e-ISSN: 0975-5160, p-ISSN: 2820-2651

Available online on www.ijtpr.com

International Journal of Toxicological and Pharmacological Research 2024; 14(6); 72-76

Original Research Article

Evaluating Predictors for Fall Related Wrist Fracture Among Elderly in A Tertiary Care Rural Hospital

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Received: 11-03-2024 / Revised: 18-04-2024 / Accepted: 22-05-2024
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Conflict of interest: Nil

Abstract

Background: Wrist fractures are one among the common injuries of the elderly leading to reduced quality of life and impaired functionality, if not treated and restored adequately. Factors like asymmetry of vestibular function, decreased plantar sensation, unstable posture and functional disability have been more commonly associated with fall related wrist fractures among the geriatric population. Objective: To determine effect of multi-sensory training (MST) on posture (muscle strength), vestibular function, vibration perception, tactile sensation and functional ability compared to wrist stabilization training (WT) among elderly with fall related wrist fractures.

Materials and Methods: Experimental research design was adopted for the study among the 130 follow up cases of wrist fracture where 88 participants were randomized to Multi-Sensory Training and 42 received Wrist stabilization Training. The training period was 12 weeks, with 4 supervised sessions by a physiotherapist and home exercises for both groups. Pre and post training measurements included Head Shake Test (HST), Semmes–Weinstein Monofilaments (SWM), Vibration perception Test, 10m Walk Test (10MWT), Five Times Sit to Stand Test (FTSTS), Activities Specific Balance Confidence (ABC) and Dizziness Handicap Inventory Scales (DHI).

Results: FTSTS, ABC, DHI were found to be statistically significant between the 2 groups. In contrast to wrist stabilization training, MST was more helpful in improving HST (p=0.001).

Conclusions: Vestibular function among the cases of wrist fracture was better with Multi-Sensory Training. It may be applied as a routine training intervention post fracture treatment. A robust sample size can be taken up to generalize its effectiveness.

Keywords: Wrist fracture Sensory function Postural stability Vestibular function Vibration perception.

Introduction

Wrist fractures are one among the common injuries of the elderly leading to reduced quality of life and impaired functionality, if not treated and restored adequately. [1] Factors like asymmetry of vestibular function, decreased plantar sensation, unstable posture, reduced strength of lower extremities and functional disability have been more commonly associated with fall related wrist fractures among the geriatric population. [2] Since wrist fractures are considered as an indicator for fracture incidence in the future specially for hip fractures, preventive measures like improving balance, function of the balance system in the inner ear and feeling in people's feet can be timely adopted which in addition might be helpful in rehabilitation of patients with fractured wrist. [3,4]

With increasing age degenerative changes occur affecting the multisensory activity in addition to posture control, body strength and reflexes. This supports the fact that one- third of individuals of more than 60 years of age are more prone to fall. [5,6] Fall can be due to psychological factor, decreased mechano-receptive sensitivity of the lower extremities, dizziness, etc. [7,8] Stimulation of sensory system in addition to muscle strengthening physical exercises might reduce incidence of fall. [9]

Objective

To determine effect of multi-sensory training (MST) on posture (muscle strength), vestibular function, vibration perception, tactile sensation and functional ability compared to wrist stabilization training (WT) among elderly with fall related wrist fractures.

Methodology

This was a randomized prospective study designed for 130 follow up cases of wrist fracture (DRF) who had undergone surgical management at Department of Orthopedics, Venkateshwara Institute of Medical Sciences, Gajraula. It was conducted from April 2023 to September 2023, post IEC approval. The sample size and population was with reference to

previous study which was followed by this exercise. [10]

The participants had to be ≥ 50 years old, having fracture of distal end radius of either side or both side (closed type) that was surgically managed within a year, irrespective of their gender. Exclusion criteria were if wrist fracture was of compound/ pathological type, history of any degenerative disease of either bones or CNS which could be a challenge in the healing of fractured bone and cognition, respectively. The cases were randomly assigned to one of the groups, either multi-sensory training group (n=88) or to the wrist stabilization training group (n=42) using a computer

generated random number list. The training period was for 12 weeks, with 4 supervised sessions by a physiotherapist and home exercises for both groups. The exercises that were used in this study are common and widely accepted:

Multi-sensory Training (MST)

This method is also referred to as "The Reykjavik model. [11] The exercises were performed barefoot on firm and soft surfaces, during movements. Attention of the subject was kept directed at distribution of weight on soles of both feet. No use of external support was allowed. This was done to control the body's movement along with its position. Moreover, they were encouraged to know their body posture control pattern and trained to correct their posture with motions at ankles. Control of posture was practiced during head movements in various directions, with eyes open, closed and during fixation of gaze. The subjects were taught how to react to sudden balance disturbances by taking a step to hinder falling and use stepping reactions when their stability was challenged by a manual push in different directions. [10,11] With respect to the type of weakness in balance, the subjects were given different exercise, which were taught to them during the sessions under supervision of ENT and Orthopedic specialist. The subjects were instructed to perform the exercise at home and focus on distribution of weight on the soles. The exercise had to be continued after taking some rest, if nausea or dizziness was experienced during the exercise.

Wrist Stabilization Training (WT)

The exercises for strengthening fractured wrist post-surgery were to be done while seated so that the control over body position is also stimulated. The exercises include elastic resistance bands, sponge ball and ball over a plate which were taught under supervision of the experts. This training was referred to from a similar study. [10] All measurements conducted to judge the gait, vestibular function, muscle strength, posture stability and sensations were conducted at baseline and completion of the study, in

addition to recording of weight and height:

FTSTS test was applied to test the strength of lower limb muscles which has been proved to be very reliable. [12,13] The gait speed was assessed by the 10 m Walk Test (10MWT) where measurements were taken twice, first when the subject walked at normal pace and second when the subject walked at the fastest speed. [14,15]

Vibration perception test over plantar surface of feet was done using a biothesiometer which produced a 120 Hz vibration. [16] Whereas, a tuning fork producing 128 Hz vibration was used to check perception over lower extremities. These sensations were graded from 1-3; 1 if vibration perceived over base of 1st metatarsal, tibial tuberosity and medial malleolus, 2 if vibration perceived over tibial tuberosity and medial malleolus and 3 if vibration was detected only over tibial tuberosity. [17–19]

The Semmes Weinstein pressure aesthesiometer (SWM) having nylon filaments was used to measure tactile sensitivity. This was done and interpreted in accordance to previous studies. [16] Normally, it ranges from 0.4 to 4 g. [16] Monofilament and biothesiometer; measured on plantar surface of heel, caput of the 1st and 5th metatarsal bones, bilaterally.

Head Shake Test (HST) was done to evaluate the vestibular function where the eye movements of patient were recorded in supine position while using infrared goggles. [20,21] Nystagmus was recorded. After head shake, 2 or more beats of nystagmus was asymmetry. [2,20]

The questionnaires for Activities Specific Balance Confidence (ABC) [22,23] and Dizziness Handicap Inventory scales (DHI) [24,25] were used as research tool which were self-administered.

Results

Interestingly, all wrist fractures were caused due to fall. 25% patients reported fall due to sudden black out while head movement while 13.1% reported fall due to accidental tripping. Wrist fracture was reported by 91(73.4%) male while 33(26.6%) were female. Among them, 38.6% were diabetic and 51.2% reported to be hypertensive. On baseline assessment, 85.5% patients had reduced lower limb strength, 71.2% had decreased plantar vibration sensitivity and 90% had complaints of discomfort/ nausea on movement of head. 25.4% of the patients had reduced tactile sensation both the lower limbs while 47.8% reported the deficit on either of the lower limbs. Moreover, 70.1% patients reported history of experiencing dizziness and 65% had reduced activities specific balance control.

The observations showed the baseline characteristics information of patients who were randomized and divided into 2 groups receiving different training- MST and WT. Body mass index,

history of wrist fracture, vibration sensation over feet (Biothesiometer) and head shake test was found to be statistically significant.

The results also show difference in the pre- and post-training assessment of the patients treated for wrist fracture for strength, gait, vibration, tactile sensitivity, vestibular function, balance confidence, dizziness and functional abilities. The study reports that there was significant improvement witnessed in ABC, DHI and FTSTS in both groups whereas the MST group in addition reports developing better HST.

Discussion

The overarching purpose of this study was to evaluate probable predictors for wrist fracture post fall among the elderly population and whether Multi-Sensory Training or Wrist stabilization Training helps in improving these deficits.

The elderly population is a high risk group for fractures. [26,27] The present study reports majority to be males who have experienced wrist fracture which is similar to finding of a previous study. [10,14] A study reports participants with wrist fracture, aged between 70 to 92 years, had significant medical history while in our study, it was noted that 38.6% were diabetic and 51.2% were hypertensive. [11]

At baseline assessment, poor lower limb strength, vestibular function, activity specific balance and dizziness was recorded among the cases of wrist fracture in both the groups. While, the study by Baldursdottir et al. report poor balance control among the subjects at beginning of the study, [10] the findings of current study reports 90% patients to have vestibular asymmetry and 38.6% had impaired plantar vibration sensitivity of foot which is in line with the findings of another study that shows 83% patients having vestibular asymmetry and 35% having decreased vibration sensitivity over plantar surface of foot. [16] Whereas, another study on the elderly population reported the participants to be physically weak and less confident in performing daily activities (as per the interview based on ABC questionnaire) at baseline. [11]

After 12 weeks of training, in current study, a change of 1.8 second of lower extremity strength from the baseline was seen in the MST group while it was 1.6 seconds in the WT group. There was no difference observed post training in 10 meter walk test (for both normal and fast walk) while a study reported fast walking speed to have increased by 0.1 m/s after MST among the participants. [10,28] A clinically significant improvement of 2.9 s in FTSTS in MST group was reported by Bohannon RW. [29] Vibration perception test using Biothesiometer in MST group had improved by 0.4 μ/m while it was 0.2 μ/m as reported by previous study. [10] Studies have shown that an improvement in muscle strength might prevent injuries related to fall. [30]

On assessing the tactile sensitivity using SWM, minimal difference in the improvement was noticed among the two groups whereas when compared to the baseline observation, an improvement of 0.2g and 0.31g was reported, respectively. Whereas it was improved only in the MST in previous studies. [10,20] A deficit in the tactile sensation makes a person prone to fall related injuries [20] thus, hinting on the fact that MST seems more effective than WT in elderly with decreased postural control.

Our study noticed statistical significant improvement in the vestibular asymmetry among patients in the MST group after 12 weeks of training and regular follow up. On head shake test, MST group showed clinically and statistically significant improvement in vestibular asymmetry ($p=0.001$) while WT group saw no change when compared to the baseline data. Similarly, participants of another study reported borderline significant ($p=0.06$) reduction of vestibular asymmetry in the MST group while there was no change in the WT group. [10] A study reports HST and monofilaments sensation to have the strongest association with wrist fracture due to fall. [20]

The group receiving multi-sensory training had better Sensory Organization Test after intervention in comparison to wrist stabilization training. [10]

Dizziness has been reported as one of the factors for fall related fractures. [3,24] In accordance with this fact, our study reports 70.1% patients of fall related wrist fracture complaining of dizziness prior to fall. Post training, a change of 4.5 and 4.1 in DHI score was seen in MST and WT group when compared from the baseline report. Similar finding was reported by another study where DHI score significantly improved in the MST group($p=0.01$). [10] Thus, statistically significant improvement was witnessed in both the groups in terms of ABC, DHI and FTSTS. Whereas HST only in the MST group was found to be significantly improving. There are studies which report that even if the strength exercises are found to be beneficial for improvement of balance, its application alone is not effective. [9,30]

Conclusion

Asymmetric vestibular function, reduced strength of muscles of the lower limbs, reduced balance confidence and dizziness might be the risk factors for causing fractures, specially wrist fracture among the elderly population. Increasing physical exercises possibly improves the posture and balance control ability of a person. Early diagnosis and treatment for the improvement of the above-mentioned factors could help in reducing the incidence of fracture in the geriatric group, thus providing quality living.

Stimulation of sensory system by multi-sensory training of an elderly individual might contribute to reduction in incidence of fall.

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