RESEARCH ARTICLE

Development and usability of functional activities specific training (FAST) table for stroke rehabilitation: mixed method design

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Abstract

Objective: To explore the current practices and trends of task-oriented training, to identify and validate functional tasks pool, and to develop the functional activities specific training table.

Method: The two-staged, mixed-method study was conducted at Pakistan Railway General Hospital, Rawalpindi, Pakistan, from September 15, 2022, to February 20, 2023. Semi-structured interviews with thematic analysis were conducted in the first phase of stage I that comprised physiotherapists from different cities to assess trends regarding task-oriented training. In the second phase, functional tasks pool was identified from literature review and categorised into four key domains. Content validity index was done for the identification of functional tasks pool by physiotherapy experts, resulting in a list of functional tasks to be incorporated in the functional activities specific training table. A table prototype was developed, and usability assessment was done with the system usability scale in stage II by patients and physiotherapists. The qualitative phase included 22 physiotherapists. For content validity, 20 experts were invited, of whom 17 responded. Usability testing involved 20 physiotherapists and 20 patients. Data was analysed using Atlas.ti and Microsoft excel.

Results: In stage I, there were 22 physiotherapists with mean age 35.09±2.81 years and mean clinical experience 5.45±0.59 years. Six interconnected themes were identified regarding current practices, while literature review led to a functional tasks pool with 200 activities that were categorised into upper extremity, lower extremity, balance, and cognition-based activities. Content validity index resulted in 100 activities suitable for functional activities specific training table. In stage II, the prototype design's usability was rated by 20 patients with a mean score of 81.25±16.5, and by 20 physiotherapy experts with a mean score of 81.37 ± 11.77.

Conclusion: Based on current practices and perception of Pakistani physiotherapists, a therapeutic functional activities specific training table was developed with 100 task-oriented training-based activities for stroke rehabilitation. It showed strong usability scores by both patients and therapists.

Key Words: Functional activities, Mixed method, Rehabilitation tools, Task-oriented training, Usability testing.

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Introduction

Stroke is the second leading cause of mortality and the third leading cause of combined mortality and disability globally.[1] Post-stroke patients experience a wide range of impairments, including motor, sensory and cognitive impairments, that significantly affect activities of daily living (ADLs) and recovery after stroke.[2] Hemiplegia and hemiparesis are common motor deficits[3] along with sensory impairments, like reduced proprioception, and kinaesthesia further limits functional motor abilities.[4] These interconnected deficits complicate rehabilitation process, emphasising the need for tailored[5], comprehensive rehabilitation programme to optimise recovery and quality of life (QOL) in stroke survivors.[6]

There are many rehabilitation approaches to overcome the post-stroke impairments, and enhance motor recovery separately for upper and lower extremities.[7] Task-oriented training or functional activities-based approach is built upon the principles of neuroplasticity and motor relearning. It has potential to address the multifaceted challenges and demands of holistic rehabilitation[8] by improving motor, sensory and cognitive impairments post-stroke.[9] Existing task-oriented training-based rehabilitation has some limitations[10, 11] that hinder the application of important concepts, such as 'action selection' and 'environmental enrichment' in task-oriented training. The 'action selection' concept is based on autonomy of patients to choose tasks from a pool that align with their daily life preferences.[12] The 'environmental enrichment' focusses on creating a diverse and stimulatingly rich environment to boost rehabilitation outcomes.[11] The lack of these

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concepts in already practicing task-oriented training (TOT)-based rehabilitation can make it difficult for patients to apply the acquired skills in real-life situations.[13] Moreover, the absence of a standardised pool of functional task-based activities limits the ability of individualised rehabilitation for the unique requirement of each stroke patient.[14]

Some therapeutic equipment's have been developed for stroke rehabilitation, like the Dominic's Board, a wooden therapeutic device designed to facilitate upper Extremity rehabilitation.[15] The Ludic-activities-based therapeutic suitcase offers a novel approach for stroke rehabilitation.[16] This intervention integrates playful activities to target proprioception, motor coordination, fine motor skills for upper extremity and cognitive training[16]. However, despite these advancements, the scarcity of specialised equipment for TOT in rehabilitation facilities restricts the variety of tasks that can be conducted for upper and lower extremity, balance and cognition all at once for holistic rehabilitation. These limitations hinder the possibilities for participating in a wide array of activities that foster brain plasticity and functional enhancements.[11,17]

The current study was planned to explore the current practices and trends related to TOT, to identify and validate functional tasks pool, to develop a functional activities specific training (FAST) table, and to assess its usability in the eyes of patients and physiotherapy experts.

Materials and Methods

The two-staged, mixed-method study was conducted at Pakistan Railway General Hospital, Rawalpindi, Pakistan, from September 15, 2022, to February 20, 2023. The study employed a sequential exploratory design based on Tseng's framework[18] for innovative product development, integrating qualitative and quantitative approaches. Stage I involved exploration and validation of functional tasks, while stage II focussed on the development and usability testing of the FAST table. Approval was obtained from the ethics review committee of Riphah International University, Islamabad, and all the participants furnished informed consent.

In the first phase of stage I, which was about qualitative exploration of TOT, thematic analysis[19] was done to explore how TOT concepts were utilised in stroke rehabilitation by physiotherapists in Pakistan. Physiotherapists were purposively sampled based on ≥5 years of neuro-rehabilitation experience and involvement in stroke rehabilitation. Sampling continued until thematic saturation was achieved during consecutive semi-structured interviews. The semi-structured interview guide was pilot-tested and refined for clarity and cultural appropriateness. The duration of interviews was 50-60 minutes, and the interviews were audio-recorded. Coding and thematic analysis was done using ATLAS.ti software.

In the second phase of stage I, a literature search of randomised controlled trials (RCTs), systematic reviews and meta-analyses was conducted across PubMed, Physiotherapy Evidence Database (PEDro) and Medical Literature Analysis and Retrieval System Online (MEDLINE) databases. A functional tasks pool was identified, and these tasks were categorised into four domains: upper and lower extremities, balance and cognition.

This was followed by content validity assessment of the identified functional tasks pool, for which a sample of 20 physical therapists with ≥5 years of experience, academics/researchers specialising in neurological rehabilitation were included. This sample exceeded commonly recommended minimums for Content Validity Index (CVI) studies.[20, 21] A structured questionnaire was used for content validity of the tasks.[22] The functional task pool validation was based on relevance, clarity and feasibility for stroke rehabilitation.

CVI was used following Lynn's method.[23] Each of the 200 tasks was rated by the physical therapists on a 5-point Likert scale for relevance, ranging from 1 = not relevant to 5 = highly relevant in Microsoft excel. Tasks with CVI ≥0.80 were retained. Item-level CVI (I-CVI) was calculated as the proportion of experts rating the item ≥4:[24]

$$\text{I-CVI} = \frac{\text{Number of experts rating item} \geq 4}{\text{Total number of experts}}$$

Stage II of the study was about FAST table design and usability testing. For conceptualisation and prototype development, a three-dimensional (3D) model of the table was created using automatic computer-aided design (AutoCAD). The table was constructed from wood with dimensions based on ergonomic standards and the Wolf Motor Function Test: height 28" (+6" activity box), width 30" and length 54". Features included six activity boxes and adjustable parallel bars (30-33" height) (Table 1).

Usability was evaluated using the System Usability Scale (SUS)[25] separately for patients and physical therapy experts following task performance with the FAST table in a controlled setting. A convenience sample of patients and physiotherapy experts was recruited based on

Table-1: Dimensions of the functional activities specific training (FAST) table.

Table Height	28 inches + 6 inches height box over the table
Table Length	54 inches
Table Width	30 inches
6 boxes on tabletop	height 6 inches 12*16 dimensions
Parallel bars attached to side of table	
parallel bars Length	72 inches
parallel bars Width	24 inches
Height is adjusted at two levels	30 and 33 inches
Mirror stand for parallel bars	
mirror height	72 inches
Mirror width	21 inches

feasibility and standard recommendations for SUS usability testing in research.[26] The total SUS score ranged 0-100, with interpretive cut-offs consistent with established SUS benchmarks (acceptable ≥68; excellent ≥80) and it was calculated using Microsoft Excel.

Qualitative data from semi-structured interviews was analysed using a six-step thematic analysis framework, including familiarisation, coding, theme development, review, definition, and reporting.[19] All audio-recorded interviews were transcribed verbatim and imported into ATLAS.ti for systematic coding and organisation. Themes were refined through iterative comparison until data saturation was confirmed. Reflexivity was maintained through audit trails and memo writing, and COREQ guidelines were followed. Quantitative data was analysed using Microsoft Excel.

Results

In the first phase of stage I, there were 22 physiotherapists from various regions of Pakistan with mean age 35.09±2.81 years and mean clinical experience 5.45 ± 0.59 years. Physical therapists were included from Lahore, Faisalabad, Peshawar, Rawalpindi, Islamabad and Jhelum cities of Pakistan.

Thematic analysis yielded six interconnected themes related to the practice of TOT in stroke rehabilitation. The first theme was TOT practices and perceptions. TOT was mentioned as a patient-focussed, repetitive, activities-based approach followed by principles of neuroplasticity. “TOT is not just repetition-based movements, it highlights the importance of daily activities, like reaching for a water glass, sit-to-stand activities, or walking on different textured surfaces for proprioception awareness." (P9)

Some of the participants perceived lack of proper guidelines for TOT application in Pakistan, may be a source of inconsistencies in local practice. “Most of the therapists utilise this approach according to the background and resources at hand.” (P12)

The second theme was motor function-based TOT. Motor function was categorised by the physiotherapists into extremities-based training, highlighting both gross and fine motor skills for upper extremity, and gait training for lower extremities. Gross motor activities were mentioned as “a focus on larger, gross movements initially, such as reaching for any object by extending arm, lifting, and encouraging weight-shifting to the affected side." (P4) Object manipulation tasks, such as buttoning clothes or grasping small items, were mentioned as fine motor activities, “to enhance dexterity and coordination." (P9) For lower limb stepping and gait activities, uneven terrain surfaces were recommended and stairs climbing activity to engage in real-world outdoor walking. It was mentioned by physiotherapist that patients were reluctant to lower limb training compliance, because “early mobility might create fear of fall in stroke patients.” (P17)

The third theme was cognitive rehabilitation. A few participants noted that TOT also supports cognitive enhancement in stroke survivors, observing that task-based activities naturally engage attention, problem-solving and planning. The therapists described incorporating dual-task exercises, where patients performed cognitive tasks, such as mental calculations, simultaneously with walking to challenge both motor and cognitive functions. "In training sessions therapists sometimes use tasks which mimics real world scenarios, like counting money and playing roles of daily routine, to improve reasoning." (P3) "in some clinics, mobile games are used to make patients able to recall names of daily use objects or sequences of different items appearing on screen." (P17) "Stroke survivors with cognitive impairments frequently face challenge with adhering to any task and they get exhausted easily." (P7) The therapists also mentioned that tasks breakdown into simpler components and using audio and visual stimuli improved patients’ involvement in treatment sessions.

The fourth theme was balance training. Balance training was considered an important training part while giving TOT for stroke. It was categorised by physiotherapists into static and dynamic postural exercises. Most of the therapists mentioned the limited availability of balance-specific therapeutic equipment in local clinics as a major limitation in rehabilitation. "Therapists in local Pakistani clinics has no balance boards and technology-assisted systems, such as virtual reality-based training tools, and balance training is confined to some basic stepping activities only." (P13) Some local rehabilitation centres use traditional balance equipment to overcome this

Table-2: Usability assessment of patients (P) and experts (E).

Participant	q1	q2	q3	q4	q5	q6	q7	q8	q9	q10	SUS Score	Average SUS score
P1	4	1	4	5	5	5	5	5	5	1	65.0	81.25
P2	5	4	5	4	5	4	5	2	5	2	72.5	
P3	3	3	3	3	3	3	3	3	3	3	50.0	
P4	4	2	4	2	4	2	4	2	4	2	75.0	
P5	5	1	5	1	5	1	5	1	5	1	100.0	
P6	4	2	5	1	4	1	5	1	5	2	90.0	
P7	4	2	5	1	4	3	5	1	5	1	87.5	
P8	4	2	5	1	4	1	5	1	5	1	92.5	
P9	4	2	5	1	4	1	5	3	5	1	87.5	
P10	4	2	5	2	4	1	5	1	5	1	90.0	
P11	4	2	5	1	4	3	5	1	5	1	87.5	
P12	4	2	5	1	4	3	5	1	5	1	87.5	
P13	4	2	5	1	4	3	5	1	5	1	87.5	
P14	4	2	5	1	4	1	5	1	5	1	92.5	
P15	4	2	4	2	4	2	4	2	4	2	75.0	
P16	4	2	4	2	4	2	4	2	4	2	75.0	
P17	5	4	5	4	5	4	5	2	5	2	72.5	
P18	4	2	5	1	4	1	5	1	5	1	92.5	
P19	4	2	5	1	4	1	5	1	5	1	92.5	
P20	5	4	5	4	5	4	5	2	5	2	72.5	
E1	5	4	5	4	5	4	5	2	5	2	72.5	81.37
E2	4	1	4	1	5	3	3	1	3	5	70.0	
E3	4	2	4	2	4	2	4	2	4	2	75.0	
E4	5	1	5	1	5	1	5	1	5	1	100.0	
E5	4	2	5	1	4	1	5	1	5	2	90.0	
E6	4	2	5	1	4	3	5	1	5	1	87.5	
E7	5	3	5	2	5	3	5	1	5	1	87.5	
E8	5	4	5	4	5	4	5	2	5	2	72.5	
E9	5	4	5	4	5	4	5	2	5	2	72.5	
E10	4	1	4	1	5	3	3	1	3	5	70.0	
E11	4	2	4	2	4	2	4	2	4	2	75.0	
E12	5	1	5	1	5	1	5	1	5	1	100.0	
E13	4	2	5	1	4	1	5	1	5	2	90.0	
E14	4	2	5	1	4	3	5	1	5	1	87.5	
E15	5	3	5	2	5	3	5	1	5	1	87.5	
E16	4	1	4	1	5	3	3	1	3	5	70.0	
E17	4	2	4	2	4	2	4	2	4	2	75.0	
E18	5	1	5	1	5	1	5	1	5	1	100.0	
E19	4	1	4	1	5	3	3	1	3	5	70.0	
E20	4	2	4	2	4	2	4	2	4	2	75.0	

SUS: System usability scale.

limitation for example, practicing gait over cushions or ambulating on uneven and textured surfaces to simulate real-life environmental demands.

The fifth theme was TOT barriers. The physiotherapists reported resource constraints, limited therapy time, basic knowledge about TOT concepts, and lack of standardised functional activities pool as primary barriers in TOT. Similarly, some therapists mentioned patient-related barriers. "Many patients cannot continue therapy sessions because of the travelling cost for regular clinic-based sessions." (P16) "TOT requires extensive time per session for proper repetition of activities, but therapists have limited time for each patient, and repetition count sometimes cannot be completed." (P14) "Stroke survivors may not experience noticeable progress immediately which may lead to reduced motivation and disengagement in repeating the tasks." (P7)

The sixth theme was cultural and contextual factors. Some therapists emphasised the influence of cultural norms and values, as well as systemic factors, such as

Figure: Functional activities specific training (FAST) table with 6 colour boxes and activities for upper limb gross and fine motor skills (a), and full view of FAST table with parallel bars and mirror attached to it (b).

healthcare infrastructure and insurance availability or panel-based treatment barriers. the participants also reported socioeconomic factors, mainly work ergonomics and financial limitations, as a barrier to accessing or providing rehabilitation services. Lastly, language and communication challenges were identified as additional barriers. This might be overcome by using visual cues and non-verbal instructions to support patient understanding to confirm patient understanding of treatment instructions. "Many traditional Pakistani families have the belief that only rest, herbal and spiritual treatment options are better and have instant results than physiotherapy exercise alone." (P18) "Many stroke patients' families terminate therapy because they are unable to afford multiple rehabilitation sessions without any entitlement." (P6) "Rural patients sometimes face challenges comprehending rehabilitation instructions provided in Urdu as they have local languages from peripheries, like Pushto, Punjabi, Potohari and Saraiki." (P14)

In the literature review phase of the study, a pool of 200 functional tasks was identified through a literature review of 35 peer-reviewed studies, of which 22(62.85%) were RCTs, 8(22.85%) were systematic reviews and 5(14.28%) were meta-analyses. Tasks were categorised broadly into domains of upper and lower extremities motor functions, balance and cognition.

In the content validation phase of the study, out of the 20 invited physical therapy experts, 17(85%) evaluated the tasks for CVI For which 100(50%) of the identified tasks met the criteria for inclusion in the final list of tasks to be designed on the FAST table. The tasks were excluded based on lack of relevance, ambiguity, redundancy or feasibility issues.

The validated tasks were categorised in four domains. There were 30(30%) tasks related to the upper extremity, involving reaching, grasping, fine motor skills, and object manipulation. There were 30(30%) tasks related to the lower extremity, involving sit-to-stand transitions, stepping, weight shifting, and gait training. There were 30(30%) tasks related to balance, involving static and dynamic balance exercises to improve postural control

and stability. Finally, there were 10(10%) tasks related to cognition, involving memory, focus and problem-solving tasks-based games.

The final list of 100 tasks was utilized in a recently published RCT with different intensities using the FAST table27.

In Stage II of the study, the 100 validated tasks laid the foundation for the development of the FAST table prototype (Figure 1). The patients rated the tool with a mean SUS score of 81.25±16.5, and the physiotherapy experts rated it 81.37±11.77, indicating high usability among both the groups (Table 2).

Discussion

The current study explored clinical practices and perceptions about TOT, identified validate functionally relevant tasks pool, and developed a TOT-based prototype FAST table for stroke rehabilitation in Pakistan. The qualitative exploration showed that physiotherapists are familiar with the value of TOT for motor, cognitive and balance training. Some variations were observed in its application due to resource limitations, lack of standardised protocols and tasks pool, and patient-related barriers. The validation of 100 functional tasks across four core domains demonstrated strong agreement among the physiotherapy experts, supporting their application on FAST table. Finally, usability testing of the FAST table prototype reported high SUS scores for both patients and therapists.

The qualitative exploration in current study shows that TOT is widely accepted as patient-focused, repetitive, activities-based approach in line with the principles of neuroplasticity in stroke that is aligned with existing research.[28] It was reported that real-life tasks incorporation, rather than isolated exercises, improves neuroplasticity. However, despite acknowledging the benefits of TOT, variability was observed in its implementation. These variations may have resulted on the basis of the availability of institutional resources, the therapists' expertise, and the patients' engagement in therapy. High-income countries have reported standardised TOT frameworks without variation in applicability.[29, 30] The qualitative findings of the current study directly informed the development process, task selection, and design rationale of the FAST table prototype based on local needs of stroke rehabilitation.

The physiotherapists categorised TOT-based stroke training into extremity-based activities, like reaching, grasping, manipulating and stepping. These findings are consistent with principles of task-specific motor learning.[28,31] Furthermore, some barriers, like patients' fear of movement, and insufficient access to specialised therapeutic tools in low-resource contexts, are also aligned with previous literature.[32] Therapists in the current study adapted the functional tasks using low-cost household items. These adaptations to local context patterns directly informed the FAST table's domain structure, while reported barriers guided the selection of low-cost, functionally relevant tasks feasible in under-resourced settings.

The current study highlights the essential role of training to improve post-stroke postural control, consistent with previous literature.[33] The therapists mentioned exercises targetting both stable postures and dynamic movements, but reported limited access to specialised balance equipment and restricted clinical space, which are challenges also described in other studies done in similar settings.[33] As a result, the professionals relied on simple alternatives, such as walking practice on different surfaces combined with weight-transfer activities. These observations guided the inclusion of balance activities in the FAST table that can be used effectively in basic clinical settings without advanced equipment.

While the current study's focus is on a traditional therapeutic tool, it is essential to acknowledge the advancements in rehabilitation technology, particularly robotic and exoskeleton devices, which have garnered attention in recent years.[34] Robotic hand rehabilitation devices have emerged as promising tools for treating motor impairments in the fingers and thumb post-stroke.[35] Similarly, power grip exoskeletons have been designed to enable independent therapy for power grip rehabilitation.[36] LE exoskeletons and ankle robotic exoskeletons further extend the scope by assisting individuals with gait impairments and ankle joint spasticity.[37,38] While the current wooden therapeutic table differs from high-tech devices, synergies exist. Its versatility enables a wide range of rehabilitation exercises covering upper and lower extremity training, balance, and cognitive exercises. Additionally, in resource-scarce settings, expensive and hard-to-obtain rehabilitation equipment can pose challenges.[39]

A locally produced wooden table with a variety of functional tasks can offer a cost-effective alternative for rehabilitation facilities to patients lacking financial resources. It can be customised to fit the unique requirements and cultural setting of the local population. The table can more effectively meet the objectives of rehabilitation by taking stroke patients in Pakistan's needs into account and using culturally acceptable design aspects.

The current study has several limitations. Long-term outcomes were not assessed, limiting the conclusion about sustained effectiveness. In addition, the patient sample lacked diversity, and findings from a single clinical setting may not be generalisable. Further research with larger samples and follow-up evaluations is needed.

Conclusion

A FAST table was developed and validated as a structured, task-oriented rehabilitation tool tailored to the functional needs of stroke survivors. Its design incorporated culturally relevant, low-cost activities across motor, balance and cognitive domains, supporting its usability for routine clinical use.

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AA: Concept, design, data acquisition, analysis, interpretation, drafting, revision, final approval and agreement to be accountable for all aspects of the work.

ANM: Concept, design, data acquisition, analysis, interpretation, revision, final approval and agreement to be accountable for all aspects of the work.

FAR: Final approval and agreement to be accountable for all aspects of the work.