Wagenaar RC, Twisk JWR, Lankhorst GJ, Koetsier JC. Intensity of leg and arm training after primary middle-cerebral-artery stroke: a randomised trial. *Lancet*. 1999;354:191–196.
28. Kwakkel G, Kollen BJ, Wagenaar RC. Long term effects of intensity of upper and lower limb training after stroke: a randomised trial. *J Neurol Neurosurg Psychiatry*. 2002;72:473–479.
29. Corr S, Bayer A. Occupational therapy for stroke patients after hospital discharge: a randomized controlled trial. *Clin Rehabil*. 1995;9:291–296.
30. Logan PA, Ahern J, Gladman JRF, Lincoln NB. A randomized controlled trial of enhanced social service occupational therapy for stroke patients. *Clin Rehabil*. 1997;11:107–113.
31. Parker CJ, Gladman JRF, Drummond AER, Dewey ME, Lincoln NB, Barer D, et al. A multicenter randomized controlled trial of leisure therapy and conventional occupational therapy after stroke. *Clin Rehabil*. 2001;15:42–52.
32. Gibson JW, Schkade JK. Occupational adaptation intervention with patients with cerebrovascular accident: a clinical study. *Am J Occup Ther*. 1997;51:523–529.
33. Cohen J. *Statistical Power Analysis for the Behavioral Sciences*. 2nd ed. Hillsdale, NJ: Lawrence Erlbaum Associates; 1988.
34. Feys HM, De Weerdt WJ, Selz BE, Cox-Steck GA, Spichiger R, Vereeck LE, et al. Effect of a therapeutic intervention for the hemiplegic upper limb in the acute phase of stroke. *Stroke*. 1998;29:785–792.
35. Jongbloed L, Stacey S, Brighton C. Stroke rehabilitation: sensorimotor integrative treatment versus functional treatment. *Am J Occup Ther*. 1989;43:391–397.
36. Turton A, Fraser C. The use of home therapy programmes for improving recovery of the upper limb following stroke. *Br J Occup Ther*. 1990;53:457–462.
37. Whitall J, McCombe WS, Silver KH, Macko RF. Repetitive bilateral arm training with rhythmic auditory cueing improve motor function in chronic hemiparetic stroke. *Stroke*. 2000;31:2390–2395.
38. Gordon WA, Hibbard MR, Egelko S, Diller L, Shaver MS, Lieberman A, et al. Perceptual remediation in patients with right brain damage: a comprehensive program. *Arch Phys Med Rehabil*. 1985;66:353–359.
39. Young GC, Collins D, Hren M. Effect of pairing scanning training with block design training in the remediation of perceptual problems in left hemiplegics. *J Clin Neuropsychol*. 1983;5:201–212.
40. Donkervoort M, Dekker J, Stehmann SJ, Deelman BG. Efficacy of strategy training in left hemisphere stroke patients with apraxia: a randomised clinical trial. *Neuropsychol Rehabil*. 2001;11:549–566.
41. Goldenberg G, Hagmann S. Therapy of activities of daily living in patients with apraxia. *Neuropsychol Rehabil*. 1998;8:123–141.
42. Goldenberg G, Daumuller M, Hagmann S. Assessment and therapy of complex activities of daily living in apraxia. *Neuropsychol Rehabil*. 2001;11:147–169.
43. Söderback I. The effectiveness of training intellectual functions in adults with acquired brain damage: an evaluation of occupational therapy methods. *Scand J Rehabil Med*. 1988;20:47–56.
44. Tham K, Tegnér R. Video feedback in the rehabilitation of patients with unilateral neglect. *Arch Phys Med Rehabil*. 1997;78:410–413.
45. Thomas KS, Hicks JJ, Johnson OA. A pilot project for group cognitive retraining with elderly stroke patients. *Phys Occup Ther Geriatr*. 1994;12:51–66.

46. Van Heugten CM, Dekker J, Deelman BG, Van Dijk AJ, Stehmann SJ, Kinebanian A. Outcome of strategy training in stroke patients with apraxia: a phase II study. *Clin Rehabil*. 1998;12:294–303.
47. Weinberg J, Diller L, Gordon WA, Gerstman LJ, Lieberman A, Lakin P, et al. Visual scanning training effect on reading related tasks in acquired right brain damage. *Arch Phys Med Rehabil*. 1977;58:479–486.
48. Walker MF, Drummond AER, Lincoln NB. Evaluation of dressing practice for stroke patients after discharge from hospital: a crossover design study. *Clin Rehabil*. 1996;10:23–31.
49. Edmans JA, Webster J, Lincoln NB. A comparison of two approaches in the treatment of perceptual problems after stroke. *Clin Rehabil*. 2000;14:230–243.
50. Barrett JA, Watkins C, Plant R, Dickinson H, Clayton L, Sharma AK, et al. The COSTAR wheelchair study: a two-centre pilot study of self-propulsion in a wheelchair in early stroke rehabilitation. *Clin Rehabil*. 2001;15:32–41.
51. Langlois S, Pederson L, MacKinnon JR. The effects of splinting on the spastic hemiplegic hand: report of a feasibility study. *Can J Occup Ther*. 1991;58:17–25.
52. Rose V, Shah S. A comparative study on the immediate effects of hand orthoses on reduction of hypertonus. *Aust Occup Ther J*. 1980;34:59–64.
53. McPherson JJ, Becker AH, Franszczak N. Dynamic splint to reduce the passive component of hypertonicity. *Arch Phys Med Rehabil*. 1985;66:249–252.
54. Poole JL, Whitney SL, Hangeland N, Baker C. The effectiveness of inflatable pressure splints on motor function in stroke patients. *Occup Ther J Res*. 1990;10:360–366.
55. Gracies JM, Marosszeky JE, Renton R, Sandanam J, Gandevia SC, Burke D. Short-term effects of dynamic Lycra splints on upper limb in hemiplegic patients. *Arch Phys Med Rehabil*. 2000;81:1547–1555.
56. Kwakkel G, Wagenaar RC, Koelman TW, Lankhorst GJ, Koetsier JC. Effects of intensity of rehabilitation after stroke: a research synthesis. *Stroke*. 1997;28:1550–1556.
57. Radomski MV. Cognitive rehabilitation: advancing the stature of occupational therapy. *Am Occup Ther*. 1994;48:271–273.
58. Gilles GM. A Neurofunctional approach to rehabilitation following severe brain injury. In: Katz N, ed. *Cognition and Occupation in Rehabilitation*. Bethesda, Md: AOTA; 1998.
59. Ferreira P, Ferreira M, Maher C, Latimer J, Herbert R, Refshauge K. Effect of applying different "levels of evidence" criteria on conclusions of systematic reviews of interventions for low back pain. Abstract presented at: Ninth International Cochrane Colloquium; October 9–13, 2001; Lyon, France.

Editorial Comment

Occupational Therapy for Stroke Patients: When, Where, and How?

Technological advances in medicine and increasing longevity in the general population have contributed to the growing number of physically disabled persons in Western countries. Functional impairment following acute illness (eg, stroke) frequently has devastating consequences, and the past several decades have witnessed increasing needs for multidisciplinary rehabilitation interventions. Occupational therapy, an essential part of rehabilitation, offers a wide range of interventions to facilitate independence among disabled patients. In recognition of occupational therapy as a key component in the multidisciplinary rehabilitation of stroke patients, this issue of *Stroke* includes a report from Steultjens and colleagues, who have documented the positive results of comprehensive occupational therapy programs on primary activities of daily living (ADLs), extended ADLs, and social participation of stroke survivors. This systematic review, in conjunction with other scientific evidence, contributes significantly to our pool of knowledge about occupational therapy research, an area that remains poorly studied. Nonetheless, a number of issues related to interventions for patients with impaired physical function following acute illness need to be addressed.

When Is Occupational Therapy Appropriate for Stroke Patients?

The goal of occupational therapy is to restore functional independence, when possible, and to facilitate psychosocial adjustment to residual disability. Unfortunately, criteria for selection of patients who would most benefit from participation in occupational therapy programs have yet to be precisely defined. The heterogeneity of functional and health problems experienced by stroke patients makes it difficult to evaluate multiple outcomes of rehabilitation. Valid negative predictors of functional recovery after acute events likely include age, urinary incontinence, cognitive impairment, delirium, functional deficits present at admission, and level of social support.[1,2] Other factors, however, make it difficult to draw definitive conclusions about the efficacy and cost-effectiveness of occupational therapy programs. These include the characteristics of the studied population and of the rehabilitation setting, the types of assessments and/or interventions, and the use of varying outcome measures.

Given the potential conflict between the increasing demand for occupational therapy programs and the development of health care services that limit the availability of rehabilitation beds, identification of stroke patients who could potentially gain improved function from such services is imperative. Although Steultjens and colleagues report a significant effect of occupational therapy on primary and extended ADLs and on social participation, the trials included in their study were very heterogeneous. The characteristics of stroke patients varied significantly, given the types of stroke and acute treatments (ie, in one trial, patients were not admitted to the hospital while in another, they were admitted to the acute stroke unit). The treatments themselves (ie, rehabilitation programs) were not similar to each other: a leisure activity intervention is not the same as an occupational therapy program. The duration of treatment significantly differed (from 30 minutes per week to 1 hour per 5 days a week), and the length of follow-up ranged from 4 weeks to 20 weeks. Furthermore, the current report provides no information concerning the effectiveness of occupational therapy programs in reducing health services use and relative costs for stroke patients. Comprehensive cost-effectiveness analyses and cost-benefit analyses are, therefore, needed to strengthen the evidence supporting endorsement of occupational therapy interventions.[3]

Where Is the Appropriate Place to Implement an Occupational Therapy Program?

Despite the growing body of evidence suggesting that improved functional performance after rehabilitation programs may relate to early initiation of treatment,[4] findings are inconclusive concerning where occupational therapy should take place. Postacute hospital settings, day care programs, home care programs, and skilled nursing facilities are the most frequent settings for current rehabilitation programs that target stroke patients. A changing health care system necessitates that occupational therapy programs focus more on the long-term health needs of disabled persons, helping them to improve functional performance while reducing the health care costs associated with disabilities. It is noteworthy that most trials included in the systematic review of Steultjens and colleagues were conducted as a part of home care programs.

Occupational therapy programs need to be client and family oriented, offering services that range from an institutional setting (ie, postacute hospital) to the community (ie, home care). The occupational therapist may represent the health caregiver who can best provide continuity of care for patients who are being evaluated to join rehabilitation programs, who enter the postacute care hospital, then move back to their homes or to an institutional setting. Therefore, the challenge is to develop occupational therapy programs that improve and/or maintain daily functions of stroke survivors in the community across a continuum of primary and secondary care. A multidisciplinary approach, along with integration of medical, rehabilitative (occupational and physical therapy), and social services into a patient's follow-up care, has already proven to decrease mortality and length of hospital stay, while improving the quality of life in a significant proportion of stroke-dependent patients, including those previously considered to be ineligible for a rehabilitation program.[1,4,5]

What Is the Best Way to Implement an Occupational Therapy Program?

Steultjens and colleagues note that a major challenge in summarizing the usefulness of occupational therapy relates to the great variability in interventions, which are implemented in very different occupational therapy settings and in numerous countries.[6] Finally, one should be able to tease out those components of an intervention that may yield the most positive effects of occupational therapy. The meta-analysis of Steultjens et al does provide detailed information about the occupational therapy programs utilized in the analyzed trials. Nonetheless, we believe that a more precise understanding of the prognostic value of physical therapy (ie, specific exercise programs), as opposed to occupational therapy interventions or integrated multidisciplinary approaches, warrants future research.

Poststroke occupational therapy programs will have even greater relevance in the future, given the increasing morbidity and longevity in the population. Increased independence in self care and mobility can enhance quality of life and diminish the health care system burden. However, the emerging lack of resources for health care services in industrialized nations and, in particular, the increasingly limited availability of rehabilitation services point to a critical need for evidence-based criteria that would determine which patients stand to benefit the most (in terms of potential for recovery) from specific occupational therapy programs. Further investigations are needed to define which parameters can predict the rehabilitative potential of various types of therapy that focus on physical, psychological, and social approaches, and whether the potential recovery of stroke subjects is influenced by different techniques and/or occupational therapy programs.

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References

1. Landi F, Bernabei R, Russo A, et al. Predictors of rehabilitation outcomes in frail patients treated in a geriatric hospital. *J Am Geriatr Soc*. 2002; 50:679–84.
2. Weimar C, Kurth T, Kraywinkel K, et al. Assessment of functioning and disability after ischemic stroke. *Stroke*. 2002;33:2053–2059.
3. Landi F, Bernabei R, Gambassi G. Occupational therapy and outcomes for older adults. *JAMA*. 1998;279:582. Comment.
4. Landi F, Zuccala G, Bernabei R, et al. Physiotherapy and occupational therapy: a geriatric experience in the acute care hospital. *Am J Phys Med Rehabil*. 1997;76:38–42.
5. Anderson C, Ni Mhurchu C, Brown PM, Carter K. Stroke rehabilitation services to accelerate hospital discharge and provide home-based care: an overview and cost analysis. *Pharmacoeconomics*. 2002;20:537–552.
6. Ballinger C, Ashburn A, Low J, Roderick P. Unpacking the black box of therapy: a pilot study to describe occupational therapy and physiotherapy interventions for people with stroke. *Clin Rehabil*. 1999;13:301–309.