



## **FRENKEL'S STABILIZATION EXERCISES IN IMPROVING THE BALANCE IN ELDERLY PATIENTS WITH NEUROLOGICAL CONDITIONS- A COMPARATIVE STUDY**

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### **ABSTRACT :**

Background: The neurological disorders and their sequelae (direct consequences) affect as many as one billion people worldwide, and identified health inequalities and social stigma/discrimination as major factors contributing to the associated disability and their impact. Frenkel's exercises are a series of motions increasing difficulty performed by ataxic patients to facilitate the restoration of rhythmic, smooth and coordinated movements. Methodology: The subjects were divided into two groups (15 each). GROUP A were given general exercises (strengthening and balance exercises) and GROUP B were given frenkel's exercises (lying, sitting and standing positions). Result: The result showed that all the interventions brought significant results in their groups, i.e. Group A (general exercise) and Group B (Frenkel's exercise). Both groups' subjects were assessed to find the TUG Score for assessing balance, risk of falls, and FES for assessing fear of falls. In addition, each outcome measure's pre-test and post-test scores were recorded. In comparison, Timed Up and Go tests were equally effective in groups, i.e. groups A and B. Still, Fall Efficacy Scale is more effective in the home based exercise than Frenkel's exercise in decreasing the FES of the patients. Conclusion: the study concluded that the home based exercise program and Frenkel's exercise were equally effective in improving the balance of the patients. However, compared to the risk and fear of falling, home based exercise was more effective than Frenkel's.

**Keywords:** Frenkel's exercises, Fall Efficacy Scale, Timed Up and Go tests, neurological disorders

### **INTRODUCTION :**

According to the World Health Organisation (WHO), neurological disorders are any diseases affecting the entirety of the nervous system (i.e. the central and peripheral nervous systems)[1]. These will be conditions involving the brain, spinal cord, cranial nerves, peripheral nerves, nerve roots, autonomic nervous system, neuromuscular junction and muscles. A neurological condition is any condition that affects the brain, spinal cord and/or nerves. Because these systems control your mind and body, neurological conditions can affect the way you think, feel, and interact with the world. Neurological conditions can affect anyone at any age. A neurological disorder is any disorder of the nervous system. Structural, biochemical or electrical abnormalities in the brain, spinal cord or other nerves can result in a range of symptoms. Examples of symptoms include paralysis, muscle weakness, poor coordination, loss of sensation, seizures, confusion, pain, tauopathies, and altered levels of consciousness. There are many recognized neurological disorders, some relatively common, but many rare. They may be assessed by neurological examination, and studied and treated within the specialties of neurology and clinical neuropsychology. Interventions for neurological disorders include preventive measures, lifestyle changes, physiotherapy or other therapy, neurorehabilitation, pain management, medication, operations performed by neurosurgeons or a specific diet.[1][2] The World Health Organization estimated in 2006 that neurological disorders and their sequelae (direct consequences) affect as many as one billion people worldwide, and identified health inequalities and social stigma/discrimination as major factors contributing to the associated disability and their impact.

Heinrich Frenkel created the Frenkel's exercise as a coordination and proprioception exercise for people with tabetic ataxia, a gait characteristic of somebody with untreated syphilis. In these exercises, the central nervous system is educated through precise repetition of exercise, particularly in the lower limbs, with high level of concentration. The exercises are carried out in three different positions: sitting, lying down, and standing. Frenkel could be regarded as the father of rehabilitation medicine because he was the first to propose the idea of exercise to improve ambulation and regain dexterity. Although the exercise was created for persons with tabetic ataxia, a form of sensory ataxia, it has been proven effective for other neurological conditions involving coordination and proprioception affectation. They are a system of exercises consisting of slow, repeated movements. They increase in difficulty over the time of the program. The patient watches their hand or arm movements (for example) and corrects them as needed. Although the technique is simple, needs virtually no exercise equipment, and can be done on one's own, concentration and some degree of perseverance is required. Research has shown that 20,000 to 30,000 repetitions may be required to produce results. A simple calculation will show that this can be achieved by doing 60

repetitions every hour for six weeks in a 16-hour daily waking period. The repetitions will take just a few minutes every hour. The brain as a whole learns to compensate for motor deficits in the cerebellum (or the spinal cord where applicable). If the ataxia affects say, head movements, the patient can use a mirror or combination of mirrors to watch their own head movements. Professor Heinrich Sebastian Frenkel- A forgotten founder of Rehabilitation Medicine. Frenkel was born and later on practiced medicine in Heiden, Switzerland. This small town became, by his vigilant and innovative work, a place of pilgrimage for neurologists. He was the first to introduce the concept of exercise to restore dexterity and to improve ambulation and so pioneered the specialty of physical medicine and rehabilitation. Frenkel's method and philosophy became the foundation of treatment for many chronic neurological disabling diseases. His personality and work influenced many famous neurologists, worldwide.

The exercises were developed by Heinrich Frenkel, a Swiss neurologist who, one day in 1887, while examining a patient with ataxia, observed the patient's poor performance of the finger-to-nose test. The patient asked Dr Frenkel about the test and was told what it meant and that he did not 'pass' the test. Several months later, on re-examination, the patient showed extraordinary improvement in coordination. Frenkel was astonished by the improvement. He had never seen such an improvement before, which was contradictory to the teaching of the day. When Frenkel asked the patient what had happened in the interval, the patient replied, 'I wanted to pass the test and so I practiced.' This event inspired Frenkel to a general assumption: 'If one patient can reduce his ataxia by practice, why not all? Or at least others?' He immediately started to study the problem in a practical manner. In his book on ataxia, Frenkel states: "The visual sense is the greatest supporting factor in the treatment". This means the patient must watch their own movements while practicing them. Frenkel's book states that the best way to perform the exercises is to do them for three minutes using some kind of timer so the exercises become less of a chore. Then the patient should do something entirely different and unrelated for fifteen minutes, say read a book or have a chat. At that point, the patient goes back to the exercises for another three minutes when it will be found that the skill has improved to a step higher from when the exercises were last done fifteen minutes earlier. It is thought that the fifteen-minute break enables the new neural connections to be created. Frenkel's book posits that these sessions should be done every day for at least six weeks. The patient can treat himself or herself and obviously in the absence of a medical practitioner must do so. However, it is better that a physiotherapist is involved. He or she motivates and guides the patient in how to watch themselves move. The therapist may also help the patient move where muscular strength is low. Frenkel states that is very important that the therapist also gives the patient pep talks and motivation. Frenkel noted that the patient had to be free from opiate and alcohol use, for instance, in order to achieve the required focus of attention. Frenkel's exercises are a series of motions increasing difficulty performed by ataxic patients to facilitate the restoration of rhythmic, smooth and coordinated movements.

#### **Principle: -**

These exercises require:

- Concentration or attention- The concentration may create the proprioceptor activities over the joint. The visual watching the movements are recorded in brain and it may improve kinaesthetic sense.
- Repetition- The repetitions of accurate movement improves the kinaesthetic sense and coordination. Repeating the movements are helpful for the cerebrum to record and memorize one particular movement perfectly.
- Precision- Movements should be accurate and rhythmical. Movement, which the patient performs, will be recorded in his brains through the visual pathways.

Throughout the workouts, the physical therapists should give verbal feedback. Through these exercises, the patients would learn how to stay balanced and prevent falls by using their visual, somatosensory, and vestibular systems. Exercises are performed with the eyes closed as somatosensory development improves.

#### **Technique:**

1. The patient is positioned and suitably clothed and the area is well lit so that he can see the limbs throughout the exercise.
2. A concise explanation and demonstration of the exercise is given before movement is attempted, to give the patient a clear mental picture of it.
3. The patient must give his full attention to the performance of the exercise to make the movement smooth and accurate.
4. The speed of movement is dictated by the physiotherapist by means of rhythmic counting, movement of her hand, or the use of suitable music.
5. The range of movement is indicated by marking the spot on which the foot or hand is to be placed.
6. Exercises are designed primarily for coordination; they are not intended for strengthening.
7. The exercise must be repeated many times until it is perfect and easy. It is then discarded and more difficult one is substituted.
8. The first simple exercises should be adequately performed before progressing to more patterns that are difficult.
9. As these exercises are very tiring at first, frequent rest periods must be allowed. The patient retains little or no ability to recognize fatigue, but it is usually indicated by a deterioration in the quality of the movement, or by a rise in the pulse rate.
10. Group work is of great value as control improves, as it teaches the patient to concentrate on his own efforts without being distracted by those of other people. In walking, he gains confidence and becomes accustomed to moving about with others, to altering direction and stopping if he wishes, to avoid bumping into them. The ability to climb stairs and to step on and off a kerb helps him to independence.
11. These sessions should be done every day for at least six weeks.

#### **Progression:**

1. Progression is made by altering the speed, range and complexity of the exercise. Quick movements require less control than slow ones.
2. Later, alteration in the speed of consecutive movements, and interruptions, which involve stopping and starting to command, are introduced.
3. Wide range and primitive movements, in which large joints are used, gradually give way to those involving the use of small joints, limited range and a more frequent alteration of direction.

4. Finally, simple movements are built up into sequences to form specific actions, which require the use and control of a number of joints and more than one limb, e.g. walking.
5. According to the degree of disability, re-education exercises start in lying with the head propped up and with the limbs fully supported and progress is made to exercises in sitting, and then in standing.

#### **Examples of Frenkel's Exercises:**

##### **Exercise for the legs in lying**

- Lying (Head raised); Hip abduction and adduction. The leg is fully supported throughout on the smooth surface of a plinth or on a re-education board.
- Lying (Head raised); one Hip and Knee flexion and extension. The heel is supported throughout and slides on the plinth to a position indicated by the physiotherapist.
- Lying (Head raised); one Leg raising to place Heel on specified mark. The mark may be made on the plinth, on the patient's other foot or shin, or the heel may be placed in the palm of the physiotherapist's hand.
- Lying (Head raised); Hip and Knee flexion and extension, abduction and adduction. The legs may work alternately or in opposition to each other. Stopping and starting during the course of the movement may be introduced to increase the control required to perform any of these exercises.

##### **Exercise for the legs in sitting**

- Sitting; one Leg stretching, to slide Heel to a position indicated by a mark on the floor.
- Sitting; alternate Leg stretching and lifting to place Heel or Toe on specified mark.
- Stride sitting; change to standing and then sit down again - The feet are drawn back and the trunk inclined forwards from the hips to get the centre of gravity over the base. The patient then extends the legs and draws himself up with the help of his hands grasping the wall-bars or other suitable apparatus.

##### **Exercise for the legs in standing**

- Stride standing; transference of weight from Foot to Foot.
- Stride standing; walking sideways placing Feet on marks on the floor. Some support may be necessary, but the patient must be able to see his feet.
- Standing; walking placing Feet on marks. The physiotherapist according to the patient's capacity can vary the length of the stride.
- Standing; turn round. Patients find this difficult and are helped by marks on the floor.
- Standing; walking and changing direction to avoid obstacles.

##### **Exercises for the arms**

- Sitting (one Arm supported on a table or in slings); Shoulder flexion or extension to place. Hand on a specified mark.
- Sitting; one Arm stretching, to thread it through a small hoop or ring.
- Sitting; picking up objects and putting them down on specified marks. Diversional activities such as plaiting, building with toy bricks, or drawing on a blackboard, lead to more useful movements such as using a knife and fork, doing up buttons and doing the hair.

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#### **Frenkel's exercises for elderly patients:**

In older persons, falls have been identified as a top concern. As we age, our physical independence may decline, directly or indirectly increasing the risk of falling. Adults 64 years and older frequently fall, resulting in wounds, fractures, physical incapacity, long-term disability and even death. Every year, almost one-third of people over 65 experience indoor falls, and half of this age group experience institutional falls. There are many causes of falls in older persons, but general muscle weakness, decreased strength and balance, and other environmental risks are the main culprits. Elderly persons who fall frequently limit their activity to reduce the chance of falling, which increases fall risk by resulting in muscle loss, strength loss and functional ability to decrease, among other things. Falls appear to be common occurrences. While some fall-related injuries may be mild, others may have adverse long-term effects. A fall could be the first indication of an undiagnosed illness. Irreversible age is the primary risk factor for falls, which affects everyone. Several factors increase the risk of falling, and one- to two-thirds of falls happen at or near the patient's home. Falling is frequently caused by muscle weakness and abnormal gait. Falls are also known to be caused by medical conditions such as vertigo, hypertension, stroke, vision impairment, substance use, sleep disorders, fever, dehydration, and other neurological conditions. Use of an assistive device, difficulty performing everyday tasks, depression, cognitive impairment, being 80 years of age or older, and using two or more drugs have also been found to be strongly related to an increased risk of falling. People over the age of 65 frequently fall. Falls reduction can lower healthcare costs. The risk variables for falls that are most easily changeable include strength, balance and flexibility. Numerous fall prevention strategies have been researched. These interventions could involve a single intervention or a mix of two or more, such as gait and balance training combined with strength and resistance training etc.; a fall risk assessment in any form or with one or more specific risk factors may be a part of single or multiple interventions. Depending on the target population, intervention may vary.<sup>10</sup> The act of keeping the body's centre of gravity within the area supporting its weight is called balance<sup>11</sup>. Muscle strength, functional use, and personal preference can be used to identify the dominant limb, and these factors may affect balance<sup>12</sup>. Muscle movement and joint placement offer the continual adjustment it needs<sup>13</sup>. Concerning gait disturbances and degeneration in the elderly, many other pathologies usually cause postural instability. The need for maintaining mobility is crucial due to the ageing population. Balance disturbance, muscle weakness, spasticity and deformities result in abnormal gait pattern. As people age, their numerous sensory systems gradually deteriorate, making it harder to maintain good posture. Balance is a person's capacity to absorb

sensory and proprioceptive cues about their position in space and generate the proper motor responses to manage bodily movement. One of the significant contributors to falling is balance issues. Balancing management involves intricate connections between numerous physical systems and entails various balance subtasks that diseases or ageing may differently impact. A variety of balance skills, including the ability to repeatedly change the base of support or move the body's centre of gravity, is essential for functional independence. Numerous studies have shown that exercise improves balance, muscle strength, daily activities, flexibility, walking speed/pace and the ability to live independently. Physical activity can assist in maintaining a high functional capacity, especially for older adults. For instance, encouraging elderly folks to exercise can help prevent falls. Lifestyle diseases can be halted by physical activity. It can be used to treat various critical illnesses while also reducing symptoms. There are studies where Home-based exercises and Frenkel's exercises have been found to improve balance and strength and reduce falls in older adults; however, there is a lack of evidence to see the comparison. Hence, this study aims to check the effectiveness of a home-based exercise program versus Frenkel's exercise in preventing falls in elderly adults.

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## REVIEW OF LITERATURE

K.Bharathi, A.Sasikumar stated that frenkel's exercise is effective than general exercise. Both had an impact in the pain and cramps among Parkinson's disease. But frenkel's exercise had an overall improvement in the coordination, balance, emotions, communication. Navjyoti Gupta, Ritika purbia stated that frenkel's exercise is more effective than Swiss ball to improve balance and mobility in Parkinson's patients. Vaishali jagtap, Amrutkuvar Rayjade, Trupti Warude, K Arundhati Shiva Prasad stated that chair aerobics and frenkel's exercise is found to be effective on balance and coordination in geriatric population. Grzegorz Mańko, Sabina Tim, Malgorzata Jekielek stated that Both Frenkel's exercises and training with the use of the stabilometric platform were effective in a rehabilitation program aimed at reducing the risk of falls among the elderly. Fatemeh Karami, Ardashir Afrasiabifar, and Shahla Najafi Doulatabad, stated that both vestibular rehabilitation and Frenkel exercise could reduce fatigue in MS patients, however, vestibular rehabilitation was more effective compared to the Frenkel exercise in reducing fatigue. Dr Mohd Shoeb, Arun Tiwari, Sonam Rai, Raghvendra Shukla, Puneet tripathi- stated that Frenkel's and PNF exercises both can be used to treat the coordination in Cerebral palsy patients. While both the treatment protocols were effective, there was slight significant improvement found in group 1 treatment over group 2. Hence it has been concluded that both the treatments can be used for the treatment of balance issue in CP patients. Eun Jae Ko, Min Ho Chun, Dae-Yul Kim, Yujeong Kang, Sook Joung Lee, Jin hwa Yi, Min Cheol Chang, So Young Lee stated that Frenkel's exercise improves sensory and balance recovery among subacute ischemic stroke patients with impaired proprioception and minimal lower limb motor weakness.

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## METHODOLOGY:

A randomized controlled design was used in this study. 30 subjects with history of fall are studied from Outpatient department of physiotherapy. The subjects were divided into two groups (15 each). GROUP A were given general exercises (strengthening and balance exercises) and GROUP B were given frenkel's exercises (lying, sitting and standing positions).

### INCLUSION CRITERIA

- Men and women aged 65 years to 80 years who have experienced falls recently.
- History of falls in the previous 6 or 12 months
- Perceiving fear of falling or having multiple falls with minor or no injury
- Able to interact with the researcher.
- Ability to understand and follow therapist instructions
- complete the training program (pre and postprotocol)

### EXCLUSION CRITERIA

- Any neurological deficits could be self-limiting, such as Parkinsonism, stroke etc.
- Disability in vision and auditory sensation
- People with recent fractures or surgeries related to knee or hip joint replacement.
- Mental disorders and behaviour caused by the use of psychoactive substances, schizophrenia (Alzheimer's disease, dementia).
- Traumatic brain injury, epilepsy.
- Those unable to ambulate independently without walking assistance, cardiovascular disease or cerebrovascular disease, e.g. (unstable angina, arrhythmia)

## PROCEDURE

After informed consent the subjects were divided into two groups randomly.

### GROUP A:

received the home based exercises programs included strengthening, co-ordination and balance exercise. Strengthening exercise: The weight cuff was placed at the ankle for the three strength exercises and repeated ten times.

1. Front knee strengthening: The patient was made to sit with their back supported in the chair, and a weight cuff was placed on the ankle. The subject was made to lift the weighted leg slowly, straighten the knee, and then lower the foot with control. The exercise was repeated ten times on one leg and ten times on the other.

2. Back knee strengthening: The ankle weight cuff was placed on the ankle with the Patient in a standing position and feet hipwidth apart, holding support. The patient was asked to lift the weighted leg backwards off the floor towards the buttock and slowly lower the foot, bringing the leg back to the initial position. The exercise was done in the repetition of 10 times alternately.
3. Side hip strengthening: With the ankle weight cuff on and the patient in a standing position with feet hip-width apart holding support. The patient was made to Lift the leg sideways, slowly away from the other foot and bring it back to the initial position. The exercise was done in the repetition of 10 times and changed legs alternately. (The exercises ended with calf raises and toe raises as a remarkable down period) Balance Exercise.
4. Knee bends: A chair or table was used as a support, and the patient's position with Feet hip-width apart, toes facing forwards, holding support; the patient bent the knees as if going for a squat and pushed the bottom backwards as though going to sit down. Making sure the patient doesn't lift the heels. They then brought the body back up to the start position.
5. One leg stand: the patient in standing position was asked to hold on to the chair with both hands lifting one leg off the ground slowly, balancing on one leg keeping the support knee soft and upright posture position for 10 seconds. They were then repeating it on the other leg.
6. Toe walking: the patient was in a standing position, feet hip-width apart and lifting the heels off the floor, keeping the weight over the toes and walking 5-10 steps forward on toes repeating it ten times.
7. Heel walking: the subject in an upright standing position holding on to the chair as support. Toes point upwards, gently step on the heels, and walk for 5-10 steps with a repetition of 10 times.
8. Sideways walking: patient position; standing tall, looking ahead, holding support; the patient was made for walking sideways and taking a few steps and walking back sideways to the starting point, with a repetition of 10 times.
9. Backward walking: Stand tall, looking ahead and straight, holding on to the support; the patient was made for walking backwards, taking 5-10 steps with a repetition of 10 times. All he balance exercises were done in 10 repetitions and progressed without support.

#### GROUP B:

received Frenkel's exercises performed in supine, sitting and standing positions.

#### A. Exercises in the supine position

1. The patient in a supine position was made to flex and straighten the leg alternately in the hip and knee joint with a repetition of 10 times (hip and knee flexion and extension).
2. The patient is in the supine position, with legs pointing upwards and moving one leg from the midline out to the side as far as possible, bringing it back to the start position with a repetition of 10 times (hip abduction and adduction).
3. The patient is lying and placing the leg on a designated area marked by the therapist or touching the hands of the therapist with their foot.
4. The patient was made to lay flat on the back, flexing the hips and knees to 90° and imitating a bicycle's pedalling movements in the air.

#### B. Exercise in a sitting position

1. The patient is in a sitting position with the back supported in the chair. The subject was asked to lift the leg slowly, straighten the knee, and then Lower the foot with control. With a repetition of 10 times alternately.
2. The patient in the Sitting position was asked to touch certain marks on the floor and stretch one leg to slide the heel to a position indicated by an effect on the floor.
3. In a sitting position with marks on the floor, the patient was asked to stretch the leg and lift the heel or toe on the specific effect.
4. Sit to stand, sit toward the front edge of the chair without an armrest; the patient's knees should be bent and feet flat on the floor. Then, placing hands lightly on each side of the seat, back and neck straight and slowly getting up from the chair, stood, paused, and sat down slowly.

#### C. Exercise in a standing position

1. Stride standing, the patient was standing with an upright posture and transferring weight from foot to foot.
2. The patient was standing with marks on the floor; the patient was asked to walk sideways, placing their feet on impacts on the floor.
3. In standing, with marks on the floor in a straight line, the patient walked, placing feet on the impact.
4. With marks on the floor in a 360° diagram, the patient rotated left and right without lifting the feet off the ground.
5. Objects were placed in certain areas as obstacles, and the patient walked and changed direction to avoid the barriers .
6. Patient in standing, moving one leg to the side or away as far out and bringing it back to the initial position (hip abduction and adduction) in smaller arcs alternately .
7. In a standing position with legs straight, knees locked, kicked front and back in a minor arc (hip flexion and extension).
8. With marks on the floor in a straight line, the patient walked in a straight line following the marked area. (All the exercises were given in relatively slow movements and progressed by increasing complexity).

## RESULT:

### GROUP A HOME BASED EXERCISES

#### Pre and Post Interventions

SCALES	PRE TEST MEAN	POST TEST MEAN	SD	MEAN
TUG	16.2	11.06	3.2555	5.2
FES	74.7	67.8	4.1016	6.9

**GROUP B FRENKEL'S EXERCISE****Pre and Post Interventions**

SCALES	PRE TEST MEAN	POST TEST MEAN	SD	MEAN
TUG	16	11.7	14.210	4.3
FES	75.6	69.4	16.803	6.2

**COMPARISON OF PRE TEST AND POST TEST MEAN VALUES IN GROUP A AND GROUP B**

	PRE TEST MEAN	POST TEST MEAN	MEAN DIFFERENCE
GROUP A	80.9	78.8	2.1
GROUP B	75.2	35.6	39.6

**DISCUSSION :**

For older patients, both lack of balance ability and lack of balance confidence are two major challenges which can contribute to falls and activity avoidance. Improvements were seen in all the parameters of group A and group B in improving the balance of the elderly patients. In contrast, home-based exercise was more effective than Frenkel's exercise compared to the risk and fear of falls.

**CONCLUSION :**

All the interventions have brought about some improvement in each group post-treatment based on the mean score, but its significance varies. Therefore, based on the inter-group analysis, this study concluded that the Timed Up and test (TUG) intervention was equally effective in groups A and B. But Fall Efficacy Scale (FES) was found to be significant only in group A, out of which the mean score of FES decreased in group A post-treatment (Home based exercise program of strengthening and balance). Therefore, we can say that this procedure helped in preventing the risk and fear of falling in elderly adults, but not much of a difference was seen in Frenkel's exercise. Therefore, it concluded that the home based exercise program and Frenkel's exercise were equally effective in improving the balance of the patients. However, compared to the risk and fear of falling, home based exercise was more effective than Frenkel's.

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