



Evaluation of Balance Exercises on Balance, Fall Risk, and Quality of Life in Postmenopausal Women

Postmenopozal Kadınlarda Denge Egzersizlerinin Denge, Düşme Riski ve Yaşam Kalitesi Üzerine Etkisi

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Abstract

Objective: This study, it was investigated the effectiveness of proprioceptive neuromuscular facilitation and Frenkel exercises on balance, fall risk and quality of life in postmenopausal women.

Materials and Methods: Forty-eight postmenopausal women were randomized to proprioceptive neuromuscular facilitation (n=24) and Frenkel (n=24) exercise groups (in the form of a home exercise program). Before the study and at the fourth week after the study, all participants were evaluated for handgrip- strength, quality of life, risk of falling, and balance (functional reach test, one leg stand test, timed up and go test, and Berg balance scale).

Results: Significant improvement was achieved in all evaluation parameters in the proprioceptive neuromuscular facilitation group ($p<0.05$). In the Frenkel group, significant improvement was observed in all evaluation parameters ($p<0.05$), except for the one-leg stand test ($p=0.064$) and the short form-36 mental health score ($p=0.057$). It was observed that there was no significant difference between the two groups in the scores of handgrip strength, functional reach test and timed up and go test ($p>0.05$).

Conclusion: Proprioceptive neuromuscular facilitation and Frenkel exercises had significant effects on balance parameters, fall risk and quality of life in postmenopausal women. Frenkel exercise program is cheaper and requires less labor, therefore, we think that it may be preferable in terms of improving balance and reducing the risk of falling in postmenopausal women.

Keywords: Balance, exercise, postmenopausal, quality of life

Öz

Amaç: Bu çalışmada postmenopozal kadınlarda proprioseptif nöromusküler fasilitasyon ve Frenkel egzersizlerinin denge, düşme riski ve yaşam kalitesi üzerine etkinliğinin araştırılması amaçlanmıştır.

Gereç ve Yöntem: Kırk sekiz postmenopozal kadın proprioseptif nöromusküler fasilitasyon (n=24) ve Frenkel (n=24) (ev egzersiz programı şeklinde) egzersiz gruplarına randomize edildiler. Tüm katılımcıların çalışma öncesi ve çalışma sonrası 4. haftada el sıkma kas gücü, yaşam kalitesi, düşme riski ve denge (fonksiyonel uzanma testi, tek ayak üzerinde durma testi, timed up and go testi ve Berg denge testi) değerlendirmeleri yapıldı.

Bulgular: Proprioseptif nöromusküler fasilitasyon grubunda tüm değerlendirme parametrelerinde anlamlı şekilde gelişme elde edildi ($p<0,05$). Frenkel grubunda, tek ayak üzerinde durma testi ($p=0,064$) ve kısa form-36 mental sağlık skoru ($p=0,057$) dışında tüm değerlendirme parametrelerinde anlamlı bir gelişme elde edildi ($p<0,05$). Gruplar arası karşılaştırmalarda ise el sıkma kas gücü, fonksiyonel uzanma testi ve timed up and go testi skorlarında iki grup arasında anlamlı bir fark olmadığı görüldü ($p>0,05$).

Sonuç: Proprioseptif nöromusküler fasilitasyon ve Frenkel egzersizlerinin postmenopozal kadınlarda denge parametreleri, düşme riski ve yaşam kalitesi üzerine önemli etkileri olmuştur. Frenkel egzersiz programı daha ucuzdur ve daha az insan gücü gerektirir, bu nedenle postmenopozal kadınlarda dengenin iyileştirilmesi ve düşme riskinin azaltılması açısından daha tercih edilebilir olabileceğini düşünüyoruz.

Anahtar kelimeler: Denge, egzersiz, postmenopozal, yaşam kalitesi

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Introduction

Balance is the ability to maintain the gravitational line that supports body weight (1). Various factors may affect balance, such as age, gender, cognitive functions, musculoskeletal disorders, sensory disorders, and muscle tone (2,3). The decrease in balance ability limits the area of daily activity patients can do and increases the risk of falls (1).

As women age, their postural balance deteriorates due to decreased functional capacity and decreased movements. In postmenopausal women, the problem of balance is manifested by walking disorders, instability and falls (4). Estrogen has been shown to increase brain blood flow, act as an anti-inflammatory agent, increase activity in neuronal synapses, and exhibit direct neuroprotective and neurotrophic effects on brain tissue (5). Estrogen also has a positive effect on muscle strength by quantitatively increasing muscle quality (6). Estrogen loss in menopause is thought to affect postural stability and balance due to the reasons mentioned above (5,7).

Proprioceptive neuromuscular facilitation (PNF) is a type of neuromuscular retraining that involves stimulation of sensory receptors to provide information about the body position and movement to facilitate the intended movement (8). While PNF exercises improve body stability and proprioceptive senses of the extremities, it can improve static balance when applied to people with normal health (1). Frenkel exercises consist of a series of slow, repetitive movements performed in different positions while lying, sitting and standing (9). Here, it is aimed to compensate the disturbed balance by using sensorial mechanisms like visual, auditory and tactile to control voluntary movement (10).

There have been very few studies in the literature comparing the effectiveness of different types of exercise on balance functions and fall risk in postmenopausal women (11-13). In addition, information on which balance exercise type is the best and most useful is still insufficient and controversial. There are many studies in which the effects of PNF exercises on balance in different patient populations are evaluated and successful (1,8). However, the relatively few studies on Frenkel exercises led us to the idea of comparing the two exercises in this patient population. Therefore, we aimed to investigate whether or not there was a significant difference between the groups who received PNF and Frenkel exercises in postmenopausal women in terms of balance functions, fall risk, and quality of life.

Materials and Methods

Participants and Study Design

In this prospective, randomized study, postmenopausal women aged 50-80 years who applied to the physical medicine and rehabilitation department of our university hospital between April 2018-August 2019 were voluntarily included in this study. Before the study, permission was obtained from the Afyon Kocatepe University Clinical Research Ethics Committee (protocol

no: 2011-KAEK-2, date: 02.03.2018). All patients gave written informed consent.

The study included postmenopausal women aged 50-80 years who can walk independently. Criteria for exclusion from the study; "1. The presence of diabetic retinopathy and nephropathy, 2. Presence of plantar ulcers, 3. Presence of coronary artery disease, 4. Presence of peripheral vascular disease, 5. Presence of visual impairment, 6. Having a history of using devices that help walk, 7. Presence of severe neurological, muscular or rheumatologic disease, 8. History of alcohol use, 9. Having a lower limb amputation, 10. The presence of dementia, 11. Having a history of malignancy, 12. Don't have hearing problems, 13. Using drugs that affect balance, 14. Patients enrolled in a regular exercise program, 15. The presence of neurological diseases that affect balance (stroke, multiple sclerosis, Parkinson's disease, epilepsy, etc.), and 16. Patients with fragility fracture."

Interventions

The patients were randomized by block randomization method and divided into PNF exercise (n=24) and Frenkel home exercise (n=24) groups (Figure 1).

In the PNF exercise group; exercises accompanied by a physiotherapist were performed 5 days a week (30 minutes) for 4 weeks. Five specific techniques were applied to the patients: dynamic stabilization, rhythmic stabilization, combined isotonic contractions, and hold-relax active motion. These techniques were applied in four hip patterns: hip extension-abduction-internal rotation, hip flexion-adduction-external rotation, hip extension-adduction-external rotation-hip flexion-abduction-internal rotation and also cross-variable knee flexion and extension. In lateral decubitus position, scapular and pelvic belt exercises in the anterior-elevation-posterior-depression diagonal were applied symmetrically and reciprocally to the patients in combined way. In addition, backbend and pull-up exercises were also given to the patients.

In the Frenkel exercise group, Frenkel coordination exercises were given in home exercise program 5 days a week for 4 weeks. Frenkel home exercises, consisting of ipsilateral shoulder flexion- hip and knee flexion, contralateral shoulder flexion- hip and knee flexion, ipsilateral shoulder abduction- hip abduction, contralateral shoulder abduction-hip abduction, ipsilateral hip extension-shoulder extension, contralateral hip extension-shoulder extension, shoulder flexion-hip and knee flexion, contralateral shoulder flexion-hip and knee flexion, ipsilateral shoulder abduction- hip abduction, contralateral shoulder abduction-hip abduction, ipsilateral hip extension-shoulder extension, contralateral hip extension-shoulder extension, backbend exercise in bed, heel-toe walking, and touching to certain points with one leg while fixing the other while standing, were given to the patients. The physiotherapist demonstrated Frenkel exercises to them once. Then, an informative brochure showing exercises like a home brochure were given. Exercises were performed in standing, open eyes and closed positions.

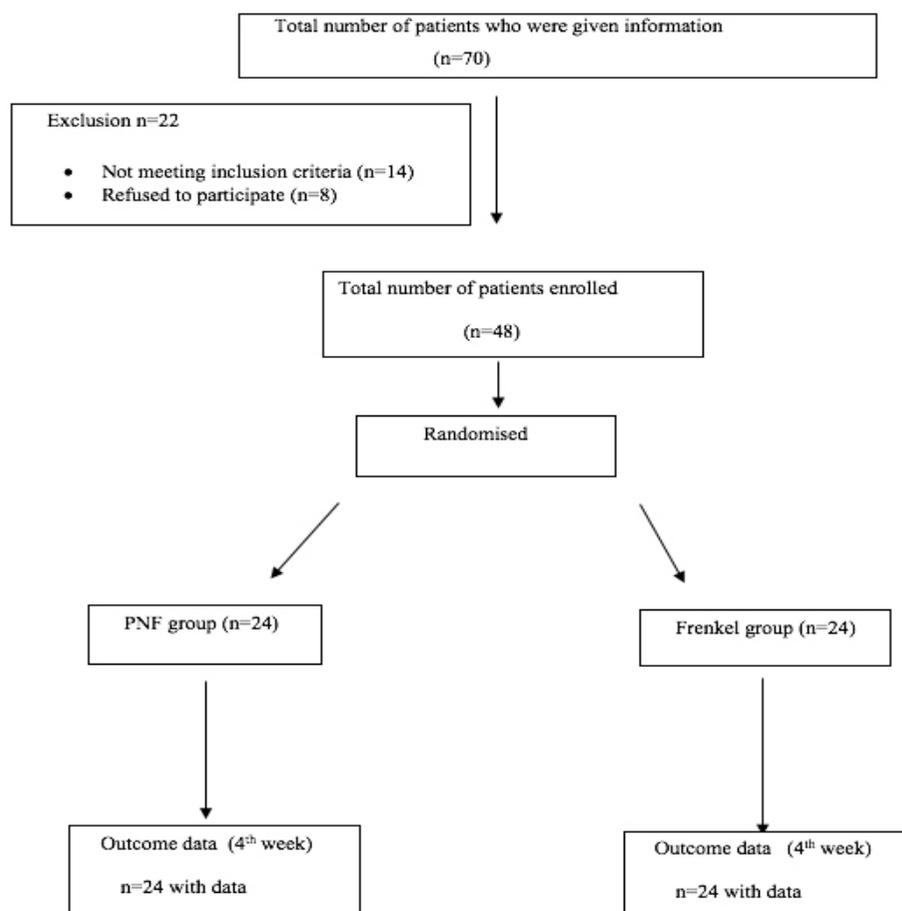


Figure 1. Flow diagram of the study
PNF: Proprioceptive neuromuscular facilitation

At the end of the study, the participant patients stated that they were satisfied with the application and had no difficulty in following the exercise program. No side effects were also seen.

Outcomes

Treatment responses were evaluated before and after the study (4th week). The demographic and clinical characteristics of the patients were recorded at the beginning of the treatment. The fall risk of the patients was evaluated by Falls Risk for Older People-community Setting (FROP-COM) parameter (primary outcome), their balance status were assessed with functional reach test (FRT), stand on one leg test, timed up and go (TUG) test and Berg balance scale (BBS), and hand gripping strength was evaluated with Jamar hand dynamometry and quality of life evaluated with short form (SF)-36 (secondary outcomes). FROP-COM; questionnaire was used to assess participants' detailed fall risk. In the questionnaire, which evaluates thirteen risk factors with a total of 28 questions, 25 of the questions determine the total score with ordinal number (0-3) or double scoring. A score of 0-20 indicates a low-moderate fall risk, and 21-60 points a high risk of falling (14,15).

The FRT is a test developed to examine forward stability. During the test, participants were asked to lie as far forward as they could without breaking the contact of their feet with the ground. The distance between the start and end positions was measured and recorded. Three trials were made and the average of the last two was noted (16).

One leg stand test; standing times are recorded by reducing the support surface of individuals and maintaining their balance on one leg with their eyes open and closed. The test was terminated after 30 seconds or when the patient's foot touched the floor. Later, the time was recorded (17).

TUG test; used to assess balance and fall risk. Using a standard chair for the test, the patient is asked to sit on the basis of the chair and stand up and walk with regular steps a predetermined distance of 3 meters in length, then, was asked to walk at walking speed, turn around and sit on the chair again. The passing time recorded in seconds with a stopwatch (18).

BBS is a scale that includes 14 instructions and is scored between 0-4 by observing the patient's performance for each instruction. Zero point is given in cases where the patient has never been

able to do the activity, while 4 point is given when the patient has completed the activity independently (19).

Hand grip strength test; was evaluated with JAMAR dynamometer (BASELINE hydraulic hand dynamometer FEI White Plains, NY 10602 USA). The patients were asked to sit flat, hold their upper arm in a neutral position and keep their elbows at 90° flexion. The forearm was held in a neutral position and they were asked to hold their elbow in extension between 0 and 30°. Then the patient was asked to grip the device with all of his/her strength. The test was repeated only three times, their averages were taken and recorded (20). Studies have shown that hand grip muscle strength and isometric knee extensor strength are well correlated.

SF-36; is a generic scale that is often used to assess the quality of life. The scale consists of 36 items and provides measurement of 8 dimensions. The scores range from 0 to 100, separately for each subscale. As the scores increase, the quality of life also increases (21).

Randomization

The patients who met the inclusion and exclusion criteria of the present study were randomized by block randomization method and divided into two groups as PNF exercise group with 24 patients and Frenkel home exercise group with 24 patients. Randomization process was conducted by a medical doctor who is not a contributor of the study. Besides, researchers and analysts were blinded, with the exception of patients.

Power Analysis

The strength of the work calculated using the "G Power-3.1.9.2" program. As a result of the analysis applied to 48 people, the first group PNF exercise (n=24) and the second group Frenkel exercise (n=24), the effect size was found to be $\alpha=0.05$, the effect size was 0.7667, and the power of the post-hoc study was calculated as 0.74.

Statistical Analysis

The data was analyzed in SPSS for Windows version 22.00 packaged program. Normality test of numerical variables was checked by using Kolmogorov-Smirnow test. In the comparison of differences between categorical variables, chi-square test was used. In the comparison of pre-treatment baseline data and percentage variation scores of both groups (post-treatment value- pre-treatment value/100), Independent t-test in the analysis of numerical data showing normal distribution and Mann-Whitney U test in the analysis of numerical data not showing normal distribution were used. Paired samples t-test was used in the comparison of pre- and post-treatment values of normally distributed numerical data. Wilcoxon signed rank test was used to compare pre- and post-treatment values of non-numerical data that did not show normal distribution. The results were analyzed at confidence interval of 95% and the significance level was accepted as $p<0.05$.

Results

Table 1 shows baseline clinical and demographic characteristics of patients with a mean age of 57.1 ± 6.2 years. A total of 13 patients (27.1%) had a history of falls in the last 6 months and 12 months. Among the groups; no significant difference was found except for SF-36 pain sub-group score ($p=0.005$) (Table 1). When examining the within-group evaluations, significant improvement was detected in all parameters in PNF group (Table 2). In the Frenkel group; significant improvement was detected to be achieved except for the one leg stand test ($p=0.064$) and SF-36 mental health subgroup ($p=0.057$) scores (Table 3). Among the groups; no statistically significant difference was determined in terms of percentage change amounts in hand gripping muscle strength, FROP-COM, FRT, and TUG test scores ($p=0.085$, $p=0.167$, $p=0.143$, and $p=0.361$, respectively) (Table 4). When the patients were compared in terms of percentage change amounts in one leg stand test and BBS scores, there was a statistically significant difference between groups ($p=0.022$ and $p=0.002$, respectively) (Table 4). In the PNF group, percentage change amounts in the one leg stand test and BBS scores were higher.

When the patients were compared in terms of percentage change amounts in SF-36 sub-groups; there was a statistically significant difference in physical function and pain sub-group scores of the groups ($p=0.000$ and $p=0.002$, respectively) (Table 4). Percentage change amount in physical function and pain scores was higher in the PNF group. No significant difference was found between the groups in terms of the other sub-groups.

Discussion

In the present study we determined that there were significant improvements in all parameters after treatment in PNF group compared to before treatment, and in Frenkel group, there were significant improvements in all parameters except the one-leg stand test and SF-36 mental health subgroup score. However, there was no significant difference between the groups, except for the BBS, one-leg stand test, and SF-36 physical function and pain subgroup scores.

Postmenopausal women at increased risk of falling (5). Since osteoporosis is also a common condition in postmenopausal women, negative conditions such as hip and vertebral fractures can lead to a higher risk of falling (12). Therefore, early detection of balance problems and assessment of the fall risk is extremely important in this group. As a result of various approaches, it will be possible to reduce the risk of developing osteoporotic fractures by giving patients balance rehabilitation.

It is important to assess the risk of falling, as falls can lead to adverse conditions such as fractures, disability and restricted daily activities (22). In this study, it was determined that there was a significant improvement in the FROP-COM evaluation parameter after the treatment in both exercise groups compared

Table 1. Baseline demographic and clinical characteristics of the patients

Variables	PNF exercise n=24	Frenkel exercise n=24	p-value
Age, years (mean ± SD)	55.6±4.8	58.7±7.1	0.085
Education (n)			
Illiterate	12	13	0.385
Primary school	10	10	
Middle-high school	2	0	
University	0	1	
Body mass index, kg/cm² (n)			
<18.5	0	0	0.122
18.5-24.9	4	1	
25-29.9	10	6	
30-39.9	8	16	
>40	2	1	
Smoking (n)			
Yes	1	2	0.551
No	23	22	
Falling in the last 6 months (n)			
Yes	2	1	0.551
No	22	23	
Falling in the last 12 months (n)			
Yes	7	3	0.286
No	17	21	
Short form-36 (mean ± SD)			
Physical functioning	61.3±18.9	70.6±15.1	0.072
Physical role	42.7±37.9	56.5±28.9	0.172
Pain	38.2±24.9	57.9±21.2	0.005*
General health	46.3±14.1	53.9±12.8	0.053
Vitality	45.2±16.6	47.7±17.1	0.609
Social functioning	52.6±21.2	60.4±21.4	0.177
Emotional role	43.1±36.1	51.4±31.1	0.321
Mental health	48.2±14.5	50.7±15.6	0.568
Hand grip strenght (kg) (mean ± SD)	38.8±9.6	43.3±9.5	0.103
FROP-COM (mean ± SD)	10.9±4.2	10.0±2.7	0.319
Functional reach test (mean ± SD)	29.5± 4.9	28.2±4.7	0.341
Timed up and go test (mean ± SD)	12.2±2.1	12.3±1.7	0.843
One leg stand test (mean ± SD)	15.2±9.1	15.8±9.4	0.725
Berg balance scale (mean ± SD)	48.7±3.6	50.5±3.7	0.054

FROP-COM: Falls risk of older people-community setting, PNF: Proprioceptive neuromuscular facilitation, SD: Standard deviation, *means p<0.05

to the pre-treatment. In our study, 13 (27.1%) of patients with had a history of falling within the last 6 months and the last 12 months. In this respect, the improvement in fall risk measured with FROP-COM was seen to be clinically important. However, in the evaluation between the groups, the difference between the pre-treatment and post-treatment measurements was not

significant. These results showed that both PNF and Frenkel exercises were effective in reducing the fall risk.

In their study, Cilento et al. (23) reported that when the elderly female patients were randomized into strengthening, functional exercise, PNF exercises and control groups, there was significant improvement in all groups compared to the control group and

Table 2. Comparison of evaluation parameters of PNF group before and after treatment

	PNF		p-value
	Pre-treatment	Post-treatment	
Hand grip strenght	38.8±9.6	46.7±10.4	0.001*
FROP-COM	10.9±4.2	9.6±4.1	0.047*
Functional reach test	29.5±4.9	34.5±4.9	0.000*
Timed up and go test	12.2±2.1	11.4±1.6	0.034*
One leg stand test	15.2±9.1	22.7±9.3	0.000*
Berg balance scale	48.7±3.6	54.0±2.4	0.000*
Short form-36			
Physical functioning	61.3±18.9	71.0±22.9	0.005*
Physical role	42.7±37.9	73.9±33.4	0.001*
Pain	38.2±24.9	70.6±22.6	0.000*
General health	46.3±14.1	54.6±15.9	0.003*
Vitality	45.2±16.6	53.1±18.4	0.002*
Social functioning	52.6±21.2	77.6±19.8	0.000*
Emotional role	43.1±36.1	69.5±39.2	0.012*
Mental health	48.2±14.5	58.0±16.2	0.007*

FROP-COM: Falls risk of older people-community setting, PNF: Proprioceptive neuromuscular facilitation, *means p<0.05

Table 3. Comparison of evaluation parameters of Frenkel group before and after treatment

	Frenkel		p-value
	Pre-treatment	Post-treatment	
Hand grip strenght	43.3±9.5	46.9±8.2	0.006*
FROP-COM	10.0±2.7	9.3±2.3	0.048*
Functional reach test	28.2±4.7	30.8±4.2	0.022*
Timed up and go test	12.3±1.7	11.1±1.6	0.002*
One leg stand test	15.8±9.4	19.1±8.5	0.064
Berg balance scale	50.5±3.7	53.5±2.3	0.000*
Short form-36			
Physical functioning	70.6±15.1	77.3±15.3	0.009*
Physical role	56.5±28.9	75.0±24.5	0.016*
Pain	57.9±21.2	67.7±25.7	0.024*
General health	53.9± 12.8	59.4±10.0	0.016*
Vitality	47.7±17.1	56.0±18.4	0.004*
Social functioning	60.4±21.4	70.3±16.4	0.019*
Emotional role	51.4±31.1	77.8±21.2	0.002*
Mental health	50.7±15.6	55.3±14.3	0.057

FROP-COM: Falls risk of older people-community setting, *means p<0.05

functional exercise and PNF protocols were the most efficient exercises reinforcing new motor learning and control theories. In a study conducted to investigate the effect of trunk stabilization exercises made with PNF on muscle activation and FRT in hemiplegic patients, 40 patients were randomized to the PNF and control groups. The study determined that PNF exercises significantly improved both the dynamic balance scores and the FRT scores (24).

TUG was found to be useful in assessing balance and postural control and quite sensitive and specific for assessing fall risk (25). In another study, women were randomized into PNF, pilates, and control groups. PNF and pilates groups were treated for 4 weeks (3 sessions per week). At the end of the study, significant improvements were determined in TUG test and FRT scores in both exercise groups compared to the control group (26). In this study, it was suggested that a better balance between

Table 4. Comparison of percentage change scores of evaluation parameters between groups

	Group		p-value
	PNF	Frenkel	
Hand grip strenght	0.24±0.27	0.11±0.16	0.085
FROP-COM	-0.08±0.4	-0.06±0.16	0.167
Functional reach test	0.19±0.21	0.12±0.23	0.143
Timed up and go test	-0.06±0.14	-0.09±0.13	0.361
One leg stand test	0.80±0.79	0.51±1.04	0.022*
Berg balance scale	0.11±0.06	0.07±0.07	0.002*
Short form-36			
Physical functioning	0.30±0.39	0.16±0.51	0.000*
Physical role	0.37±0.75	0.51±0.74	0.507
Pain	0.95±0.76	0.26±0.60	0.002*
General health	0.24±0.34	0.15±0.30	0.298
Vitality	0.22±0.32	0.45±1.43	0.446
Social functioning	0.68±0.75	0.32±0.54	0.051
Emotional role	0.47±0.90	0.62±0.74	0.549
Mental health	0.29±0.47	0.14±0.30	0.244

FROP-COM: Falls risk of older people-community setting, PNF: Proprioceptive neuromuscular facilitation, *means p<0.05

agonist and antagonist muscle activation was achieved after PNF exercises, and PNF reduced coactivation. With this mechanism, it was announced that PNF exercise improved static and dynamic balance, stabilometric parameters, and TUG test performance (26). Similar to the aforementioned studies, in our study, we also found significant improvements in FRT and TUG test parameters in both PNF and Frenkel groups after treatment compared to before treatment.

In a study whose average age was greater than us, the effects of ramp walking exercise with PNF on the dynamic balance of stroke patients were examined (27). BBS and FRTs were significantly increased in the PNF group after treatment, however, no significant difference was observed in the parameters evaluated in the control group (27). In a study by Rajhani-Shirazi et al. (28), the effects of two exercise protocols on clinical balance measurements were investigated in 60 patients with diabetic neuropathy. For this purpose, patients were randomized to Frenkel exercise, Swiss ball exercise and control group. After the treatment, a significant improvement was found in BBS in both groups. However, in the comparison between the groups, the improvement in the Swiss ball exercise group was found to be significantly higher. As a result of the study, it was stated that Swiss ball exercise can be preferred compared to Frenkel exercise in order to increase balance functions in diabetic neuropathy patients (28).

Similarly, in the present study, a significant improvement was determined in BBS and one leg stand test after the treatment in the PNF group. While there was a significant improvement in Frenkel group in BBS evaluation after treatment compared to the pre-treatment, there was no significant improvement

in stand on one leg test. Besides, when we compare both groups, the improvement found in BBS and stand on one leg test in PNF group was determined to be significantly higher. It is thought that these improvements can be explained with manual resistance mechanism leading to maximum motor stimulation through stretching reflex, manual contact, verbal stimulation, and audiovisual biofeedback by PNF exercises.

Grip strength is thought to be a reliable determinant for whole body strength in older adult (29). In a study by Teixeira de Carvalho et al. (30), the effect of pilates and PNF methods on muscle strength increase was investigated. At the end of the study, both pilates and PNF methods were indicated to provide significant improvement of muscle strength in knee flexors and extensors (30). Excitability of spinal alpha motor neurons increases through peripheral receptors and peripheral nerves during PNF exercises. In their study conducted to evaluate the effectiveness of Frenkel exercises on improving lower extremity motor function in patients with subacute stroke, Ko et al. (31), randomized fourteen patients into Frenkel group and control group (traditional rehabilitation program) and no significant improvement was obtained in both groups in terms of muscle strength with Motricity index after treatment.

In this study, we found significant improvement in both exercise groups. However, we couldn't find a significant difference between the groups. Based on the previous literature, it is thought that the muscle strength increase we obtained in the Frenkel group may be due to the postural stability increase provided with the same exercise and secondarily increased motor unit stimulability and the increased muscle fatigue resistance. With Frenkel exercises, body core muscles and waist

and leg muscles also work and thus coordination and muscle strength also increase.

Among the quality of life tools used to evaluate general patient results, the most widely used one is SF-36. There are studies in the literature indicating that both PNF and Frenkel exercises enhance the quality of life (31,32). In our study, there was significant improvement in SF-36 subgroups after treatment in PNF group compared to before treatment. On the other hand, in Frenkel group, significant improvement was found in all SF-36 sub-groups except for mental health after treatment compared to the pre-treatment. In the comparison of the two groups, a significant improvement in favor of PNF was determined in SF-36 physical function and pain sub-groups. No significant results were found in the comparison of the other subgroups. Based on these results, it was concluded that both Frenkel and PNF exercises had a positive effect on quality of life.

There were some limitations of the present study. First, we evaluated patients immediately after treatment. The control time could be kept longer to assess the long-term effects of PNF and Frenkel exercises. Another limitation is that the Frenkel exercises were given as a home exercise program. It's not known how properly these exercises which were not performed under the supervision of a physiotherapist or physician were performed by the patients. It would be good to encourage patients by phone to do the exercises. However, as far as we know, there are no randomized studies comparing the efficacy of PNF and Frenkel exercises, which have previously proven efficacy on balance in postmenopausal, in this regard, it is thought that the results of the present study would provide an important contribution to the literature.

Conclusion

To conclude, it was determined that PNF and Frenkel exercise programs had significant effects on balance parameters, fall risk and SF-36 quality of life scale in postmenopausal women. However, we could not find a significant difference between the two groups. Frenkel home exercise program is cheaper, easier, and requires less manpower, so we think it may be more preferable in terms of improving balance and reducing the risk of falls in postmenopausal women.

Ethics

Ethics Committee Approval: Before the study, permission was obtained from the Afyon Kocatepe University Clinical Research Ethics Committee (protocol no: 2011-KAEK-2, date: 02.03.2018).

Informed Consent: All patients gave written informed consent.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: S.S., H.Y., Ü.D., H.T., M.Y., M.K., Concept: S.S., H.Y., Ü.D., H.T., M.K., Design: S.S., H.Y., Ü.D., H.T., M.Y., M.K., Data Collection or Processing: S.S., H.Y., Ü.D., H.T., M.Y., M.K., Analysis or Interpretation: S.S., H.Y., Ü.D., H.T., M.Y.,

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