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Reliability And Validity of the Function In Sitting Test(FIST) for non ambulatory individuals with Subacute Spinal Cord Injury: A Pilot Study.

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ABSTRACT

Background: The function in sitting test (FIST) was developed for stroke patients and modified for spinal cord injury patients. FIST SCI is a recently developed outcome measure that requires rigorous investigation to establish its psychometric properties. The aim of this report is to share the preliminary findings of a bigger study exploring the reliability and validity of FIST—SCI. **Methodology:** Data from 8 non ambulatory patients with subacute SCI are being reported here. Two independent raters administered the FIST SCI and Motor Assessment Scale to the patients at 1 week and 2 months. Transfer ability was assessed with ICF codes to explore the potential of FIST SCI to predict the ability to transfer. **Results:** Inter-rater reliability was found to be excellent(ICC =0.9 to 0.9) and intra-rater reliability (0.99 to 0.99) with a 95% Confidence Interval, FIST Has an excellent correlation with MAS (0.80 to 0.90). FIST-SCI scores differentiated between people who needed help transferring and those who could do it on their own by strong Negative correlation (r -.80 to -.90) FIST and d 4200 Transferring oneself while sitting. FIST and d4201 Transfer in lying show a Strong negative correlation(r-.80to -.90). **Conclusion**: This pilot study concludes that the FIST is a consistent and accurate outcome measure for individuals with subacute spinal cord injury. Additionally, FIST-SCI can predict their transfer ability**.**

KEYWORDS- Function sitting Test, Reliability, Validity, Spinal cord Injury, Transfer Skill.

INTRODUCTION

A person's ability to participate in life after a spinal cord injury (SCI) can be significantly affected by their functional sitting balance (FSB). According to Anderson, trunk stability is considered the third most important factor in enhancing the quality of life for individuals with SCI. Functional sitting balance relies on several key elements that are essential for assessing seated equilibrium. These elements include the capacity to: (1) maintain seated balance statically while sitting quietly (steady state control); (2) move while seated while maintaining postural control (proactive control); (3) sustain seated postural control during external environmental disturbances (reactive control); and (4) utilize the lower extremities to assist in balancing the trunk[1]. Sitting balance is directly related to transfer performance: the ability to maintain balance while sitting is a prerequisite for carrying out functional activities such as eating, dressing, and transferring while sitting and standing up is important. Proper seating provides a stable and supportive base for transfer activities. A sense of position in space is also an important factor when attempting transfers. Additionally, the ability to accurately and precisely

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control purposeful movements of the center of gravity in different directions is also important[2]. Function In Sitting Test was developed by Gorman et.al in 2010 for stroke patients due to the absence of a gold standard for sitting balance assessment tool. Psychometrics of the FIST in the non-ambulatory SCI group were initially published by Abou et al. Using the lateral modified Functional Reach Test, this study discovered moderate convergent validity (rZ0.64; PZ.001) and high test-retest reliability (intraclass correlational coefficient [ICC] 0.95)[3].

There are just six studies on FIST, including two on stroke, two on chronic SCI, one on multiple sclerosis, and one on individuals with balance disorder[4].
Depending on the extent of the injury, the area of the spinal cord where it happened, and the destroyed nerve fibers, there are many different kinds of disabilities linked to spinal cord injury (SCI). Among them, a balance disorder during walking, standing, and sitting positions is brought on by the loss of sensory functions such as tactile, pressure, and warmth sensations as a result of motor dysfunction and sensory nerve fiber destruction as a result of motor nerve destruction from the brain to the trunk and limb[5].
The rehabilitation process for people with SCI is divided into three stages: acute, subacute, and chronic. Considered as early acute SCI < 72 A subacute spinal cord injury is a neuro recovery time that is typically less than 18 months. Consideration of chronic SCI after 18 months[6].
Three primary components comprise balance control: maintaining a static posture; maintaining control of balance during voluntary movements; and regaining control following an unplanned loss of balance (reactive)[7,8].
It is crucial to evaluate each of the three components in order to provide an accurate assessment of the balance control in individuals with SCI. Because balance control varies depending on the job, it is equally crucial to do the evaluation in postures that are often employed in everyday life. It has been suggested that after an SCI, a person's balance control system would gradually reorganize because of the progressive formation of certain motor synergies for balance control while sitting that involve even non-postural muscles. These techniques are necessary as sitting is among people's most basic daily activities.
But most of the Outcomes focus on the standing balance like the Berg Balance Test, Functional Independence Measure, and Performance Oriented Mobility Assessment—Balance subscale. Some Outcomes have been developed recently that focus on sitting balance[6]. Function in sitting Test has all components to assess sitting balance but need for reliability and validity for Sub acute Spinal cord injury.
Transfer performance is directly impacted by sitting balance control. For transfer tasks to have a firm basis of support, the right seating position is essential. So it is important to assess FIST can predictive transfer ability[9].

These Pilot study conducted to reduce the possibility of squandering time and money on a large-scale study that can later run into serious problems by enabling researchers to test and improve their research techniques, spot any flaws, and evaluate the viability of their study design on a smaller scale.

METHODOLOGY

This Longitudinal observational study was conducted on Non ambulatory individuals with spinal cord injury in VPMH Physiotherapy OPD Ahilyanagr in a duration of 6 Months with purposive sampling of 8. Patients with subacute spinal cord injury both male and female with ages ranging from 18 to 60 years and who can maintain static sitting balance Were included in the study. This is part of a larger Psychometric study which is still in the process of conduction.

Procedure: After obtaining Ethics committee approval subjects fulfilling the inclusion criteria willing to participate in the study were recruited. All information related to the conduct of the study was provided to them in the language they understand.

Patients were assessed with Function in Sitting Test-Spinal cord injury, Motor Assessment Scale – Spinal cord injury, Transfer ability on 3 occasions that is day 1, after one week, and 2 months by Rater 1 and 2. Raters were not permitted in testing space together, and Participants were directed to not discuss. Performance of test with two raters. The score was taken on different score sheets for 2 follow up.

For FIST-SCI, the patient was in a sitting position with half femur on the surface with hip, and knee flexed to 90 degrees with feet supported and back

unsupported. Up to three trials of each test item were conducted. Verbal directions and demonstration were given by the Investigator. The first 3 components include nudge in anterior, posterior, and Lateral direction with light pressure on the body. It was followed by static sitting side to side, sitting moving head side to side, sitting with eye closed, Sitting lifting your foot, Turning, and touching a spot behind you, forward lean, Lateral lean, Touching dorsum of the foot, Posterior scooting, Anterior scooting, Lateral scooting. A score for each item was based on the level of assistance required to perform the task.
For MAS-SCI, the patient was sitting on a plinth with 90-degree flexion in knees and hips, back unsupported, and feet on the floor. Up to three trials of each test item were conducted. For Transfer skill ICF: The patient was asked about the difficulty level they experienced while performing the different tasks included in the ICF codes for transfer.

Function in Sitting Test Individuals with Spinal Cord Injury(FIST- SCI): The FIST –SCI is 14 items of observational functional outcome measures Graded on a 0 to 4 in which score 4 = completes task independently 3=increased time, 2= Upper extremity support, 1= Needs assistance 0=Dependent Total score ranging from 0 to 56. The initial validity of the FIST-SCI is reported, but further assessment is required. Reliability is excellent in the Chronic SCI population[10].

Motor Assessment Scale (MAS) item: MAS consists of six different items. It is a six-point ordinal scale where the scores of each item are ranked in order of difficulty. It assesses static and proactive sitting balance control and takes 10 min to perform, less if the Participants cannot perform all tasks. Scores 1–3 are mainly related to static balance control, while scores 4–6 are mainly related to proactive balance control. The inter-rater reliability was for MAS (kw 0.83–0.91) and the validity was little to moderate[11]. Before testing the subsequent task, each level of the scale was successfully finished. When a participant was unable to finish a task, they were awarded the score from their most recent completion.

The ICF Code for Transfer skill: The ICF is the world standard for conceptualizing and classifying functioning and disability, agreed upon by the World Health Assembly in 2001. Components for assessing Transfer skill

- d420 Transferring oneself,
- d4200 Transferring oneself while sitting: Moving from a sitting position on one seat to another seat on the same or a different level, such as moving from a chair to a bed.
- d4201 Transferring oneself while lying: Moving from one lying position to another on the same or a different level, such as moving from one bed to another. The ICF -Core Set for SCI illustrated a high construct validity with some of the generic and disease-specific measures[12].

Scoring:

- 0 No difficulty,
- 1 Mild difficulty,
- 2 Moderate difficulty,
- 3 Severe difficulty,
- 4 Complete difficulty

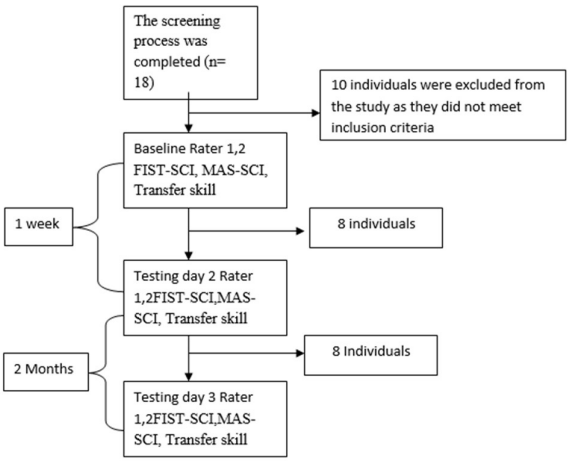

Figure 1: Procedure of the study.

DATA ANALYSIS

SPSS, version 30 was used for all statistical analyses. Interrater and interrater reliability was determined by Interclass correlation coefficient (ICC ; two-way, Mixed model, absolute agreement) ICC Interpretation 0–0.39 Poor reliability, 0.4–0.74 Modest reliability, 0.75–1 Excellent reliability 13. Pearson's Correlation was used between FIST,MAS, and ICF codes of transfer. Correlation value interpretation 0.01 – 0.09 Trivial or none,0.10 – 0.29 Low to medium ,0.30 – 0.49 Medium to essential,0.50 – 0.69 Essential to very strong ,0.70 – 0.89 Very strong ,0.90 – 0.99 perfect[14].

RESULTS

Table 1 shows the demographic data of individuals included in the study. A total of 8 Participants participated in this study. Of which 6 are male and 2 are female with an average age mean of 36.8 years Duration of Spinal cord Injury. ASIA Impairment with ASIA A = 2, B= 1, C=2 and D= 3. The type of Spinal cord Injury is Complete =2 and Incomplete =6.

Gender	Male 75**% (n= 6)**
	Female 25% (n= 2)
Age (Mean) in years	36.8 ±14.1
Duration of SCI(Mean) in Months	10.8 ±5
ASIA Impairment	**ASIA A** = 25% (n= 2)
	ASIA B = 12% (n= 1)
	ASIA C = 25% (n= 2)
	ASIA D = 37 % (n= 3)
Type of SCI	**Complete** = 25% (n= 2)
	Incomplete = 75% (n= 6)

Table 1. Demographic data of patients included in the study.

Table 2. Shows Mean and sd 2 raters of Three duration baseline, 1 week and after 2 months. Table 3 Shows a Strong Correlation (0.89 to 0.91) FIST and MAS and also a strong negative correlation (-.82 to -.91) FIST and d 4200 Transferring oneself while sitting. FIST and d4201 Transfer in lying show a strong negative correlation (-.80 to -.91). Table 4 shows Inter inter-rater reliability of FIST Excellent reliability (0.997 to 0.998) ICC was calculated at three different time durations. It shows high reliability at all three intervals. Intra Rater ICC FIST was calculated ranges from (0.996 to 0.998) it shows Excellent reliability. With 95% Confidence Interval

DISCUSSION

Reliability and Validity of FIST- SCI in Subacute SCI

This study highlights the reliability and validity of the Function in Sitting Test (FIST) in individuals with subacute spinal cord injury (SCI). The intraclass correlation coefficients (ICC) for intra-rater and inter-rater reliability were excellent (0.996–0.998), confirming that FIST provides consistent and reproducible results across different raters and test sessions. These findings align with previous research on the reliability of FIST in other neurological conditions. For instance, JongHun Sung et al. reported excellent test-retest reliability (ICC = 0.97) in 20 non-ambulatory individuals with Multiple Sclerosis (MS), though their study did not find a significant correlation between FIST and posturography-based sway area (ρ = −0.267, P = 0.25)[15].

Outcome Measures	Mean± SD	Baseline	After 1 week		After 2 Months	
		Rater 1	Rater 1	Rater 2	Rater 1	Rater 2
FIST SCI		44.75 ± 11.47	45.12± 11.45	45.12± 11.56	45.12± 11.45	45.12± 11.56
d4200 Transferring oneself while sitting		1.25± 1.83	1.25± 1.83	1.25± 1.83	1.12± 1.80	1.12± 1.80
d4201 Transferring oneself while lying		1.12± 1.64	1.12± 1.64	1.12± 1.64	1± 1.60	1± 1.60
MAS SCI		4.37± 0.74	4.37± 0.74	4.37± 0.74	4.37± 0.74	4.37± 0.74
		Rater 2				

Table 2: Mean and Standard Deviation (SD) of Two Raters Over Three Durations.

Furthermore, concurrent validity testing in this study showed an almost perfect correlation between FIST and the Motor Assessment Scale for SCI (MAS-SCI), reinforcing the ability of FIST to assess functional sitting balance in this population. These results are in

agreement with findings by Sharon L. Gorman et al., who reported strong concurrent validity between FIST and other functional measures like the Berg Balance Scale (BBS) and Functional Independence Measure (FIM) in inpatient rehabilitation settings (Spearman r = 0.71–0.85)[16].

Correlation with Functional Transfer Ability –

This study also investigated the relationship between FIST scores and transfer ability. We found almost perfect negative correlations between FIST and d4200 (transferring while sitting) and d4201 (transfer in lying). This suggests that individuals with higher FIST scores experience fewer difficulties during transfers. These results are consistent with findings by Abou et al., who demonstrated a strong correlation between mFRT and transfer activities, further supporting the idea that sitting balance plays a crucial role in functional transfers.[17]

The clinical implication of this finding is that FIST-SCI demonstrates potential as a predictor of transfer ability in individuals with subacute SCI. However, longitudinal studies are needed to confirm whether FIST can be used as a reliable tool for predicting functional independence in different phases of Rehabilitation.

Measurement tools	r Value		
	Baseline	After 1 week	After 2 Months
Correlation of FIST and MAS	0.916	0.899	0.899
Correlation of FIST and d4200 Transferring oneself while sitting	-.826	-.852	-.918
Correlation of FIST and d4201 Transfer in lying	-.809	-.836	-.918

Table3: Pearson's Correlation of FIST, MAS, and ICF Codes.

Comparison with Other Studies-

Libak Abou et.al carried out a study in non-ambulatory individuals with 26 chronic spinal cord injury Individual outcome measures used are FIST,

Outcome measures	ICC		
	Baseline	After 1 week	After 2 Months
Inter-Rater ICC FIST	0.997	0.998	0.998
Intra Rater ICC FIST	-	0.996	0.998

Table 4: Intraclass Correlation Coefficient (ICC) for Reliability of FIST.

the modified Functional Reach Test (lateral and forward mFRT), and a posturography assessment. In these Test-retest reliability was found to be excellent (ICC = 0.95) and MDC of 4. However, FIST correlation was found with only lateral mFRT (r = 0.64, P = 0.001) but not with forward mFRT and the VTC[17].This is because forward mFRT and the VTC likely evaluate different constructs than the FIST. The mFRT and the VTC solely evaluate the dynamic stability limits of sitting balance without hand support, whereas the FIST assessment incorporates all aspects of sitting balance and considers the extent of hand support used. Also strong correlation between mFRT and Transfer activities was found because of both concentrate on the dynamic limits of stability of sitting balance[18].

Psychometric Testing of a modified version of the Function in Sitting Test for Individuals with Chronic Spinal Cord Injury was conducted by Anne E. Palermo et.al . She conducted a study on 38 SCI individuals and found that Inter- and intra-rater reliability was excellent (intraclass correlation coefficient (0.98 and 0.98, respectively) and internal consistency was excellent (.94) but Validity testing found a moderate relationship between the MAS-SCI and the FIST-SCI (r, .522; P<.05) The MAS-SCI shows a moderate correlation with a person's capacity to carry out a transfer, as indicated by the FIM, and includes several of the same tasks found in the FIST-SCI, but it does not assess reactive balance or sensory integration. According to the SEM (1.3) and MDC (3.5) for the FIST-SCI, a difference of 4 points on the FIST-SCI signifies a genuine change that exceeds measurement or rater error. These values are comparable to those observed for the FIST among a group of inpatients[19].

FIST was developed by Sharon L. Gorman et. al.'s 14-item scale. In this study they item-to-total score correlations ranged from 0.82 to 0.93. The mean score was 34.29 (sd= 16.51), the standard error of the mean of 2.97, and the standard error of measurement of 2.03. The correlations between item-to-total scores were still statistically significant and were within the good range of 0.82 to 0.93[17.] In the acute/subacute stroke population, comparisons between two functional assessment scales—the Modified Rivermead Mobility Index and the Motor Assessment Scale—demonstrated strong internal consistency within each scale and consistency between the scales, with the exception of the sitting balances items on both[20].

CONCLUSION

This pilot study concluded that the Function in Sitting Test (FIST) is a reliable and valid outcome measure for individuals with subacute spinal cord injury (SCI). Additionally, FIST-SCI demonstrates potential as a predictor of transfer ability in this population. The results of the full-scale study will be published soon.

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