Reliability of modified functional reach test in the assessment of balance function in people with spinal cord injury: A systematic review

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Abstract

Objective: To systematically review studies reporting reliability of modified functional reach test for the assessment of sitting balance function in people with spinal cord injury.

Method: The systematic review was conducted in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines, and comprised research studies published in English language from the earliest record till October 2019 on the subject of reliability of modified functional reach test in assessing balance function in adult spinal cord injury patients.. Prominent databases were searched with relevant key words to shortlist the targeted studies.

Results: Of the 108 studies retrieved initially, 6(5.55%) were included in the current systematic review. All the 6(100%) studies reported only test-retest reliability of modified functional reach test. Of them, 4(66.6%) studies measured only forward reach, while 2(33.3%) measured reach in different directions. All 6(100%) studies reported good to excellent reliability of modified functional reach test with interclass coefficient values ranging from 0.78 to 0.99.

Conclusion: Modified functional reach test was found to be a reliable tool for assessing sitting balance function in individuals with spinal cord injury.

Keywords: Balance, Functional reach, Reliability, Spinal cord injury. (JPMA 71: 2040; 2021)

Introduction

Neurological disorders often cause sensory and motor impairments which in turn lead to poor balance function.[1] Impaired balance is one of the major causes of dependency and poor quality of life (QOL) in patients with neurological conditions.[2] Without proper postural control, patients cannot even perform simple motor tasks, such as drinking water, personal hygiene and other activities of daily living (ADLs).[3] Similarly, complex motor tasks, such as ambulation and fine movement, cannot be accomplished without good balance control.[4] Just like other neurological conditions, spinal cord injury (SCI) almost always results in impaired balance function.[5] Balance problems lead to poor rehabilitation outcomes and frequent falls in people with SCI.[6] Moreover, impaired balance is one of the major hindrances in the community re-integration of SCI population.[7]

Several biomechanical and clinical assessment tools have been devised to assess balance function in patients with neurological conditions.[8] Majority of these assessment tools use sophisticated instrumentation and instructions due to which they are rarely used in clinical settings.[9]

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Clinicians always prefer to use those assessment tools which are applicable as well as reliable and are less time-consuming.[10,11] One such balance assessment tool is the functional reach test (FRT) which is commonly used in clinical practice due to its simplicity, applicability and reliability.[12] FRT is performed in standing position because it assesses standing balance, while the modified FRT (mFRT) is performed in sitting position as it assesses sitting balance.[12,13] Because motor-complete and non-ambulatory motor-incomplete SCI individuals mostly remain in the sitting position, mFRT is used for non-standing SCI population.[13]

Despite the fact that FRT and mFRT are extensively described in literature for the assessment of balance function in various neurological conditions,[10,12] literature regarding these assessment tools for SCI population is scarce. Without high-quality evidence, the use of these outcome measures in clinical practice for the assessment of balance function of SCI patients may be questionable. Therefore, the current systematic review was planned to take a look at studies reporting reliability of mFRT for the assessment of sitting balance function in individuals with SCI.

Methods

The systematic review was conducted according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[14] Literature search was performed in databases Medline, Allied and

Complementary Medicine Database, Excerpta Medica Database, Healthcare Management Information Consortium, British Nursing Index, PsycInfo, Cumulated Index to Nursing and Allied Health Literature, Health Business Elite, Scopus and Physiotherapy Evidence Database. The search was performed using the terms Spinal Cord (Injury, Damage, Compression, Ischaemia, Trauma, Contusion, Laceration, Transaction, Syndrome), or Spinal (Fracture, Subluxation, Dislocation, Injury, Trauma), or Cervical vertebrae injuries, or Lumbar vertebrae injuries, or Thoracic vertebrae injuries, or SCI, or Paraplegia, or Quadriplegia, or Tetraplegia, and Modified functional reach test or mFRT or Sitting functional reach or Seated functional reach and Reliability or Psychometric properties or Reproducibility or Consistency. Truncations were used when appropriate.

Endnote X7 was used to remove duplicates. Reference list scanning of the retrieved articles was performed to find out additional articles. After that, two researchers independently screened all the retrieved articles and studies fulfilling the eligibility criteria were separated. In case of any disagreement between the two researchers, a third researcher was consulted to resolve the discrepancy.

Research studies published in English language from the earliest record to October 2019 that reported any type of reliability of mFRT in assessing balance function in adult SCI population were included. Those studies were excluded which reported correlation of mFRT with other outcome measures and not explicitly reported reliability of the mFRT. Reviews, commentaries, letters to editor, conference papers and short communications were also excluded.

The principal author studied all the included articles and the information extracted included participant characteristics, type of reliability assessed, interclass coefficient (ICC) values, and conclusive remarks about reliability of mFRT. COnsensus-based Standards for the selection of health Measurement INstruments (COSMIN)

checklist was used to assess risk of bias in the included studies. Because the current study only assessed reliability, the reliability box of the COSMIN checklist was completed for the included studies.[15,16] The extracted information was verified by two researchers and in case of any disagreement, a third researcher was consulted.

Results

Initial literature search in different databases identified 108 research articles. After the removal of duplicates, 59(54.6%) articles were left. Of these, 51(86.4%) were excluded because they either used mFRT for the assessment of balance function in SCI individuals or reported correlation of mFRT and FRT with other assessment tools, but did not report its reliability. Out of the remaining 8(13.6%) studies, 1(12.5%)was excluded because it reported reliability of standing FRT in SCI individuals.[17] Another study which reported reliability of mFRT was also excluded because it was published in Korean language.[18] As such, of the total 108 studies identified, 6(5.55%) were included in current systematic review.

Methodological quality of the studies varied (Table 1).

Clinical characteristics of the participants also varied across the studies; 1(16.6%) study had motor-complete,[13] 1(16.6%) had motor-incomplete,[19] 1(16.6%) had both motor-complete and motor-incomplete[11] and 1(16.6%) had non-standing SCI participants[20] while 2(33.3%) studies did not report completeness/incompleteness.[21,22] All 6(100%) studies reported only test-retest reliability of mFRT. Of them, 4(66.6%) studies[13,20-22] measured only forward reach, while 2(33.3%)[11,19] measured reach in different directions. All 6(100%) studies reported good to excellent (ICC range: 0.78-0.99) test-retest reliability of mFRT for assessing balance function in people with SCI (Table 2).

Discussion

Balance control is a complex motor skill which requires

Table-1: Risk of bias assessment.

Question	Lynch et al. 1998	Adegoke et al. 2002	Sprigle et al. 2003	Sprigle et al. 2007	Boswell Ruys et al. 2009	Field-Fote and Ray 2010
Were patients stable in the interim period on the construct to be measured?	Adequate	Adequate	Doubtful	Doubtful	Adequate	Adequate
Was the time interval appropriate?	Doubtful	Doubtful	Doubtful	Doubtful	Very good	Very good
Were the test conditions similar for the measurements?	Adequate	Adequate	Doubtful	Doubtful	Doubtful	Adequate
For continuous scores: Was an intraclass correlation coefficient (ICC) calculated?	Adequate	Adequate	Adequate	Very good	Very good	Very good
For dichotomous/nominal/ordinal scores: Was kappa calculated?	NA	NA	NA	NA	NA	NA
For ordinal scores: Was a weighted kappa calculated?	NA	NA	NA	NA	NA	NA
For ordinal scores: Was the weighting scheme described?	NA	NA	NA	NA	NA	NA
Were there any other important flaws in the design or statistical methods of the study?	Very good	Very good	Very good	Very good	Very good	Very good

NA, Not applicable

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Table-2: Summary of the studies reviewed.

Study	Participant information	Type of reliability	ICC (95% CI)		Conclusive remarks
Lynch et al. 1998[13]	30 male participants (age=30.8±7.2 year) with motor complete SCI (ASIA A & ASIA B) were divided into 3 groups;	Test-retest reliability			The study concluded that mFRT is a reliable tool to measure sitting balance in people with motor complete SCI.
	Group 1(n=10): C5-C6		Group 1	0.94	
	Group 2(n=10): T1-T4		Group 2	0.85	
	Group 3(n=10): T10-T12		Group 3	0.93	
Adegoke et al. 2002[20]	20 non-standing SCI participants (age=43.15 ± 10.3 years; 13 male & 7 females) were divided into 3 groups;	Test-retest reliability			mFRT is highly reliable tool.
	Group 1(n=8): C5-T1		Group 1	0.98	
	Group 2(n=6): T6-T8		Group 2	0.98	
	Group 3(n=6): T10-L1		Group 3	0.99	
Sprigle et al. 2003[22]	22 participants (age range=18-64 years) with SCI of duration ≥6 months	Test-retest reliability	0.87		mFRT has good test-retest reliability
Sprigle et al. 2007*[21]	20 participants (age range=16-32 years; 15 male & 5 females) with traumatic SCI (11 tetraplegia & 9 paraplegia) of duration ≤ 6 months	Test-retest reliability	0.85		Test-retest reliability of mFRT was graded as good.
Boswell Ruys et al.[11] 2009	30 participants (age=35±11 years; 24 male & 6 females) with SCI (21 ASIA A, 3 ASIA B, 5 ASIA C, 1 ASIA D) of duration 2 months to 37 years	Test-retest reliability	Lateral right	0.80 (0.62-0.90)	The test was deemed reliable.
			Lateral left	0.86 (0.72-0.91)	
			450 right	0.83 (0.67-0.91)	
			450 left	0.82 (0.66-0.91)	
			Forward right	0.87 (0.75-0.94)	
			Forward left	0.89 (0.79-0.95)	
Field-Fote and Ray [19] 2010	32 participants (age=44.9 ± 11.2 years; 25 male & 7 females) with motor incomplete SCI (23 tetraplegia & 9 paraplegia; 25 ASIA C & 7 ASIA D) of duration > 1 year	Test-retest reliability	Forward reach	0.95	Test-retest reliability of mFRT is high for all directions of reach in individuals with motor incomplete SCI.
			Left reach	0.81	
			Right reach	0.78	
			Backward reach	0.83	

ASIA: American Spinal Injury Association; mFRT: Modified Functional Reach Test; SCI: Spinal Cord Injury.

*The study had 2 groups; however, only group 2 patients were involved in measuring reliability of functional reach test, that's why only group 2 participant's information is presented here.

integration of sensory and motor systems.[23,24] For normal sitting, standing, walking and other functional tasks, balance control is necessary.[25,26] Neurological disorders, such as stroke, traumatic brain injury and SCI, result in impaired balance control which predispose patients with neurological disorders to an array of complications.[27] Assessment and training of balance is an integral part of comprehensive rehabilitation of patients with neurological diseases.[28,29] The mFRT tool is one the most commonly used assessment methods for sitting balance, and studies have reported that mFRT is highly reliable in assessing balance function in different neurological conditions.[10,30] However, there is limited literature available regarding reliability of mFRT in people with SCI. Therefore, there was a dire need to assimilate all available studies reporting reliability of mFRT for assessing balance function in people with SCI.

The current systematic review showed that mFRT is reliable in people with SCI. Studies which assessed reliability of mFRT for other neurological disorders and elderly population also reported that mFRT is a reliable tool for

assessing sitting balance.[8,10,31] All the 6 included articles in the current review assessed test re-test reliability of the mFRT. Only 1 study was found which reported inter- and intra-rater reliability of the mFRT in SCI population, but that study was excluded from the current review as it was published in Korean language. The English abstract of that study reported that mFRT has high inter-rater reliability with ICC value of 0.97.[18] None of the included studies in the current review reported inter- or intra-rater reliability of mFRT in SCI population, but good inter-rater reliability of standing FRT was reported by Srisim et al. in individuals with motor-incomplete SCI.[17] The study of Srisim et al. was also excluded from the current review as it assessed standing FRT only.

Of the included studies, only 2 separately assessed reliability of mFRT for tetraplegic and paraplegic SCI individuals. For tetraplegics, ICC value of mFRT ranges from 0.94 to 0.99, while for paraplegic ICC value ranges from 0.85 to 0.99.[13,20] Similarly, only 2 studies measured reach in different directions.[11,19] Except right reach assessed by Field-Fote and Ray[19], which had ICC value of 0.78, ICC value

in all directions was ≥0.8. It is obvious from the results that mFRT can be used for the assessment of balance function in SCI individuals with different neurological conditions and different level of impairments. Compared to other directions, mFRT is highly reliable for assessing forward reach. ICC values for forward reach are almost equivalent to ICC values of Berg balance scale in SCI population[16,32].

Despite the fact that the current study was a systematic review, it has some limitations. Protocols of the current systematic review were not registered. Moreover, due to scarcity of literature regarding reliability of mFRT in SCI population, the current study failed to report inter- and intra-rater reliability of mFRT for people with SCI. It is recommended to conduct large trials to truly determine different types of reliability of mFRT in SCI individuals.

Conclusion

There are limited studies available in literature reporting reliability of mFRT in people with SCI. On the basis of current literature, it is concluded that mFRT has good to excellent reliability in assessing sitting balance function in individuals with SCI.

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