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Stroke survivors talk while doing: Development of a therapeutic framework for continued rehabilitation of hand function post stroke in patients' own environment

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Abstract

Study Design—Qualitative study to identify themes and explore mechanisms underlying recovery of hand function post stroke for individuals discharged from rehabilitation services.

Purpose of the Study—Post-stroke hemiparesis frequently results in persistent hand dysfunction; the mechanisms of functional recovery are however poorly understood. We assessed the perspectives of community-dwelling patients with chronic stroke on their hand function limitations and recovery to explore the feasibility of developing a theoretical framework for understanding the process of continued post-stroke recovery.

Methods—Eight patients with chronic post-stroke hemiparesis were interviewed and videotaped while they performed a battery of 20 upper limb tasks. Qualitative analysis consisted of two investigators independently reviewing the videotapes and reading the transcribed conversations, identifying significant issues and then comparing their observations to determine common themes and develop emerging concepts.

Results—Four core themes pertaining to impairment and recovery of task-specific ability emerged: 1) Spasticity can be overcome actively through task-specific attempts to use the affected arm and hand; 2) Use of the affected arm can be facilitated by adopting positions that reduce the effect of gravity on the arm or enable gravity to act as a natural assist in the movement; 3) Task-specific skill can be attained by repeatedly attempting specific component movements of tasks in the context of a variety of different tasks; and 4) Frustration impedes task performance but a mental state of 'detached focus' can improve the motivation to use the affected arm.

This research was conducted at the Mount Sinai School of Medicine, New York, and presented as a scientific paper at the annual meeting of the Association of Academic Physiatrists in 2009.

Conclusions—These themes suggest a therapeutic framework for continued upper limb rehabilitation in patients' own environment to maximize functional recovery in patients long after their stroke, and generate hypotheses which may lead to the development of new therapeutic protocols.

Introduction

Hemiparesis is the most common motor impairment after a stroke that frequently leads to persistent hand dysfunction. Studies have shown that while 82% of patients with stroke ambulate independently,[1] only 5% to 34% achieve full upper limb function.[2,3] These differences in recovery of upper and lower limb are thought to be partly due to less time spent in rehabilitating the upper limb[4–6] and decreased spontaneous use of the affected upper limb, both of which contribute to learned non-use.[7] Once discharged from inpatient and outpatient rehabilitation services, the gap between upper and lower limb function often widens because patients' do not know how to maximize use of their affected hand in their own environment, and options for continued therapy in a formal setting are limited.

Hand and finger movements during most functional tasks are also more complex than leg and foot movements during gait,[8] and even the simplest task requires the integration of several interrelated abilities.[9–11] For example, the relatively uncomplicated task of grasping a cup requires reaching for the cup, coordinating hand shape formation for grasping during reach, coordinating finger movements and fingertip forces during grasping and releasing, visuomotor coordination, tactile-motor coordination and finger individuation.[12] Impairment in any of these abilities can lead to hand dysfunction, and successful rehabilitation may depend on the identification and treatment of each of the specific underlying impairments. Alternatively, recovery may depend on global processes that affect these interrelated abilities simultaneously. More likely, upper limb functional recovery is mediated by processes occurring at both global and task-specific levels. At this time little is known about what specifically should be done to assist and maximize recovery of hand function. The lack of a theoretical framework for rehabilitation of upper limb function,[13] especially once the patient is in his or her own environment in the community is a significant impediment to use of the affected arm and hand in daily life.

Purpose of Study

Patients have first-hand knowledge about the difficulties they have encountered when performing functional tasks and the strategies that sometimes led them to regain this ability. Even though individual stroke survivors may differ in the specific difficulties they encounter, and some patients may recover hand function better than others, there may be common underlying themes in their difficulties and recovery patterns. The purpose of this qualitative study was to examine recovery of the ability to use the arm in daily life after stroke from the stroke survivors' point of view, to identify common themes and explore the potential to develop a theoretical framework for rehabilitation of hand function. The qualitative data for this study was gathered through a systematic process and is presented using the patients' words and descriptions to facilitate recognition and comprehension of their experiences.[14]

Methods

Eight patients between 44 and 66 years of age with chronic hemiparesis as a result of a stroke with unilateral hand dysfunction who were willing to talk about their efforts to regain hand function since their stroke were recruited from the community to participate in the study. The time since stroke ranged from 1.3 – 13.4 years (15–161 months), and all the subjects had moderate disability with some ability to reach and grasp with their affected hand (Table 1). The study protocol was approved by the Institutional Review Board and informed consent was obtained according to the declaration of Helsinki. Each participant made two visits to the research laboratory. At the first visit, screening assessments were performed to ensure that participants met the inclusion-exclusion criteria, which ensured that they formed a relatively uniform cohort to facilitate interpretation of their descriptions, and that the descriptions were not affected by other perceptual, cognitive and/or language deficits or comorbid conditions The inclusion criteria were: (1) Complaints of unilateral hand dysfunction resulting from a stroke; (2) Previously right-handed as confirmed by Edinburgh Handedness Inventory;[15] (3) A score of > 24 on Folstein's Mini Mental Status Examination, suggesting absence of dementia;[16] (4) Ability to complete the reading comprehension, listening and oral expression subtests on the short-form of the Boston Diagnostic Aphasia Examination[17] to rule out significant aphasia; (5) Ability to read newsprint held at arm's length separately with each eye (with glasses on) to rule-out significant deficits in visual acuity; (6) Ability to count fingers in all four quadrants of the visual field with each eye on confrontation testing, ruling out significant peripheral visual field defects; (7) Ability to bisect a straight line within 5% of the midpoint, ruling out clinically significant spatial neglect;[18] (8) Ability to demonstrate accurate use of scissors, suggesting absence of ideomotor apraxia.[19] The exclusion criteria were: (1) History of surgery or other significant injury to either upper limb; (2) Current treatment with botulinum toxin injections or intrathecal baclofen; (3) Previous neurological illness such as head trauma, epilepsy, or demyelinating disease; (4) Complicating medical problems such as uncontrolled hypertension, diabetes with signs of polyneuropathy, severe renal, cardiac or pulmonary disease, or any other severe concurrent medical problem. Total testing time did not exceed two hours for this visit.

During the second visit, the patients performed the Functional Task Battery, which consists of twenty upper limb tasks sampling common activities of daily living (Table 2). This battery was compiled from tasks in available upper limb functional batteries[20,21] to include a wider range of proximal and distal, unimanual and bimanual, and symmetric and asymmetric tasks than available in any one battery. We adapted the template and general instructions for administration of the functional task battery from that for the Wolf Motor Function Test. Each task was first demonstrated by the examiner and then the patient attempted to perform it in the same manner, with the affected arm/hand in the case of one-handed tasks. No constraint or assistance was allowed during the first attempt which was timed and limited to 2 minutes. After each task was completed, a series of open-ended questions were asked (Table 3) and further attempts at the task were allowed to enable the patients to express themselves fully as to what they experienced in their attempt to complete the task. The patients were encouraged to freely elaborate on both global and task-specific difficulties encountered during each task, and on any changes in their ability with the particular task they just performed and related tasks they perform in daily life since they had their stroke. The interviews were captured on audio and video. Three hours were allotted for the second visit, and adequate rest breaks were provided to prevent fatigue.

Qualitative Data Analysis

The patient interviews were transcribed by a transcribing service and checked for accuracy by P.R. The transcripts were then analyzed by two investigators (R.S. and P.R.) who independently read through them and watched the videotapes. The first reading of the transcript was done to get a sense of the patients' overall functional difficulties. Specific problems in task performance in the lab and in daily life, and recovery experiences were identified for each patient. The transcripts were then re-read and the videotapes were examined, as needed, to determine patterns or themes pertaining to task difficulty and recovery common across the patients. Themes were then compared among investigators to assess whether the observations were sufficiently consistent to develop core themes. Any developing theme was followed up by referring back to the transcripts and videotapes for confirmation and visualization of the context. Each core theme that developed is supported here by direct quotations (in italics) from at least three patients. There was no attempt to confirm observations in all eight patients; however, it was assumed that phenomena reported by at least three patients were unlikely to be idiosyncratic and might be the stepping stone for development of new theoretical insights into post-stroke recovery.

Results

Four core themes pertaining to impairment and recovery of task-specific ability emerged.

Theme 1: Spasticity can be overcome actively through task-specific attempts to use the affected arm and hand

All patients experienced stiffness in their limb post stroke, and this was articulated as a major challenge to performing tasks both in the lab and in daily life over the course of their recovery. However, repeated attempts with the affected arm appeared essential for overcoming the stiffness. P6 stated, *"No matter how bad [the spasticity], I overcame it. At first, I fought the tone in order to do the prayer beads. But then it came as I did it and it became easier*. P2 concurred by stating, *"Before you do anything you almost have to stretch in preparation. Whenever I found [that] I was able to do something, I kept doing it until it got better and better. Once I was able to get some movement, I did it all night long…once I got it moving, it moved easier."*

P3 considered the development of spasticity to be inherently positive. He felt that *"[stiffness] is associated with a breakthrough in getting new ability…the stiffness is exactly like the stiffness you feel on the first day of training for the rugby season."* He continued, *"I just feel that I could do it if I practiced* (i.e kept trying)*."* The key to reducing stiffness and increasing functional ability seemed to be to keep using the arm before it got more stiff: *"A few months ago, I was better able* [than earlier after the stroke] *to perform the task. I was a little more dexterous. I think practicing made a big difference because I persisted, knowing that if I [kept trying], I would eventually be able to do it",* said P8. P5 concurred*, "Practice! I can do things now that I couldn't do then. I tried practicing [tying shoes], to get the same result… I purposely wear my sneakers every weekend, just so that I have to tie them."* Thus the patient's statements suggest that even though spasticity is a challenge to task performance, it can be overcome actively through repeated task-specific attempts at doing the task.

Theme 2: Use of the affected arm can be facilitated by adopting positions that reduce the effect of gravity on the arm or enable gravity to act as a natural assist in the movement

The patients described several strategies that could assist with task performance despite their spasticity. Strategies that reduced the effect of gravity on their arm included supporting the affected arm on a surface, using the strength of their shoulder musculature to support the arm, using smaller movements, and bringing the objects closer to their body. Strategies that enhanced the effect of gravity included changing the orientation of the object, their arm or hand so that gravity naturally assisted the action such as leaning forward to let the arm hang down to open the fingers.

For instance, P7 described how he was able to spoon beans more successfully. *"I had to reset and position myself to change the orientation [of my arm]"* such that his affected shoulder and elbow were supported, to perform the task. He explained, *"Raising my arm was difficult…but I had the support of the table and was able to do it* (spoon the beans)*. If* *the table is too low or too high, I am not able to perform some of these functions. I couldn't do it if the table was not there stabilizing and giving support."* P7 found several tasks difficult to perform because *"the problem is in my shoulder…the shoulder and the upper arm control the rest of the arm."* In addition, P7's performance was impeded by weakness of his upper arm "*making it difficult to support the hand to grasp."* When P7's elbow was supported during a task, he *"felt very confident about holding the cup with his hand. When the arm feels weak, I note I cannot carry it too much longer and keep it from dropping."* P3 agreed that resting part of his arm enabled him to perform fine motor tasks because "*The key [to success] actually was stabilizing the hand. By resting it on the table, I could stabilize it, and it was fine."*

According to P8 support of the arm from the strength of the shoulder musculature is necessary to use the hand effectively to perform tasks, observing that *"my hand feels heavy because the support in the shoulder is not quite enough."* P1 also described *"a lack of grasping sense in the hand"* secondary to weakness in the shoulder. He stated that difficulty in performing tasks, *"always comes from the shoulder and stiffness in the shoulder does not give me enough [movement] to perform the task with the hand."* P4 noted that he could control his hand better when movement at the shoulder was more controlled. Once he engaged his shoulder muscles he had the realization that *"this [shoulder] is really a part of me now, I guess. I have to use it to move [the hand],"* and he was able to improve his task performance.

P6 could not tie the laces of shoes set on the table (standard placement in our study); they had to be placed on the floor next to his feet. He stated, *"The shoes I use are [on the floor]. The reaching up [on the table] is more difficult for me. This position is foreign to me."* P7 agreed by stating, *"I always tie my own laces but my hand is always [stiff]…I need the gravity to help me. And I have been [able to do] it for 13 years."*

Greater distance of the hand from the body meant less stability for the arm, which also hindered performance. If the task required reaching, P6 noted *"The further I reach with my body, the less control I have. That is why I compensate a lot of the movement by staying a lot closer to myself, [which] allows me to do a lot of things myself."* Thus the patient's statements suggest that use of the affected arm can be facilitated by adopting positions that reduce the effect of gravity on the arm or enable gravity to act as a natural assist in the movement.

Theme 3: Task-specific skill can be attained by repeatedly attempting specific movements in the context of similar tasks

Some participants performed a task well during the test battery because they had experience with a similar task at home. P8 explains her ability to flip cards because, *"It's a similar motion to when I read. I try to hold the left page with the same position."* P6 was able to succeed in stacking checkers because, *"I play scrabble all the time, at least an hour a day."* However, P2 and P4 were unable to perform two very similar tasks. For example, P4 could not grasp a cup or mug with a palmar grasp, but could grasp a water bottle. P2 also struggled with grasping objects but was able to grasp a telephone receiver very well because *"In one job I had after my stroke, the phone was on the left (affected) side and I just started using my left hand to answer the phone."*

Successful performance seemed to be dependent on how closely matched the movements in the tasks at home were to those required for the tasks in the Functional Task Battery. For instance, P1 had difficulty picking up a checker piece, even though she could spoon with relative ease, stating *"I have to struggle because the finger pads [of the index finger and thumb] are not easy for me to grip [with]. This finger [index] stiffens up and it goes straight* *out every time."* P7 performed well in grasping a mug, holding a fork and opening a jar. However, he had difficulty picking up a phone because, *"The problem is that there is change in the orientation."* The difficulty was more with positions or movements that were unfamiliar to them. Thus the patient's statements suggest that it is not just repeating a particular task over and over again, but paying attention to and developing an awareness of the *component movements* of tasks, so that they can be repeated and reinforced in the context of a variety of different tasks.

Theme 4: Frustration impedes task performance but a mental state of 'detached focus' can improve the motivation to use the affected arm

After a stroke even the simplest tasks require great effort and concentration. P3 stated, *"I just concentrated very hard until my finger pressed down* (referring to the buttons on the phone)*, and I was being very careful with how much pressure I applied with my right hand."* Similarly, P2 stated, *"I am concentrating. I have to put all effort to try and release. It is really straining. But if I stop concentrating on holding [my fingers] open, they will just close. It takes every bit of concentration to keep them open."* P6 similarly stated, *"It is like you have to tell it to release and have to think harder."*

However, excessive effort could also easily overwhelm and frustrate patients, making the task increasingly difficult to perform. P8 noted, "*It is hard for me to describe where all the effort is because there is so much. It is the frustration I face every day."* P5 also noted that *"I was angry at myself that I could not do things"* and being upset caused an *"inability to straighten out tension [in my] fingers"* and led to even greater difficulty with the task.

When patients became overwhelmed with a task, poor performance often lead to a vicious cycle of frustration, build-up of emotional tension, progressive deterioration in performance, and giving up on the affected hand, both during performance in the lab and (as they reported) in daily life since their stroke. P2 observed "*I have been adapting all my tasks accordingly"* because he would become overwhelmed with using his affected hand for the activity. *"I just do it with [my unaffected arm]…because it is…easier. It has been detrimental to me just training myself not to use [my affected hand]."* When typing, P5 also resorted to using his unaffected arm. He stated, "*It is frustrating. I say, 'the hell with this because I have so much work to do!' I used to be the world's fastest two-hand typist. Now I'm the fastest one hand typist."* P7 also was in agreement stating, "*It's laziness on my part. Frankly, I would rather use my right [unaffected] hand. Why use my left if my right will suffice? I use my left hand very seldom, when it is absolutely necessary."*

However, if patients attempted to use their affected hand in a playful manner and got into the "zone", they rose to the challenge without getting frustrated and had a positive experience with task performance. P5 stated, *"I play games with the shaving can cover all the time. I will knock it off into the sink, pick it up, put in my hand, and turn it over. I refuse to use my other hand to do it."* Similarly, if concentration did not emotionally overwhelm the patient, performance outcome improved. After completing a difficult task during testing, P7 shared*, "… it was like a little victory, but you have to have [tolerance for] these little frustrations to get to the victory."* P3 stated that he had to "*do something different…to get whatever will give me more control over my arm. That was my reckoning and [I] went back to the gym."* Changing his mental approach to using his affected hand made a *"huge difference and [I] could do much, much more."*

Discussion

This qualitative study examined the perspectives of community-dwelling patients with chronic stroke on their experience in regaining use of the affected hand, and led to the emergence of four core themes: 1) Spasticity can be overcome actively through task-specific attempts to use the affected arm and hand; 2) Use of the affected arm can be facilitated by adopting positions that reduce the effect of gravity on the arm or enable gravity to act as a natural assist in the movement; 3) Task-specific skill can be attained by repeatedly attempting specific component movements of tasks in the context of a variety of different tasks; and 4) Frustration impedes task performance but a mental state of 'detached focus' can improve the motivation to use the affected arm. Each of these themes is discussed below and a theoretical framework based on these themes is articulated to assist patients in regaining hand function post stroke (Table 4).

Conversations with the patients revealed that the more they attempted to use their affected hand to perform various tasks, the less stiff they felt in their joints and muscles over time. However, the typical challenge after a stroke is that stiffness prevents movement or results in abnormal movement in an unintended direction. This makes attempts at using the affected arm extremely difficult. Patients who attempted to actively self-manage their stiffness found that positions that reduced the effect of gravity on the arm or enabled gravity to act as a natural assist in the movement, achieved by supporting the arm on a surface, activating their shoulder muscles, holding the object closer to the body or reorienting their arm assisted task performance. Research has shown that dynamic stiffness results from both intrinsic (muscle fibers and surrounding connective tissue) and reflex mechanisms.[22] Also, joint position and voluntary muscle contraction levels, particularly during anti-gravity movements, can have a bearing on both mechanisms.[23,24] Gravity assisted training using table-top or robotic support has led to improvement in arm motor impairment particularly in patients with moderate-to-severe hemiparesis.[25,26] However, the effort required to support the limb against gravity is thought to contribute to position sense in the limb;[27–29] therefore, gravity-supported positions may be of less value in patients with lower levels of impairment.

The patients suggested that they could also actively support their arm against gravity by learning to use their shoulder muscles. Movements of the shoulder joint are complex and are characterized by a smooth coordination between scapular and humeral movements, known as the scapulo-humeral rhythm.[30] Studies indicate that the scapulo-humeral rhythm is disturbed after stroke, on both the affected and unaffected side; the altered pattern of shoulder movement includes increased shoulder elevation and abduction and decreased scapular external rotation.[31–34] Increased abduction of the shoulder is associated with an increase in involuntary elbow, wrist, and finger flexor synergy.[35,36] Preliminary studies from our lab found that facilitating scapular mobilization and external rotation can decrease spasticity in the entire upper arm and increase the available range in shoulder external rotation, and elbow, wrist and finger extension.[37] Thus strengthening the muscles that restore scapulo-humeral rhythm may avoid abnormal arm movement patterns and facilitate learning of desirable movements.

The third common theme that arose was that a task-specific skill can be attained by practicing component movements of a task that are embedded in other tasks, requiring similar positioning of the shoulder and elbow, and orientation of the hand and fingers. Task-specific training is recommended to enhance learning post stroke as it has been shown that improved skill in one task does not easily generalize to a different unpracticed task.[38] However it is not possible to practice every single task one might encounter. Furthermore, the goal of motor learning is to ultimately be able to generalize skill to unpracticed new tasks. Therefore one might ask what type of practice will generalize skill to many similar tasks. Patients in our study reported that transfer of skill to unpracticed tasks occurred when an individual had experienced similar movements in the context of other tasks. Thus we propose a different approach to task-specific practice: perhaps one can provide movement-specific training by first selecting movements that are common to many different tasks and then making sure that the patient pays attention to *how* the task is accomplished rather than focusing just on completing it. For example, most functional tasks may be broken down into components such as reaching, grasping, and manipulation. These component tasks may be further broken down into their movement subcomponents such as, for reaching, shoulder flexion and elbow extension.[39] If a patient has difficulty coordinating shoulder flexion and elbow extension during reach, then one approach may be to selectively train the combined shoulder flexion-elbow extension movement in the context of simple, but relevant functional tasks requiring reaching towards various objects at different distances. This type of movement training would train functional coordination between shoulder flexion and elbow extension which is embedded in all reaching movements, rather than either of these movements alone.[40] Based on a patient's level of ability, one may selectively train the movement components for reaching, grasping, and/or manipulation tasks for greater generalization.

The final theme that emerged from our conversations with the patients was that using the affected arm is difficult and requires a great deal of effort and concentration. However, the *mental attitude* to practice may differentiate successful practice from failed practice. Patients who concentrated too hard on tasks and became emotionally vested in its outcome reported increased stiffness and worsening of performance, which led to frustration and a desire to give up. In one report of a case of a pianist with a stroke, conscious attention to movement outcome on the affected side led to greater difficulty with movements on that side. However, when his attention was directed elsewhere or on moving his unaffected hand, he spontaneously moved his affected hand.[41] In our study, patients reported greater success with practice when they adopted a mindset of 'detached focus', where they seemed to be able to dissociate the mental effort of concentrating on a task from the emotional attachment to task outcome. Kleiber et al. have noted that attitudes that reflect freedom, openness to experience, and intense engagement, commonly associated with leisure activities, significantly affect both the experience of illness or disability and the recovery process, particularly in the reconstruction of possibility within the rehabilitation context.[42] Such attitudes may raise the likelihood of achieving the optimal experience referred to as "flow",[43] or "being in the zone".[44] "Play" may also direct the attentional focus externally to the physical effect of the movements rather than internally, which has been found to facilitate skill learning.[45,46] Furthermore, negative psychological symptoms are common after stroke and are associated with lower functional outcomes.[47] Improving mood through enjoyable activities may accelerate physical recovery.[48] Thus removing the stressful aspects of practice may lead to greater success in task performance and reinforcement of continued practice that is necessary for learning new patterns of movement post stroke.

Conclusions

Hand function is inherently complex and a cohesive framework for rehabilitation of hand function post-stroke is currently lacking. Stroke survivors are well-placed to provide insight into strategies that helped them. The four core themes that emerged from this qualitative study provide important new insights into strategies to facilitate use of the affected hand in daily life after stroke for community-dwelling individuals with chronic hand dysfunction but without significant perceptual, cognitive and/or language deficits or comorbid conditions. Since this is a descriptive study the concepts may be applicable in the acute-inpatient and outpatient post stroke rehabilitation settings as well. The themes generate new hypotheses that may be tested using quantitative research methods. "Talking while doing" may be a useful qualitative approach to understand hand function limitations and treatment approaches geared for individual patients.

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Table 1

Patient Demographics.

Patient #	Age	Gender	Handedness	Hemiparesis	Months since stroke	Months of Occupational Therapy	Affected upper extremity Fugl-Meyer score
1	66	Female	Right	Left	50	14	37
2	61	Male	Right	Left	108	10	38
3	58	Male	Right	Right	15	15	40
4	48	Male	Right	Right	79	60	19
5	49	Male	Right	Left	41	36	36
6	44	Male	Right	Right	26	8	35
7	66	Male	Right	Left	161	20	40
8	59	Female	Right	Left	28	7	36

Table 2

One- and two-handed activities of daily living that are part of the Functional Task Battery, listed by the movements that are required.

1. One-Handed Tasks:
   - **a.** Shoulder-elbow coordination:
     - **i.** Reach and retrieve a one pound weight
     - **ii.** Wipe spilled water
   - **b.** Forearm pronation and supination
     - **i.** Flip cards
     - **ii.** Spoon a bean
   - **c.** Whole-hand grasp and object manipulation:
     - **i.** Drink from mug (using palmar grasp & hook grasp)
     - **ii.** Squeeze an orange (halved)
   - **d.** Three-finger grasp and object manipulation:
     - **i.** Pinch lemon wedge
     - **ii.** Write a word
   - **e.** Two-finger (precision) grip and object manipulation:
     - **i.** Flip a light switch
     - **ii.** Stack checkers
     - **iii.** Place pegs in a pegboard
   - **f.** Visuomotor coordination/proprioception:
     - **i.** Finger-to-nose (eyes open and closed)
   - **g.** Tactuomotor coordination/stereognosis:
     - **i.** Count coins (with eyes closed)
   - **h.** Finger individuation:
     - **i.** Dial a number on touch-tone phone
     - **ii.** Type a word on keyboard
2. Two-Handed Tasks:
   - **a.** Bilaterally asymmetrical:
     - **i.** Put on a coat (gross arm movements)
     - **ii.** Open a jar (palmar grasp)
     - **iii.** Cut meat (precision grasp and manipulation)
   - **b.** Bilaterally symmetrical:
     - **i.** Eat a sandwich
   - **c.** Bilateral dexterity:
     - **i.** Tie shoe laces (on a table)
     - **ii.** Button a coat (two lower buttons)

Table 3

Questions asked after each task.[*]

- What difficulties did you encounter in completing this task?
- Do you feel you have adequate strength in your muscles to perform this task? (Weakness)
- Are the movements in your joints adequate to perform this task? (Range-of-motion)
- Do your muscles tighten as you attempt to perform this task? (Muscle tone/spasticity)
- Does this task tire you? (Fatigue)
- Do you feel any discomfort or pain in performing this task? (Pain)
- Do you feel able to coordinate and/or sequence the actions? (Joint co-ordination)
- Can you feel the object and how you are moving? (Sensation/proprioception)
- Do you have difficulty seeing or perceiving the object? (Vision)
- Are you able to perform the movement as fast as you would like? (Timing)
- How did you regain the ability to perform this task?
- What is your experience doing similar tasks?
- [If unsuccessful] What therapy do you think you need to be able to perform this task?
- [If unsuccessful] Do you think this task is important in your day to day life and something you would like to work on mastering?

[*]The specific impairment assessed by the questions is noted in parentheses. Each question was asked in simpler language, repeated and/or explained as needed, and followed up by probes to get at greater detail.

Table 4

Framework for continued post-stroke upper limb rehabilitation in patients' own environment.

Theme	Implications for therapy
1. Spasticity can be overcome actively through task-specific attempts to use the affected arm and hand.	Actively work through movement deficits with the affected arm and hand using strategies that make movement possible.
2. Use of the affected arm can be facilitated by adopting positions that reduce the effect of gravity on the arm or enable gravity to act as a natural assist in the movement.	Use strategies that stabilize the arm against gravity passively or actively (using shoulder musculature), or use gravity as a natural assist.
3. Task-specific skill can be attained by repeatedly attempting specific component movements of tasks in the context of a variety of different tasks.	Facilitate selective and ecologically valid practice of impaired movements or movement combinations embedded within a variety of different tasks.
4. Frustration impedes task performance but a mental state of 'detached focus' can improve the motivation to use the affected arm.	Promote a mindset of openness to experience as in "play", using leisure activities, art, gaming, and music making to provide a positive reinforcing experience for task practice.