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Assessment of balance and fear of falling in individuals with acute ankle sprain: A cross-sectional pilot study

Mandira B. Patil, MPT.[1], Shobhalakshmi S. Holla, MPT.[1], S. M. Ajoy, DNB Orthopaedics.[2], Manisha R. Patel, MPT.[3]

[1]Department of Musculoskeletal Sciences, Ramaiah College of Physiotherapy, M S Ramaiah University of Applied Sciences, [2]Department of Orthopaedics, Ramaiah Medical College, [3]Department of Physiotherapy, Ramaiah Memorial Hospital, Bengaluru, Karnataka, India.

***Corresponding author:**
Shobhalakshmi S. Holla, Ramaiah College of Physiotherapy, M S Ramaiah University of Applied Sciences, Bengaluru, Karnataka, India.

pshobha76@gmail.com

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ABSTRACT

Objectives: The primary objective of this research was to assess balance, pain, and fear of falling (FOF) among individuals with an acute ankle sprain. The secondary objective was to correlate FOF with pain and balance.

Methods: The research was conducted among individuals with acute ankle sprain —two to three days after removal of two weeks of casting at M S Ramaiah hospitals, Bengaluru. The primary outcome measures were the Short Falls Efficacy Scale-International (Short FES-I) and the star excursion balance test (SEBT), and the secondary outcome measure was the numerical pain rating scale (NPRS). Cutoff points for Short FES-I defined in prior research using receiver operator characteristic plots were used in this study. For Short FES-I, frequencies and percentages were employed. The NPRS and SEBT were measured using means and standard deviations.

Results: The results showed that among 21 individuals, 76.2% had FOF. Among those with FOF, 56.25% had moderate FOF, and 43.75% had severe FOF. Mean SEBT scores were greater for the uninvolved limb than for the involved limb. Spearman's Rho test showed that the Short FES-I and NPRS showed no correlation ($P = 0.102 > 0.05$), and Short FES-I and SEBT showed a significant correlation ($P = 0.003 < 0.05$).

Conclusion: The FOF was present in two-thirds of those with acute ankle sprains, and balance impairment was present in individuals with Grade II ankle sprains. Among individuals with FOF, the degree of FOF was moderate to severe. There was a significant negative correlation between FOF and balance, but no correlation was found between FOF and pain.

Keywords: Ankle sprain, Balance, Fear of falling, Pain, Short Falls Efficacy Scale

INTRODUCTION

The ankle complex is made up of several segments and joint systems that affect how the lower limbs interact with the ground during stance and gait.[1] The intricate articulations of the talocrural, subtalar, and distal tibiofibular joints constitute the ankle complex.[2]

One of the most common musculoskeletal ailments is a sprained ankle, which is more common among physically active adults. The occurrence of chronic ankle instability is linked to the high likelihood of recurrence of ankle sprains.[3] Many grading and staging methods are available for lateral ankle sprains. Ankle sprains are categorized using one of the most practical and

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appreciated I–III grading systems: Grade I: A mild sprain; Grade II: Mild-to-moderate laxity; and Grade III: Total ligament rupture.[4]

Up to 70% of people, who have experienced at least one ankle sprain, have chronic symptoms such as pain, sense of instability, weakness, and swelling or have experienced recurrent ankle sprain.[3] Frequent sprain of the ankle in individuals with persistent ankle instability is strongly predicted by a prior episode of injury, diminished ankle dorsiflexion range of motion, and balance deficits.[5] Some of the effects after an ankle sprain include deficits in strength or power, range of motion, perception of position sense, motor strategy and motor control, and a sense of balance.[6]

To keep the line of gravity inside the base of support, the foot and ankle complex must be adequately stable because it is the sole component of the body, which comes in contact with the surface of the ground while a person is weightbearing. Muscles of the ankle complex help maintain static balance. Therefore, a loss of strength and the associated perception of loss of balance that occurs after an ankle sprain may cause a fear of falling (FOF). The research conducted by Pol *et al.* in 2022 showed that FOF is independently correlated to pain in the foot.[7]

The FOF is characterized as a "Persistent concern of falling, which ultimately restricts daily activities."[8] The significant behavioral aspect of FOF is self-limited activity avoidance, which produces a downward spiral or vicious cycle that leads to weakness and decreased independence. The FOF might result in muscle wasting, balance deficits, altered walking patterns, deterioration of health, and falls.[9] Patients' FOF may also make them engage in fewer rehabilitation-related activities, which could affect the program's effectiveness. All of this could raise the risk of further injuries.

As there is a high prevalence of re-injury after an ankle sprain, identifying the FOF at the acute stage can improve the rehabilitation effectiveness, thereby lessening the likelihood of repeated injury. As there is not enough data to conclusively prove that people with acute ankle sprains experience FOF, the present study aimed to assess FOF and related factors in individuals with an acute ankle sprain. Hence, the primary objective of the research was to evaluate balance, pain, and FOF, and the secondary objective was to correlate FOF with pain and balance.

MATERIALS AND METHODS

This cross-sectional pilot study was conducted in MS Ramaiah Orthopedic and Physiotherapy Outpateint Department (OPD), Bengaluru, India, from December 2022 to June 2023.

Based on the study by Lanoue *et al*.,[8] the expected population standard deviation (SD) was assumed to be 3.2, and t-distribution was employed to estimate the sample size of 21. Subjects were enrolled from M S Ramaiah Orthopedic and Physiotherapy OPD. The study comprised subjects, who had sustained Grade II or III ankle sprains managed by two weeks of casting and who were ambulatory. The subject's ages ranged from 18 to 50 years. Grading of ankle sprain was done by the orthopedic surgeons. Subjects with cognitive impairments and neuromuscular disorders were excluded after the screening by the center's neurology department. In addition, subjects with a past incidence of fracture or dislocation or any operations of the lower limbs, a history of systemic illness, vestibular dysfunction, and ocular impairment were also excluded from the study.

The orthopedic surgeon treated individuals with Grades II and III ankle sprains using casts. Two to three days following the removal of the cast, they were added to the study. The study procedure was explained, and informed consent was obtained, after which a detailed assessment was performed. Outcome measures were described to the participants, and they were encouraged to fill in those outcome measures. These included the Short Falls Efficacy Scale-International (Short FES-I) and numerical pain rating scale (NPRS), which were reported by the participants, and the star excursion balance test (SEBT) assessed by the primary investigator.

Short FES-I was employed to measure FOF. It is a seven-item questionnaire. Every item is scored from 1, not concerned, to 4, severe concern. Scores of each item are added to get the total score, spanning from 7 (not concerned) to 28 (most severe concern). The cutoff point is defined to distinguish between low and high concerns (Short FES-I: 7–10; 11–28).[10] Total scores can be explained by classifying the data into three groups: Mild (7–8), moderate (9–13), and severe (14–28) concern about falling. The FES-I scale has been validated in individuals with imbalance and dizziness and showed excellent test-retest reliability.[11] The short FES-I scale has almost as good psychometric properties and discriminative power as the FES-I and is less time-consuming.[12]

The SEBT was used to measure balance. Included in the test were the anterior (ANT), posteromedial (PM), and posterolateral (PL) reach directions. The procedure followed previously published criteria.[13] The subject's stance leg length was then used to normalize the reach distance. Limb length measurement involved calculating the distance between the most distal part of the medial malleolus and the ANT superior iliac spine. A statistical analysis was conducted using the normalized mean for all three directions.[14] Following the recording of the normalized reach distance in each direction, the normalized Composite Score (CS) for all directions was determined.[13]

The NPRS was used to measure pain. The NPRS is a well-known and valid tool for assessing pain on an 11-point scale, with "0" denoting no pain and "10" denoting the excruciating

pain possible.[15] The NPRS has acceptable responsiveness, construct validity, and test-retest reliability.[16]

Statistical analysis

The IBM Statistical Package for the Social Sciences version 20 statistical software was used to analyze the data, and tables and graphs were produced using Microsoft Word and Excel. Demographic data were descriptively represented. The primary objective was analyzed descriptively and represented as mean, SD, and percentage. For the secondary objective, the Shapiro–Wilk normality test was used to check if the data was normally distributed. The data was not normally distributed; hence, non-parametric tests were used.

RESULTS

The present study was comprised 21 (n = 21) participants. The demographic information of the subjects is given in Table 1.

The results of Short FES-I and NPRS according to sex and grade of an ankle sprain are shown in Table 2. The results of SEBT among individuals with Grade II ankle sprain are shown in Table 3. There was a significant difference in the mean values of ANT, PM, and PL normalized reach distances and CS between the involved and uninvolved limbs, with the uninvolved limb having greater mean values for ANT, PM, and PL normalized reach distance and CS than the involved limb.

To assess the FOF, we identified a cutoff score for Short FES-I from a validation study by Delbaere *et al.* 2010.[10] In this study, a score of 7–10 was considered as no FOF, and a score of 11–28 was considered as having FOF. Among 21 subjects having acute sprain of the ankle, 16 (76.2%) had FOF (Short FESI score > 11) and 5 (23.8%) had no FOF (Short FESI score < 10). Among 16 subjects who had FOF, 9 (56.25%) had moderate FOF (Short FES-I score 9–13) and 7 (43.75%) had severe FOF (Short FES-I score 14–28).

As a secondary analysis, Table 4 shows a correlation between Short FES-I, NPRS, and SEBT. Concerning the correlation between Short FES-I and NPRS, the correlation between Short FESI and NPRS was not statistically significant (P > 0.05). A strong negative correlation was found between Short FES-I and the CS of SEBT (r = 0.7, P = 0.003). A moderate negative correlation was found between Short FES-I and PL (r = 0.06, P = 0.01), PM (r = 0.5, P = 0.04) reach of SEBT, and the ANT reach of SEBT showed no correlation with Short FESI (P = 0.1).

Table 1: Descriptive statistics for baseline data: Age, BMI, sex, and grade of ankle sprain.

Variables	Mean±SD	
Age (years)	25.29±5.05	
BMI kg/m^2	25.7±5.5	
	Frequency	**Percentage**
Sex		
Male	6	28.6
Female	15	71.4
Grade		
II	16	76.2
III	5	23.8

SD: Standard deviation, BMI: Body mass index

Table 2: Descriptive data of the outcome measures – Short FES-I and NPRS.

Variables	Short FES-I		NPRS	
	Mean	**SD**	**Mean**	**SD**
Sex				
Female	12.4	2.41	5.13	1.68
Male	14.17	4.2	3.5	0.54
Grade				
II	12.56	3.07	3.94	0.92
III	14	2.9	7	1
Total	12.9	3.03	4.67	1.62

NPRS: Numerical pain rating scale, Short FES-I: Short Falls Efficacy Scale-International, SD: Standard deviation

Table 3: Descriptive data of outcome measure-SEBT.

Variable	Mean (SD)	
	Uninvolved limb	**Involved limb**
ANT (%)	87.5±7.2	80.5±6.2
PM (%)	76.9±9.2	69.1±7.8
PL (%)	79.8±8.7	72.5±8.1
CS (%)	81.4±7.9	79.1±8.4

ANT: Anterior, PM: Posteromedial, PL: Posterolateral, CS: Composite score, SEBT: Star excursion balance test, SD: Standard deviation

Table 4: Correlation between fear of falling, pain, and balance.

Correlation	NPRS	CS	ANT	PL	PM
Short FES-I					
Spearman's rho correlation coefficient	0.367	−0.71	−0.4	−0.6	−0.5
Sig. (2-tailed)	0.102	0.003	0.12	0.01	0.04

NPRS: Numerical pain rating scale, CS: Composite score, ANT: Anterior, PL: Posterolateral, PM: Posteromedial, Short FES-I: Short Falls Efficacy Scale-International

identify if a correlation exists between FOF and pain and balance as a secondary analysis. The SEBT results showed a significant difference in the mean values of normalized reach distances and CS between the involved and uninvolved limb, with the mean values of the uninvolved limb being more than the involved limb. This aligns with the results of the study by Alghadir *et al.*[5] In this population, deficits in proprioception, particularly the unconscious (reflexive) part of proprioception as opposed to the conscious (voluntary) part, can lead to balance issues.[17] Proprioception is crucial for maintaining balance and allows the body to be stable and oriented during static and dynamic activities.[18] This shows that in people with ankle sprains, altered proprioception causes impairment in balance.

The study found that 76.2% of the subjects with an acute ankle sprain had a FOF. The results of this investigation will be very important in addressing related health issues that are a consequence of FOF among people with ankle sprain.

The current research results also suggested that among individuals with FOF, 56.25% of subjects with acute ankle sprain had moderate FOF, and 43.75% had severe FOF. Proprioceptive deficits and other factors, such as reduced joint motions, muscle strength, and pain, lead to problems with balance in people with ankle sprains. The FOF might arise when there is a perception of balance loss in everyday situations.[7]

In the present study, FOF was higher in males than females. This aligns with the results of the study by Kouchaki *et al.*, which found that men experienced more FOF than women.[19] This contradicts the findings of the previous studies by Wang *et al.*[20] and Merchant *et al.*[21] where they found that men experienced less FOF when compared to women. The conflicting results might be due to the previous studies being conducted in older age people where FOF was related to degenerative conditions, and males might have under-reported their FOF due to being perceived as weaker.

The findings of the current investigation suggest that people with Grade III ankle sprain experienced more FOF than individuals with Grade II ankle sprain. This might be because individuals with Grade III ankle sprain exhibit more instability when compared to individuals with Grade II ankle sprain due to decreased ankle range of motion, especially dorsiflexion, due to which the joint may be moved into plantar flexion, which is a more unstable position,[22] and people with more balance problems exhibit high FOF during their functions.[23]

In the present study, the correlation between FOF and pain was moderate (r = 0.367) and not statistically significant (P = 0.102). This is in contrast to the study by Patel *et al.*, which reported that pain, especially in the back, hips, knees, and feet, could affect postural stability and gait mechanics, which in the long run may heighten feelings of instability and a FOF, which as a result may decrease the frequency, duration, and level of physical exertion. Falls might also be caused by knee buckling and pain-related restriction of muscular activity. The difference in the results may be attributed to the chronicity of the pain considered in their study, which leads to alterations in brain structure and function, including reduced gray matter volume in brain regions involved in pain processing and motor control and diminished executive function and attention.[24]

The findings of the present study suggested that there was a negative correlation between FOF and balance. This is in line with the results of the investigation done by Sapmaz and Mujdeci, 2021 and Kumar *et al.*, 2014, where they found a correlation between FOF, dynamic balance, and mobility.[25,26]

The relationships between balance issues, falls, psychological issues, and cognitive issues have primarily been discussed separately for each of the components. The likelihood of these elements coexisting and interacting, however, is higher.[27] Inactivity associated with FOF may be more strongly influenced by ankle proprioception.[28]

According to the model of fear avoidance of falls, FOF can cause a person to restrict their activity level excessively, which can result in muscular wasting, balance impairments, altered walking patterns, physical deterioration, and eventually falls. A self-imposed limitation of activity mediates the detrimental effects of FOF on physical performance along with falls. It is well-known that inactivity has an adverse impact on falls, illness, and frailty of the body. The effect of FOF on other psychological concepts, such as quality of life (QoL), depression, and social exclusion, could also be explained by a similar pathway.[9]

After an ankle sprain, FOF is a serious psychological illness that can have grave consequences on a person's physical, mental, and emotional health. The FOF might have a significant role in an individual's daily life. It may cause decreased physical activity, which can cause muscle wasting, a decline in cardiovascular fitness, and weight gain. Furthermore, this fear can result in a loss of self-assurance in one's body and abilities, possibly adversely affecting social interactions, self-esteem, and general QoL.

The current research findings suggest that assessing FOF in individuals with ankle sprain will be beneficial. The FOF has been associated with activity avoidance, which may interfere with the rehabilitation process, which in turn may result in a higher risk of re-injury. Hence, healthcare experts can assist people in overcoming this fear and regaining their confidence in daily tasks using a multidisciplinary strategy that includes education, regular assessment, physical therapy, cognitive behavioral therapy, virtual reality and simulation,

exposure therapy, psychological support, and environmental adjustments**.**

There were a few limitations in the present study. First, the study's sample size was small. Hence, it is difficult to generalize the results to a larger population. Second, the outcome measures used were "self-reported," which might have raised the possibility of bias. Further, the patients with associated depression were not excluded from the study. Finally, the selection of participants and the assessment were conducted by the primary investigator of this study, due to which there are chances of biased results.

CONCLUSION

Two-thirds of the individuals with acute ankle sprain had FOF. The individuals with Grade III ankle sprain experienced more FOF than those with Grade II ankle sprain. Balance impairment was present in individuals with Grade II ankle sprain. There was a correlation between FOF and balance, and no significant correlation was found between FOF and pain. This study concludes that it is crucial to create rehabilitation strategies that take into account both physical recovery and psychological well-being.

Recommendations

A larger sample size is advised for future studies. It is also suggested that future studies on this subject should employ more objective outcome measures. Further study in this area should be carried out by strengthening the selection process and using another physiotherapist to perform the assessment before using outcome measures to prevent bias.

AUTHORS' CONTRIBUTIONS

MBP and SSH conceived and designed the study, analyzed and interpreted data, and wrote the initial and final draft of the article. ASM and MRP were involved in the design and data collection. All authors have critically reviewed and approved the final draft and are responsible for the manuscript's content and similarity index.

ETHICAL APPROVAL

Ethical clearance for this cross-sectional study pilot was obtained from the Ethical Committee of Ramaiah Medical College and Hospital Ref. No: MSRMC/EC/PG-14/2022 on August 24, 2022.

DECLARATION OF PATIENT CONSENT

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have consented for their clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY FOR MANUSCRIPT PREPARATION

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

CONFLICTS OF INTEREST

There are no conflicting relationships or activities.

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