Independently Getting Off the floor (IGO): a feasibility study of teaching people with stroke to get up after a fall

Sarah G Dean[1]
Leon Poltawski[1]
Krystal Warmoth[1]
Victoria A Goodwin[1]
Victoria H Stiles[2]
Rod S Taylor[1]

[1]University of Exeter Medical School, Exeter, UK
[2]Sport and Health Sciences, University of Exeter, Exeter, UK

Corresponding author: K. Warmoth, University of Exeter Medical School, South Cloisters, St Luke's Campus, Exeter EX1 2LU. K.Warmoth@exeter.ac.uk; tel: +441392 726003

Abstract

Background: Falls are common among stroke survivors but many are not taught how to get up again. A technique from Action for Rehabilitation following Neurological Injury (ARNI) addresses this problem. We investigated the feasibility and safety of teaching this technique to stroke survivors.

Methods: Stroke survivors (mean 7.1 years post-stroke) with mild-to-moderate disability (mean modified Rankin Score 2.4), who could get up with assistance but not independently, received up to six sessions of training to independently get off the floor (IGO). The primary outcome was IGO success; safety and feasibility were investigated by participant and trainer interviews, biomechanical and video analysis and expert panel review.

Findings: Six of the 10 participants achieved IGO and five of nine retained the skill two months post-training. One to six sessions (median 3) were needed to master IGO; one minor but no serious adverse events occurred. Expert reviewers indicated training involved an acceptable risk of falls and no concerns for knee and wrist positions.

Conclusions: This feasibility study indicates IGO may be useful. IGO was taught to and safely used by selected stroke survivors. Further assessment of IGO has now been part of a pilot randomised controlled trial of ARNI based stroke rehabilitation.

Keywords
Falls – Rehabilitation – Exercise – Stroke

Introduction

Falls are common among stroke survivors with up to 73% falling within the first six months (Batchelor, Mackintosh, Said & Hill, 2012; Forster & Young, 1995), often with severe consequences (Batchelor *et al.*, 2012; Jorgensen, Engstad & Jacobsen, 2002). Stroke survivors can have long-lasting losses in physical abilities (e.g., balance and gait) as well as cognitive and sensory impairments that can increase the likelihood of falling (Weerdesteyn, de Niet, van Duijnhoven & Geurts, 2008). Therefore, a risk of falling is not only a health concern immediately post-stroke but also as survivors get older. However, in one study, after a non-injurious fall, it was found that more than half those with stroke were unable to get up (Tinetti, Liu & Claus, 1993). This can potentially lead to "long lie," or remaining on the floor for more than an hour after a fall, complications such as hypothermia, dehydration and pressure sores (Lord, Sherrington, Hylton & Close, 2007; Reece & Simpson, 1996) and require emergency ambulances.

Although not all fallers require a hospital visit (Darnell, Mason & Snooks, 2012), fear of falling may lead to reduced activity (Tinetti *et al.*, 1993) and restrictions to participation, so lessening opportunities for stroke recovery and loss of independence (Andersson, Kamwendo & Appelros, 2008). Stroke survivors state that post-stroke falls have several consequences, including limiting activity and participation, increasing dependence, and developing a fear of falling (Schmid & Rittman, 2009). Fear of falling was reported by stroke survivors as one of the reasons that their social activities had reduced after their stroke (Dowswell, Lawler, Dowswell, Young, Forster & Hearn, 2000). The fear of falling was associated with future strokes (as the initial experience of falling occurred during the stroke) and concerns about being hurt as well as the subsequent impact of an injury on function and independence (Schmid & Rittman, 2009). Survivors discussed falling regularly and having a pervasive concern and embarrassment about it (Schmid & Rittman, 2009). Furthermore, concern about falling can add to the psychological burden felt by carers (Kelley, Graham, Christy, Hersch, Shaw & Ostwald, 2010).

Action to reduce these fears has been recommended (Forster & Young, 1995; Schmid & Rittman, 2009). Teaching stroke survivors to get up from the floor may help to allay their fears and those of their carers. If a fall does occur, being able to rise independently may reduce ambulance call outs and healthcare costs (Darnell *et al.*, 2012). It may also give people confidence to participate in society knowing they can help themselves and not be left on the floor for hours at a time, whether at home or outside. The independence gained by being able to get off the floor without assistance could prevent further declines in health as well as enable wider social participation. However, the skill of getting up from the floor is rarely taught. Findings from a National UK audit and a survey suggest very few older people who fall, or who are at risk of falling, are taught how to get up again (Goodwin, Martin, Husk, Lowe, Grant & Potter, 2010; Lamb, Gates, Fisher, Cooke, Carter & McCabe, 2007). For stroke survivors, this lack of training may be because they have complex needs and unilateral impairments requiring different approaches to that traditionally used with other populations (Reece & Simpson, 1996). In addition, patients and/or therapists may lack the confidence to practise this task for fear of injury or failure (Simpson & Salkin, 1993).

Most research to support post-stroke falls is focused on prevention. A recent systematic review suggests that current interventions to prevent falls after stroke have not reduced the rate of falls (Verheyden, Weerdesteyn, Pickering, Kunkel, Lennon, Geurts & Ashburn, 2013). Therefore, it may more beneficial investigate interventions designed to support stroke survivors after they have fallen. However for older or post-stroke populations, there is a paucity of research with this aim (Goodwin & Dean, 2012). Current techniques for teaching getting off the floor are aimed at the general older population and focus on backward chaining involving the use of a chair (Cox & Williams, 2016), which is the standard technique for getting to and from the floor. This technique is not necessarily applicable to stroke survivors with unilateral impairments or for helping people to be completely independent of aids. It relies on the person making their way to a chair, which can sometimes not be feasible (e.g., outside or on the street). Information on what is taught about getting off the floor within NHS physiotherapy services is outdated (Simpson & Salkin, 1993), and current provision is unknown. In this paper

In response to these issues, we report on a potential technique that could aid fall recovery for stroke survivors. The founder of Action for Rehabilitation Following Neurological Injury (ARNI; www.arni.uk.com) developed a technique for independently getting up from the floor as part of the exercise programme designed specifically for people with hemiplegia and other stroke-related impairments (Balchin, 2011). The ARNI programme includes a variety of strategies and techniques including education in exercise principles after stroke, developing skills in goal setting, functional problem solving and self-monitoring, and establishing a programme of regular independent home-based exercise. It comprises a sequence of movements that take stroke-related impairments into account without requiring a chair or other support. We have called this novel technique 'Independently Getting up Off the floor', or IGO. Although anecdotal evidence indicates stroke survivors can master IGO, some clinicians have noted the potential for excess strain, especially for knee and wrist joints. No previous research has evaluated IGO. We therefore conducted an early phase feasibility study to explore its safety, whether it can be taught and how well it works for stroke survivors prior to deciding whether to include IGO in a pilot randomised trial of a rehabilitation programme based on ARNI techniques (Dean, Poltawski, Forster, Taylor, Spencer, James, Allison, Stevens, Norris, Shepherd, Landa, Pulsford, Hollands & Calitri, 2018).

Following guidance for the development and evaluation of complex interventions (Craig, Dieppe, Macintyre, Michie, Nazareth, Pettigrew & Medical Reseach Council, 2008), we designed a before-and-after case series with a sample of stroke survivors. Specific research objectives were to:

1) Describe of the key features of IGO and acceptable variations;
2) Identify risks associated with teaching, learning and using IGO;
3) Establish the feasibility of teaching IGO;

4) Estimate the proportion of stroke survivors that master IGO;
5) Identify factors contributing to success or failure in mastering IGO.

Methods

We used mixed methods to collect quantitative, observational and qualitative data, and we conducted an expert panel review. Quantitative data were collected to assess mastery of IGO (Objective 4 and 5). Observational data were collected using video recordings of the sessions to assess any risks (Objective 2), feasibility (Objective 3) and factors contributing to the mastering IGO (Objective 5). Interviews were conducted to collect qualitative data about the feasibility of teaching IGO (Objective 3 and 5). An expert panel reviewed the observational data to designate key features of IGO and acceptable variations (Objective 1), identify risks (Objective 2) and mastery of IGO (Objective 5). The study was approved by the local NHS Research Ethics Committee (Reference 12/SW/0095).

Participants

A convenience sample of participants was recruited via local stroke clinical, research and support networks. Those interested were screened for eligibility, initially by telephone and then at face-to-face assessment, during which informed consent was obtained. Principle inclusion criteria were:

- stroke survivors with hemiplegia or hemiparesis, ambulant and capable of unsupported standing;
- ability to get up from the floor using a chair, or with minimal or moderate assistance but not able to get up independently;
- discharged from rehabilitation services;
- no known contraindications to exercise;
- ability to give informed consent;
- willing to travel to a training centre.

Participants were excluded if they were already able to get up off the floor independently, not ambulant or capable of standing unsupported or were not stroke survivors with hemiplegia or hemiparesis.

Questionnaires to establish cautions or contraindications to exercise (American College of Sports Medicine, 2010) were completed by participants' GPs prior to enrollment. Recruitment continued until ten participants completed training. This small sample was deemed sufficient to meet the feasibility objectives of the study (Arain, Campbell, Cooper & Lancaster, 2010) within limited funding resources.

Intervention

The principles and sequence of movements of IGO are described in the ARNI manual (Balchin, 2011) and allows for adaptation to individual capabilities and preferences (http://successfulstrokesurvivor.com/). Key components specifically assist balance and movement for people with one-sided weakness, such as using a "tripod" of both legs and one arm in kneeling, and rapid foot and hip rotation when rising. IGO is a five-step technique that allows for survivors to get from floor-sitting to stable standing independently without aids.

IGO begins from a sitting position as ARNI teaches diverse techniques of how to recovery from a fall (lying on the floor) into a sitting position.

Participants received up to six hours of one-to-one training with one of four ARNI trainers. One trainer was the developer of IGO. The others were Exercise Professionals who had received training in the ARNI principles and techniques were accredited by the ARNI Institute to work with stroke survivors, and had received supervised practice teaching of IGO. At session one the trainer assessed participants and taught them IGO. If not mastered at this initial session, up to five additional sessions at home or a gym were provided. Sessions were scheduled for one hour over the following one month period. IGO technique was practiced several times during the session. Training was performed with participants wearing shoes, and the only equipment that was used was a sturdy chair and when at the gym a mat. During sessions, a trainer observed the knee and wrists for possible strain and, if necessary either guarded or supported participants when they moved into some positions. They also provided verbal instructions and reassurance. For safety, participants were encouraged to use the chair to get down and up to the floor until they had mastered IGO. After learning the IGO, participants were encouraged to practice to build strength and make the action habitual.

Assessment

Quantitative data

Baseline self-reported data included: age, time since stroke, co-morbidities, stroke-related impairments, history of falls in past six months and levels of exercise. Measures included the modified Rankin Scale (Bruno, Shah, Lin, Close, Hess, Davis, Baute, Switzer, Waller & Nichols, 2010); the Stroke Impact Scale (Duncan, Wallace, Lai, Johnson, Embretson & Laster, 1999; Lin, Fu, Wu, Hsieh, Chen & Lee, 2010); the Stroke Self-efficacy Questionnaire (Jones, Partridge & Reid, 2008) and the Falls Efficacy Scale – International (Yardley, Beyer, Hauer, Kempen, Piot-Ziegler & Todd, 2005).

The primary outcome measure was dichotomous: the ability to get from floor-sitting to stable standing within five minutes independently (without aids). By definition, no participant was able to do this at baseline. Secondary outcomes were the degree of assistance required to get from floor to standing, using a 6-point grading system (See Supplementary File 1) adapted from the Functional Independence Measure (Keith, Granger, Hamilton & Sherwin, 1987), and adverse events (e.g., injurious fall or sprained wrist). Assessment took place at baseline, post-intervention (immediately after the end of training) and, for those who mastered IGO, two months post-intervention. Screening and all assessments were conducted by the same research physiotherapist.

Video analysis by expert panel

We purposively sampled sessions for video recording: all first sessions, a selection of mid and later sessions and all those who mastered IGO. Video analysis forms were developed (see Supplementary File 2) to identify: safety risks in teaching or using IGO; variations from standard IGO technique; examples of good and bad practice in teaching IGO. Four academic physiotherapists and three clinicians (two physiotherapists and an occupational therapist), all with specialist expertise in stroke rehabilitation, used these forms independently to evaluate approximately 15 hours of recordings. Two of these experts were members of the research team but were not involved in recruitment or data collection. The expert panel met to consider key features of IGO, the safety of training and using IGO, factors affecting success or failure, and feasibility of use in stroke rehabilitation.

Biomechanical Analysis

Biomechanical analysis assessed joint strain risk with four participants who had mastered IGO. We focused our resources at joints identified as ‘at risk’ by our clinical advisors. Specifically, these were strains due to instability in the frontal plane of the knee on the hemiplegic side or to over-extension of the contralateral wrist. Therefore three-dimensional joint angles of the hemiplegic leg and the contralateral arm were obtained using a Vicon Motus 120Hz motion capture system (Vicon, Oxford, UK). Eight cameras recorded IGO using a customised joint co-ordinate system with computer software (Vicon Version 9.1) tracking and plotting dynamic wrist flexion/extension angle and knee abduction-adduction angle to provide an indication of knee varus/valgus positions during IGO. Flexion-extension of the wrist describes the relative movement between the longitudinal axes of the forearm and pronation-supination axis of the wrist. Adduction-abduction angles of the knee describe the relative movement of the longitudinal axis of the tibia about the flexion-extension axis of the knee. Participants demonstrated IGO several (average of three) times. Each recording was checked for range of joint angles with the most easily visible angle recordings being selected for more detailed analysis.

Semi-structured Interviews

Acceptability and satisfaction with training, as well as impact and safety, were discussed with participants post-intervention. Two Exercise Professionals were interviewed following the completion of the study about the feasibility and safety of teaching IGO, and factors affecting participants’ mastery of it. Topic guides were used, and notes made during and immediately after interviews. Interviews were conducted by a member of the research team at a convenient time and location for the participant.

Data analysis

The primary outcome (proportion of patients able to do IGO) is reported as a risk difference and the 95% confidence interval at each follow-up points, taking into account the paired nature of the data using the ‘mcci’ (matched case control immediate) command in Stata/IC, version 11.2 (StataCorp, College Station, Texas). Secondary outcomes are reported descriptively at baseline and follow-up as means and standard deviations where appropriate. The experts’ individual responses on the video analysis forms were collated and summarised for the panel meeting. During the meeting, the summaries were discussed and recommendations were compiled and agreed by members. If there was disagreement between video assessors or a concern regarding safety then a third panel member was asked to re-appraise the video.

Biomechanical data on wrist and knee movements were corrected relative to neutral standing and maximal angles for wrist flexion/extension and knee adduction-abduction were calculated for each participant. Analysis was conducted by a research team member who is an expert in sports biomechanics. Repeated wrist extension beyond 90 degrees would be considered a risk to wrist function (McLaren, Byrd, Herzog, Polikandriotis & Willimon, 2015) and any instances of this occurring were noted. Peak knee varus/valgus angles were compared with knee flexion to extension for possible risk. Means and standard deviations of the extension and varus/valgus values were also calculated.

Supported by Nvivo software, descriptive thematic analysis for the qualitative data were conducted, based on the principles of Framework Analysis (Pope, Ziebland & Mays, 2000). Interview data were analysed regarding the positive and negative experiences of training, physical and psychological outcomes, and factors influencing learning. Participant and trainer interview data were analysed separately, then compared. A report of the findings was sent to participants to ensure accuracy, completeness, fairness, and perceived validity.

Results

Eleven participants were enrolled in the study (Figure 1). Ten completed training and one withdrew after the first session. Table 1 summarises baseline characteristics; most participants were several years post-stroke (Mean (SD) = 7.1 (4.2) years) and reported low to moderate levels of exercise. Co-morbidities comprised diabetes (n=6), low back pain (n=2), total hip replacement (n=1), gout (n=1) and peripheral neuropathy (n=1). Most had moderate to severe fear of falling. Five had at least one fall in the previous six months (all needed help to get up). Two required ambulances but were not conveyed to hospital.

Insert Figure 1 about here.

Insert Table 1 about here.

Quantitative outcomes

Compared to baseline, six out of 10 participants (risk difference: 60%, 95% CI: 19% to 100%) achieved the primary outcome immediately post-training and five of nine (56%, 95% CI: 12% to 96%) at two months post-training (see Table 2). Participants mastered IGO in between one and six sessions (median of three sessions). An additional participant was deemed borderline, requiring only supervision and prompting to achieve IGO. All 9 participants seen at 2-month follow-up retained it. All but one required less help to stand after completing training. One adverse event occurred: a person with diabetic neuropathy stubbed a toe during training. Trainers also indicated several non-injurious falls occurred but the number was not recorded.

Insert Table 2 about here.

Formal tests of association were not appropriate with this sample size, but no patterns were observed linking mastery of IGO with baseline demographics, modified Rankin Score, questionnaire scores or prior exercise levels.

Video analysis

No safety concerns were noted by the expert panel, although practice was observed to vary from the manual description. These variations were deemed acceptable by the panel as the technique can be adapted to individual capacities and preferences (Balchin, 2011). The standard was considered prescriptive, to the extent of insisting people used one arm when they were capable of using both. The strict version of the technique was thought to be more appropriate for people with obvious hemiplegia; others can use different methods. Key elements of IGO, as identified by the panel, were: (a) use of the “tripod” to enhance stability; (b) a stable intermediate “resting” position of half kneeling ± hand on floor; (c) rotation of the trunk during kneel-to-stand to distribute the weight over the feet and enhance stability; (d) moving the centre of mass back over the feet during rising and “growing upward” in a flowing movement.

The panel suggested that occasionally inappropriate trainer positioning and manual handling may have posed a risk of injury to participants or trainers. For example, trainers lifted heavy clients from the ground or were not standing in the optimal place to protect the person if they should fall. However, these issues were not regarded as particular to teaching IGO. They suggested that an additional trainer or assistant would be essential for safety with more disabled participants or the use of an aid such as an emergency lifting cushion. Confidence-building through “supervised risk-taking” was judged desirable for effective learning, as was adaptation of IGO to individual abilities. The panel concluded that IGO provides a viable and adaptable method for getting up from the floor independently and could be taught by clinicians (e.g., nurse, physiotherapist, or occupational therapist) or Exercise Professionals with knowledge and training in stroke rehabilitation.

Biomechanics

Motion analysis showed that participants who had mastered IGO followed key principles of IGO but with modifications to accommodate specific impairments and preferences (e.g., due to arthritis or preferring to use both arms). Despite this variation, wrist positioning during sit-to-kneel was common to all, with extension angles of $76\text{-}83^0$ (group mean 80.7^0, SD 2.6^0). Observed wrist extension values were all below the risk level (i.e. 90^0). Greater variation in wrist position was observed in the kneel-to-stand phase, but extension was always less than 90^0.

Peak knee adduction-abduction angles recorded during the knee extension phase of IGO indicated participants either approximated a neutral position with minor fluctuations about zero or performed the rising phase in a varus (bow-legged) alignment. One participant demonstrated 2.5^0 of tibial abduction indicating a knee valgus position, but this magnitude was not considered sufficient to pose a risk to either knee medial collateral or anterior cruciate ligament strain (Hewett, Myer, Ford, Heidt Jr, Colosimo, McLean, van den Bogert, Paterno & Succop, 2005; Powers, 2010), even with repeated performances of IGO.

Interviews

Experiences of training

High levels of satisfaction were reported, including by those who failed to master IGO. However, one person withdrew because they disliked being on the floor, and most participants reported initial nervousness about getting onto the floor as many had not done this by choice since before their stroke.

The trainers indicated that instability during some parts of IGO might cause falls, but these did not pose a significant risk to trainee or trainer as they could usually be anticipated and controlled; and injury risk was further minimised through the use of mats if a fall did occur. However, they felt that a training assistant or equipment might be needed for safe handling of heavier or more disabled trainees. Trainers suggested focusing on learning one functional technique (*i.e.* IGO) was artificial and it may be better taught as part of a broader training programme.

Physical and psychological outcomes

One participant reported using IGO after a fall at home when previously he would have waited for help. Another survivor rose independently after sitting on the ground with friends, a position she would avoid previously. Of those who mastered IGO, most continued practising it after training ended. Two reported reverting to using a chair but said they could do so more easily and confidently than previously. Several participants expressed delight at learning to stand independently long after their stroke, suggesting that it gave them an appreciation of their potential to improve in other ways and increased motivation to exercise regularly. However, those not mastering IGO expressed frustration at their perceived failure, and some suggested that further training may have led to success.

Factors influencing learning process

Both participants and trainers stated trust as important for building confidence, both to get onto the floor and to practise movements that risked having a fall. Fatigue limited session length or frequency of practising the technique for several participants. A participant with receptive aphasia found IGO diagrams helpful. Another suggested IGO should start from a lying position, as if after a fall.

Trainers identified factors limiting IGO mastery as weakness in muscles of the lower limb and muscles related to core-stability, soft tissue tightness, and obesity. They underlined the importance of individual adaptations of IGO and the commitment to shared problem-solving to overcome difficulties. Trainers indicated that all participants were capable of mastering IGO with sufficient training and personal motivation.

Discussion

This early phase feasibility study findings suggest that some stroke survivors, who were not able at the start of the study were able to learn IGO after the training, even several years after their stroke. However, a proportion of those trained were unable to master IGO within the six session allowed. The study suggests possible reasons for this, but further research is required to establish the factors that might limit an individual's capacity to benefit from this training. Nevertheless, the proportion of the sample mastering IGO, and the benefits they reported, suggest that such research is warranted. The biomechanical and expert visual analysis found no evidence of risk of joint strain in carrying out the standard IGO movements although a low risk of minor injury was noted during the observation of IGO training. This suggests IGO may be a potentially useful intervention to help people get up from the floor independently, safely and without aids and that it can be learned by selected long-term stroke survivors with minimal, focused training.

Biomechanical analysis indicated that those who mastered IGO did not put the knee or wrist under undue strain in the loaded positions required by the technique. Some risk of falling is inherent in learning IGO as participants need to build strength, momentum, and confidence in the technique, but in a controlled environment, this injury risk appears small. Whilst risk of falling is acceptable in the training, it is not if due to trainer inattentiveness, therefore refining the trainer's manual and their supervised practice of support and guarding techniques is recommended. The present study found that the some participants mastered IGO within a single session, whereas other survivors with moderate disability (as measured with the modified Rankin Scale) learned it within six sessions. However, muscle weakness and obesity may inhibit mastery and further more general training and fitness work would be likely be needed. However, learning IGO is of practical benefit since it enables individuals to get up where no help is available. Other possible benefits include increased self-confidence, the discovery of the potential for other improvements (e.g., functional gains, lower limb strength), and enhanced motivation to exercise. These secondary outcomes may also occur for those who do not master IGO.

Our study is one of the first to focus on teaching stroke survivors to get up off the floor independently as opposed to using equipment, furniture or other forms of assistance. Most falls-related research and services concentrate on preventing falls rather than how to get up after them (Costello & Edelstein, 2008; Verheyden *et al.*, 2013). Whereas we postulate that despite receiving such interventions many stroke survivors will still fall, and they need to be prepared to cope with this situation, however, as already noted, current techniques for teaching getting off the floor are not aimed at the needs of stroke survivors (Cox & Williams, 2016). IGO offers an alternative technique that may be more appropriate for stroke survivors (including those with hemiparesis) and does not require assistance of aids. Although more research is needed, IGO offers a possible coping strategy for the self-management of falls in stroke survivors as most of our participants claimed they had never been shown how to get up from the floor during their rehabilitation.

According to our participants, mastering IGO is dependent upon collaboration between trainer and trainee to address individual problems, and on confidence-building for getting onto the floor and committing to particular movements. However, IGO is not a specific technique with a rigid sequence of steps, but a flexible approach based on the key manual elements. This makes it a complex intervention to evaluate, but our work provides the first step in this research development process. Moreover, it is modifiable to the needs and abilities of the individual which made it feasible for participants with different levels of disability and co-morbidities.

In this study, training was provided to stroke survivors who had been discharged from rehabilitation, typically several years previously, suggesting IGO is not a skill all stroke survivors acquire in the natural recovery period after stroke. Indeed, six of those screened to take part were excluded because they were found to be capable of IGO, often to their surprise as they had not attempted it before. Whilst our result of six out of ten is modest, it is important to note that for the participants, who were on average seven years post-stroke, IGO was an important achievement and a new post-stroke skill for them. Furthermore the risk of falling remains as stroke survivors get older and this can contribute to health concerns throughout their post-stroke lifespan (Weerdesteyn *et al.*, 2008); thus their ability to independently get off the floor may be a useful later life skill. Acquiring this skill could help promote, or maintain, independence through allowing the stroke survivor to continue with their physical activities and social participation, which are associated with less decline in health and frailty in older people (Gobbens, van Assen, Luijkx, Wijnen-Sponselee & Schols, 2010; Puts, Toubasi, Andrew, Ashe, Ploeg, Atkinson, Ayala, Roy, Rodríguez Monforte, Bergman & McGilton, 2017).

The strength of this study was the mixed methods approach to address uncertainties in the feasibility and acceptability of teaching IGO and as part of early development work for designing and evaluating a complex intervention for stroke survivors (Craig *et al.*, 2008). The study limitations include the relatively small number of sessions used for video analysis and that biomechanical analysis was restricted to two joints once IGO had been mastered and was not assessed during actual training sessions. Since biomechanical analysis of sessions was impractical during this small study the panel of experts were used instead to evaluate the training session videos. Biomechanical analysis was not performed on the participants who did not master IGO; future work should investigate if these stroke survivors are at more risk of any possible joint strain. Our small study focused on collecting the primary outcome data at follow-up and conducting the interviews rather than further evaluation using self-report outcome measures; thus additional pre-post case analysis could not be performed across the different time points. Future work could collect data at baseline, post-intervention and later follow-ups to test change in such measures (for example the Stroke Self-Efficacy Questionnaire and the Falls Efficacy Scale). The overall evaluation of impact is also limited by the small sample and short follow-up, lack of comparator group and blinding of outcome assessment. These limitations could be addressed in a future randomised controlled trial.

Conclusions

This early phase feasibility study suggests that selected stroke survivors can be taught to get off the floor independently, even several years post-stroke. The IGO technique may be a suitable strategy to guide training, but further research with a larger sample is required to investigate to whom, and at what stage of the rehabilitation process, it may most effectively and safely be provided. Regaining the capacity to get up from the floor could bring significant functional and psychological benefits to people with stroke, so further research is warranted. A pilot RCT with blinded outcomes assessment has been undertaken to evaluate the acceptability of a rehabilitation programme based on ARNI principles, including the IGO technique (http://clahrc-peninsula.nihr.ac.uk/research/retrain) as well as to check the feasibility of running a definitive RCT (Dean *et al.*, 2018). This will allow us to further assess the safety, benefits and costs of incorporating IGO training within stroke rehabilitation.

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Declarations of interest

The authors report no specific declarations of interest.

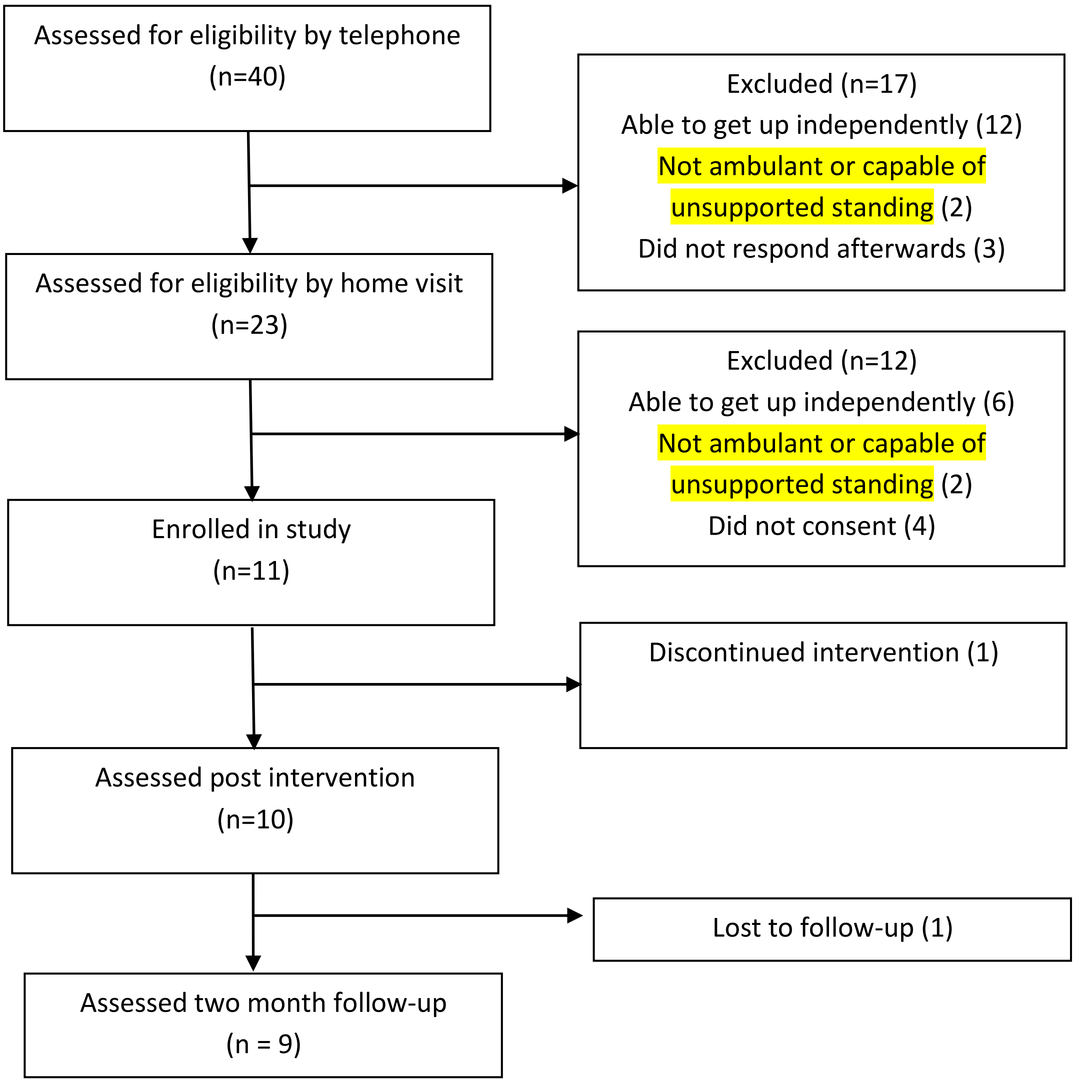

Figure 1: Participant flow chart

Table 1: Baseline characteristics of participants

Case	Age (y)	Gender	Time since stroke (y)	mRS	Falls in past 6 months	SIS-phys	SIS-mob	SSEQ	FESI	Exercise levels	Mobility aids
1	64	F	5	3	n	50	49	37	98	Low	Stick
2	86	F	11	2	n	80	89	76	34	Mod	Stick
3	57	M	6	3	n	35	67	44	63	Low	Stick
4	65	F	0.25	2	n	65	82	86	56	Low	Stick
5	71	M	5	2	y	70	69	80	66	Mod	Frame
6	65	F	7	3	n	60	73	67	67	Low	Stick/ frame
7	78	F	5	2	y	60	82	79	55	Low	Stick
8	53	M	3	3	y	30	51	85	83	Low	AFO, crutch
9	73	M	14	2	y	100	91	94	53	High	None
10	60	M	12	3	y	60	67	82	39	Mod	Stick
11	51	F	10	2	n	25	84	77	59	Mod	AFO
Summary (mean and SD unless indicated)	65.7 10.6	55% female	7.1 4.2			57.7 22.2	73.1 14.3	73.3 17.7	61.2 18.0		

mRS: modified Rankin Scale score; SIS-phys: Stroke Impact Scale-physical subscale; SIS-mob: Stroke Impact Scale-mobility subscale; SSEQ: Stroke Self-efficacy Questionnaire; FESI: Falls Efficacy Scale–International; AFO: ankle foot orthosis. Questionnaire scores expressed as percentages, higher scores indicate better health status, except for FES-I (lower score is better).

Table 2: Outcome measures for participants

Case	Ability Scale using chair Baseline	Ability Scale no aids Baseline	Ability Scale no aids Post-training	Ability Scale no aids 2 month Follow Up	Dichotomous Success (Y/N) Post-training	Dichotomous Success (Y/N) 2 month Follow Up	Training sessions received
1	3	2	3	missing	N	N	6
2	6	3	withdrew	-	-	-	1
3	6	2	5	3	N*	N	6
4	5	2	6	withdrew	Y	-	1
5	5	1	1	-	N	N	6
6	5	2	6	6	Y	Y	6
7	6	4	6	6	Y	Y	1
8	6	3	6	6	Y	Y	1
9	6	4	6	6	Y	Y	2
10	4	2	4	3	N	N	6
11	6	3	6	6	Y	Y	4
Summary Median (IQR)	6.0 (5.0,6.0)	2.0 (2.0,3.0)	6.0 (4.3,6.0)	6.0 (4.5,6.0)			4 (1,6)
LOCF imputed			6.0 (3.5,6.0)	4.5 (3.0,6.0)			

Ability scale. 6: fully independent; 5: requires standby assistance, verbal prompting or help with set-up; 4: provides > 75% of necessary effort; 3: provides 50-74% of necessary effort; 2: provides 25–49% of necessary effort; 1: provides < 25% of necessary effort or is unable to do the task.

* Borderline: physically able but required verbal prompting.

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