



The Use of Long-Handled Brush as an Assistive Device for Improving Bathing Satisfaction in Spinal Cord Injury Patient: A Case report

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Abstract

Background: Spinal cord injury (SCI) is a damage to spinal cord that results in temporary or permanent impairment or loss of sensory, motor, and bladder function. The aim of this study was to assess the effectiveness of a comprehensive rehabilitation therapy program combined with the provision of a long-handled brush to improve independence in bathing activities. **Objective:** A 30-year-old man was diagnosed with spinal cord injury at American Spinal Injury Association (ASIA) Impairment Scale (AIS) B, motor level C5, caused by neurofibromatosis. Impaired hand muscle function resulted in poor hygiene due to the inability to reach his lower body part. **Methods:** Adaptation techniques, environmental modifications, and the provision of assistive devices were important components of the occupational therapy rehabilitation. Focused on maintaining upright sitting position by controlling and strengthening trunk posture while scrubbing the lower body with a long-handled brush. **Results:** Five weeks after the comprehensive occupational rehabilitation program showed improvement characterized by Canadian Occupational Performance Measure (COPM) scores for bathing activity performance from 3 to 5 and bathing activity satisfaction from 4 to 6. **Conclusions:** The implementation of comprehensive rehabilitation therapy program using a rehabilitative frame of reference combined with an assistive device effectively improved independence in bathing activities.

Index Terms- activity of daily living, assistive devices, bath, occupational therapy, spinal cord injury.

INTRODUCTION

The partial or complete loss of sensory and/or motor function in spinal cord injury (SCI) sufferers is associated with immense human suffering due to the inability to perform daily activities independently (Guest et al., 2022). About 90% of SCIs are caused by trauma, including traffic accidents, falls, sports or unintentional accidents, with men being the most commonly affected group (Arsh et al., 2020 : Alizadeh et al., 2019). SCI can also be caused by non-traumatic conditions, including infections, degenerative disease, neoplasm and inflammation (Pertwi et al., 2017). The most commonly vulnerable region is cervical area, with C5 having the highest incidence, followed by C4, C6, T12, L1 and T10. (Arsh et al., 2020 : Alizadeh et al., 2019).

Sensory motor function in SCI patients requires a longer time to recover compared to other tissue, thus resulting in longer transition to active daily living. Patients with cervical- level SCI, whether complete or incomplete, manifest tetraplegia that

causes various degrees of dependence in daily activities (WHO, 2013). Impaired daily activities result in weakness from the shoulder muscles to the intrinsic and extrinsic finger muscles, trunk control muscles, and respiratory muscles (Nas et al., 2015 : Amini et al., 2018). In addition, patients often complain of fatigue, breathing difficulty, and disturbances in sitting due to trunk muscle weakness, which leads to the inability of the upper extremities to manipulate movements when performing daily activities.

In the rehabilitation phase of SCI, maximum independence might be achieved by modifying the patient's environment and educating caregiver according to patient's level of injury (Nas et al., 2015). Severe functional impairment can lead to difficulties in self-care, movement, social and physiological adaptation. The goals of a rehabilitation program not only focus on patient's functional ability but also require support from family members to improve patients' to return to a productive and fulfilling life by enabling them to perform self-care activities independently using assistive devices. One

of the assistive devices is a long-handled brush, which may improve the patient's ability to reach difficult areas due to weakness in the upper extremities. (WHO, 2013 : Peev et al., 2020). This study aims to evaluate patient satisfaction with the use of a long-handled brush to improve patient's ADL by independent in bathing activities.

CASE PRESENTATION

A 30-year-old man presented to the medical rehabilitation clinic at Indonesia University Hospital with complaints of weakness in his upper and lower limbs. The patient was diagnosed with spinal cord injury AIS B level C5 caused by neurofibromatosis. He underwent tumor removal surgery in 2018 and began a rehabilitation program in 2019. The decrease in upper extremity muscle strength has negatively impacted his work quality and overall quality of life. The patient works as a programmer, which requires prolonged sitting and good postural control. One of the daily activities the patient hopes to perform independently is bathing. He expressed that the lower part of his body remains dirty because he cannot reach the area while bathing.

Spinal neurofibromatosis compresses the nerve and spinal cord results in upper extremity weakness, causing a loss of movement ability that requires fine motor skills. On physical examination found motor key function shown in table 1. Decreasing bilateral motor strength score started C4-C6 at 4, C7, C8 at 3, and T1 at 2 and no sensory deficit in upper extremity. Supportive examination was conducted before and after rehabilitation programs to evaluate patients' performance using COPM and FIM in areas such as basic activities of daily living, activity intolerance, and impaired hand function.

Goals of the rehabilitation program were to maximize the patient's ability in daily living activities in particular bathing through improvement of biomechanical exercises training and the use of assistive devices.

Table 1. American Spinal Injury Association (ASIA) impairment scale.

Motor Key Muscle		
Left	Motric	Right
4	C5	4
4	C6	4
3	C7	3
3	C8	3
2	Th1	2

Interpretation :

Total paralysis

Visible or palpable contraction

Active movement, gravity eliminated

Active movement, against gravity

Active movement, against some resistance

Active movement, against full resistance

AIS	Description
A	Complete. No sensory or motor function is preserved in the sacral segments S4-S5.
B	Incomplete. Sensory but no motor function is preserved below the neurological and includes the sacral segments S4-S5.
C	Incomplete. Motor function is preserved below neurological level and more than half of key muscle below the neurological have muscle grades less than 3 (grade 0-2).
D	Incomplete. Motor function is preserved below the neurological level, and at least half of key muscle below the neurological level have a muscle grade greater than or equal to 3.
E	Normal. Sensory and motor function are normal.

Table 1. Describe spinal cord injury according to ASIA

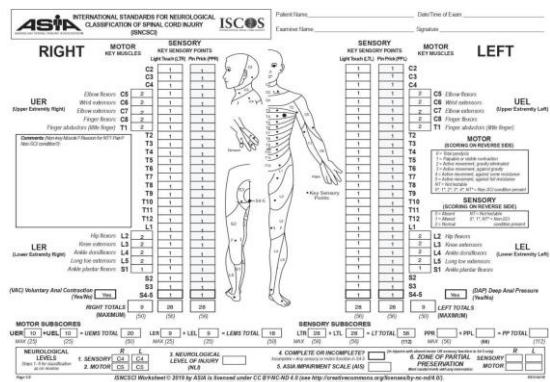
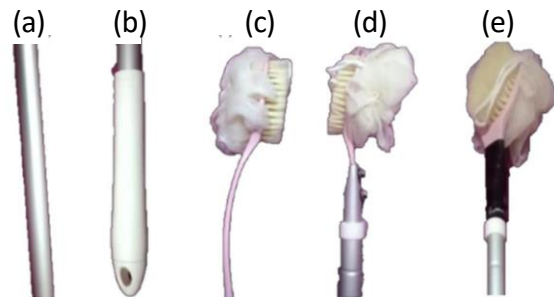


Figure 1. Showed neurological level injury of patient according to ISNCSCI. The tools of right and left side of the body.

The provision of a long-handled brush is intended to improve the patient's ability to reach areas far from the trunk during bathing. The tip of the brush is connected to a scrubbing brush specifically designed to enhance patient's ability to reach their lower body. Initially, the long-handled brush was constructed from two aluminum sticks with a length of 107 cm and a weight of 155 grams, then connected to be adjusted according to patient's reach ability. The aluminum sticks are attached to the brush or scrubbing tool using bolts and then coated with rubber to prevent skin injury (Sadeh et al., 2022).



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Figure 2. Part of long-handled brush tool : (a) 2 length-adjustable aluminum sticks. (b) A handle made of plastic. (c) Brush and scrub in one. (d) Connecting aluminum sticks and brushes with bolts. (e) Coating bolts and aluminum tips with rubber.

Table 2. Functional Independence Measure (FIM) before and after rehabilitation

Motor Component	Before	After
Self-care		
Eating	3	3
Grooming	5	3
Bathing	3	4
Dressing upper body	4	4
Dressing lower body	1	1
Toileting	1	1
Sphincter control		
Bladder management	6	6
Bowel management	6	6
Mobility/transfer		
Bed-chain-wheel chair	3	3
Toilet	1	4
Tub-shower	1	1
Locomotion		
Walk-wheelchair	3	3
Stairs	1	1
Total motor component	38	40
Cognitive Component	Before	After
Communication		
Comprehensive	8	8
Expression	7	7
Social cognition		
Social interaction	6	6
Problem solving	7	7
Memory	7	7
Total cognitive component	32	32
Total FIM	70	72

Table 2. showed FIM Score, 1: total assistance, 2: maximal assistance, 3: moderate assistance, 4: minimal assistance, 5: supervision, 6: modified independent, 7: complete independent.

Evaluation of ADL using FIM and COPM showed in table 2 and 3. The FIM score before therapy was 70, meaning that patient could perform self-care and mobility independently with moderate assistance. After the rehabilitation program, there was improvement in self-care, particularly in bathing and grooming by score 4, meaning that patient needs about 50% of assistance during activities (moderate assistance). The improvement in hand power and movement has positively impacted the patient's level of satisfaction in performing bathing activities.

Table 3. Canadian Occupational Performance Measure (COPM)

Problem	Before therapy	After Program*	Independence Use**
Bathing			
Urgency	9	9	9
Performance	3	5	5
Satisfaction	4	6	8

*5 Weeks after program

**2 Weeks of independent use

Results of the Canadian Occupational Performance Measure (COPM) was in table 3 showed self-care is the most important area in self-care, especially bathing. The initial score of performance and satisfaction score were both 3/10. Five weeks after a comprehensive rehabilitative program, combined with the use of a long handled brush as an assistive device, the patient had improved in satisfaction and performance in bathing with a score of 5/10 and 6/10. Further evaluation within two weeks, COPM showed further improvement score 8/10.

DISCUSSION

The spread of neurofibromatosis into the cervical spinal cord resulted in paralysis of the upper and lower extremities and difficulty in postural control, particularly in maintaining an upright position (Ozelie et al., 2009). Tetraplegia, or paralysis in all four extremities, including the extrinsic muscles, making it difficult for patients to reach areas far from the trunk. Consequently, patients often feel dissatisfied with the cleanliness of their bathing activities.

The use of a biomechanical frame of reference through prescribed exercises aimed to maintain postural control, that the patient could erect their trunk easily and improve ability to use assistive devices. Additionally, stretching exercises and muscle-strengthening exercises with gradually increasing loads are performed to support the use of assistive devices and to test the patient's cardiorespiratory endurance (Trosfer et al., 2020). The provision of assistive devices is based on compensatory techniques within the biomechanical frame of reference, which includes the use of prostheses and orthoses, modifying the environment or replacing the physical environment, and adapting the mode of activity (Saulino et al., 2023).

Independence in self-care, including eating, dressing, bathing, and mobility in bed and wheelchair, correlates with upper extremity functioning and impairment of trunk below the neurological level of individuals with cervical or thoracic SCI (Gede et al., 2021). Previous studies have reported a correlation between trunk stability and reaching activities. Participants with less postural control exhibited a body trajectory and the center of pressure (COP) with multiple disturbances when performing an aiming task. Conversely, those with better postural stability showed better performance in coordinated reaching tasks. Postural dysfunctions are also related to the degree of disability and the ability to perform self-care functions (Alizadeh et al., 2019; Galeiras et al., 2013). While performing reaching tasks in daily living, there will be an anterior tilt of the pelvis, flexion in lower lumbar segment, and extension in the thoracic segment. These movements indicate that subjects should have good trunk and postural control when performing arm task (Cornejo et al., 2023). This is in line with suggestions that an erect sitting posture has more benefits compared to a slumped posture as it elongates the spine, reduces the need for arm elevation and muscle strength, and ensures a larger shoulder range of motion. Additionally, the maximum range of axial rotation of the trunk increases with a more erect sitting posture (Cornejo et al., 2023; Yakut et al., 2023). In addition, simulation in performing ADL in cervical SCI improved satisfaction in using assistive devices.

Quality of life in SCI patients is strongly influenced by the extent to which they engage in social activities in the community. Psychological support for family members (caregivers) is also important. This includes providing necessary information, discussing the prognosis of recovery, understanding the impact of patient dependency, preventing secondary complications, and setting realistic expectations for the rehabilitation therapy (Söke et al., 2018).

CONCLUSION

Patients with SCI often had difficulty performing daily activities due to a loss or decline in motor function. Providing comprehensive rehabilitation therapy using a rehabilitative frame of reference and assistive device considered effective to improve satisfaction and performance in bathing activities.

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CONFLICT OF INTEREST

No conflict of interest to for the research, authorship, and/or publication of this article.

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All authors have contributed to all processes in this research, including preparation, data gathering and analysis, drafting and approval for publication of this manuscript.

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No ethical statement for the research, authorship, and/or publication of this article

INFORMED CONSENT

Informed consent was obtained from interview participants

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