Review Article

Telerehabilitation Approaches for Stroke Patients: Systematic Review and Meta-analysis of Randomized Controlled Trials

Jing Chen, MD, Wei Jin, MD, PhD, Xiao-Xiao Zhang, MD, Wei Xu, PhD, Xiao-Nan Liu, MD, and Chuan-Cheng Ren, MD, PhD

Background: Stroke remains one of the most common causes of adult disability in the world. In recent years, diverse telerehabilitation programs have been conceived and studied to improve the abilities of the activities of daily living and increased independence of stroke patients living at home. The systematic review was conducted to determine whether telerehabilitation leads to an improvement in abilities of activities of daily living for stroke patients. *Methods:* Randomized controlled trials (RCTs) evaluating the effects of telerehabilitation in stroke survivors living at home were identified by searching 7 electronic databases from inception to March 2015, and by hand searching for conference literatures between 2000 and 2015. Assessments of risk bias and data extraction were conducted independently by 2 reviews. *Results:* The search strategy identified 2587 records, of which 11 studies were thought to be eligible. Pooled results from 7 studies showed no significant differences in abilities of activities of daily living (Barthel Index scale: standardized mean difference [SMD] –.05, 95% confidence interval [CI] –.24 to .13; Berg Balance Scale: SMD –.05, 95% CI –.7 to .37) and motor function (Fugl-Meyer Extremity: SMD .05, 95% CI –.09 to 1.09) between groups. *Conclusions:* This review provides limited, moderate evidence that telerehabilitation of all approaches has equal effects with conventional rehabilitation in improving abilities of activities of daily living and motor function for stroke survivors. Further research of RCTs in this area (rehabilitation field of telemedicine) is ungently required to extend the evidence base. **Key Words:** Rehabilitation—stroke—telemedicine—systematic review—meta-analysis.

Introduction

Stroke remains one of the most common causes of adult disability in the world.[1-3] Stroke survivors are physically deconditioned and commonly suffer a range of functional disability that may persist throughout their life and have some limitations in terms of quality of life and independence.[4,5] An organized system of multidisciplinary care, such as a stroke unit, can be effective in reducing the adverse outcomes compared with less organized inpatient care.[6] However, the hospital care resources are limited in most regions. Moreover, inconvenient

From the Department of Neurology, The Fifth People's Hospital of Shanghai, Fudan University, 801 Heqing Road, Minhang District, Shanghai 200240, China.

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Address correspondence to Chuan-Cheng Ren, Department of Neurology, The Fifth People's Hospital of Shanghai, Fudan University, 801 Heqing Road, Minhang District, Shanghai 200240, China. E-mail: rccfsn17@sina.com.

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transportation and costly rehabilitation programs restrict most stroke survivors from receiving professional supervised rehabilitation, which may delay the best rehabilitation time.[7,8] Thus, an urgent need for new outpatient rehabilitation and recovery training strategies that meet the specific needs of patients and their caregivers still exists.[9]

In recent years, diverse telerehabilitation programs have been conceived and studied to improve the abilities of the activities of daily living and increased independence of stroke patients living at home.[10,11] Home-based telerehabilitation is defined as a rehabilitation method wherein clinicians use telecommunication devices (e.g., telephone, videophone, audio–videoconference) to provide rehabilitation intervention strategies, evaluation, and support for disabled persons living at home.[12]

Clinical trials about the effects of telerahabilitation for stroke have been inconclusive: some studies report that telerahabilitation shows more beneficial effects on functional recovery compared with conventional rehabilitation,[13,14] whereas others do not.[15,16] The only fully published systematic review of randomized controlled trials (RCTs) has tried to examine the effects of telerehabilitation on functional recovery, cognitive function, health-related quality of life, cost-effectiveness, and satisfaction in stroke survivors.[17] The review search was completed in November 2012 and 10 RCTs, involving a total of 933 participants, were included in the literature. In this review, pooled data failed to show significant differences in independence of activities of daily living and motor function. No other conclusions were reported on account of the insufficient evidence regarding cognitive function, quality of life, cost-effectiveness, and satisfaction. In the review, the absence of a clear definition of telerahabilitation ("the delivery of rehabilitation services via information and communication technologies") may be one of the factors leading to the results. As such an extensive definition embraces a range of rehabilitation programs that include intervention, assessment, education, consultation, prevention, and supervision. Although this review included only the studies involving the rehabilitation services of intervention and assessment, it is difficult to come to a conclusion about the effects of telerehabilitation on stroke patients considering the variable nature of the implementation of different interventions. Given that it has been more than 2 years since the publication of this systematic review, more published studies as well as new approaches to telerehabilitation may have recently emerged, which have made us reconsider the issues. It is hypothesized that there may now be significant effects of telerehabilitation in improving abilities of activities of daily living, motor function, quality of life, satisfaction, and cost-effectiveness for stroke patients.

Methods

Search Strategies and Search Selection

The following electronic databases were searched from inception to March 2015: the Cochrane Library, AMED, Medline, Embase, CINAHL, PyschINFO, and Web of Science. Conference literatures between 2000 and 2015 were hand searched. RCTs evaluating the effects of telerehabilitation in stroke survivors living at home were eligible for inclusion (Box 1).

Search terms were based on appropriate Medical Subject Headings and other headings including stroke, poststroke, cerebrovascular accident, telerehabilitation, rehabilitation, telemedicine, home, day hospital, and outpatient. No language restrictions were imposed on the searches or the identified studies. Reference lists of all retrieved studies were checked for further studies. Two authors (J.C. and W.J.) independently screened the titles and abstracts (if available) of identified publications and eliminated obviously irrelevant studies according to the predefined eligibility criteria. Full texts for the remaining articles were obtained for further review. Any disagreements were resolved through discussion. The authors of selected studies were contacted to ask if they had any further unpublished data.

Box 1. *Eligibility criteria for inclusion in study*

1 Randomized controlled trials.
2 Stroke survivors* (>18 years old).
3 Rehabilitation interventions and assessment via telemedicine, telecommunication media, and intervention programs including phone, videoconferencing, telerahabilitation system, robot-assisted rehabilitation, and virtual and augmented reality therapy.
4 Compared telerehabilitation or a combination of telerehabilitation and conventional rehabilitation with conventional rehabilitation or no rehabilitation.
5 Minimum cumulative duration of rehabilitation intervention 4 weeks.

*Diagnosed of stroke according to the criteria of the World Health Organization: a syndrome of rapidly developing symptoms and signs of focal, and at times global, loss of cerebral function lasting more than 24 hours or leading to death with no apparent cause other than that of vascular origin.[18]