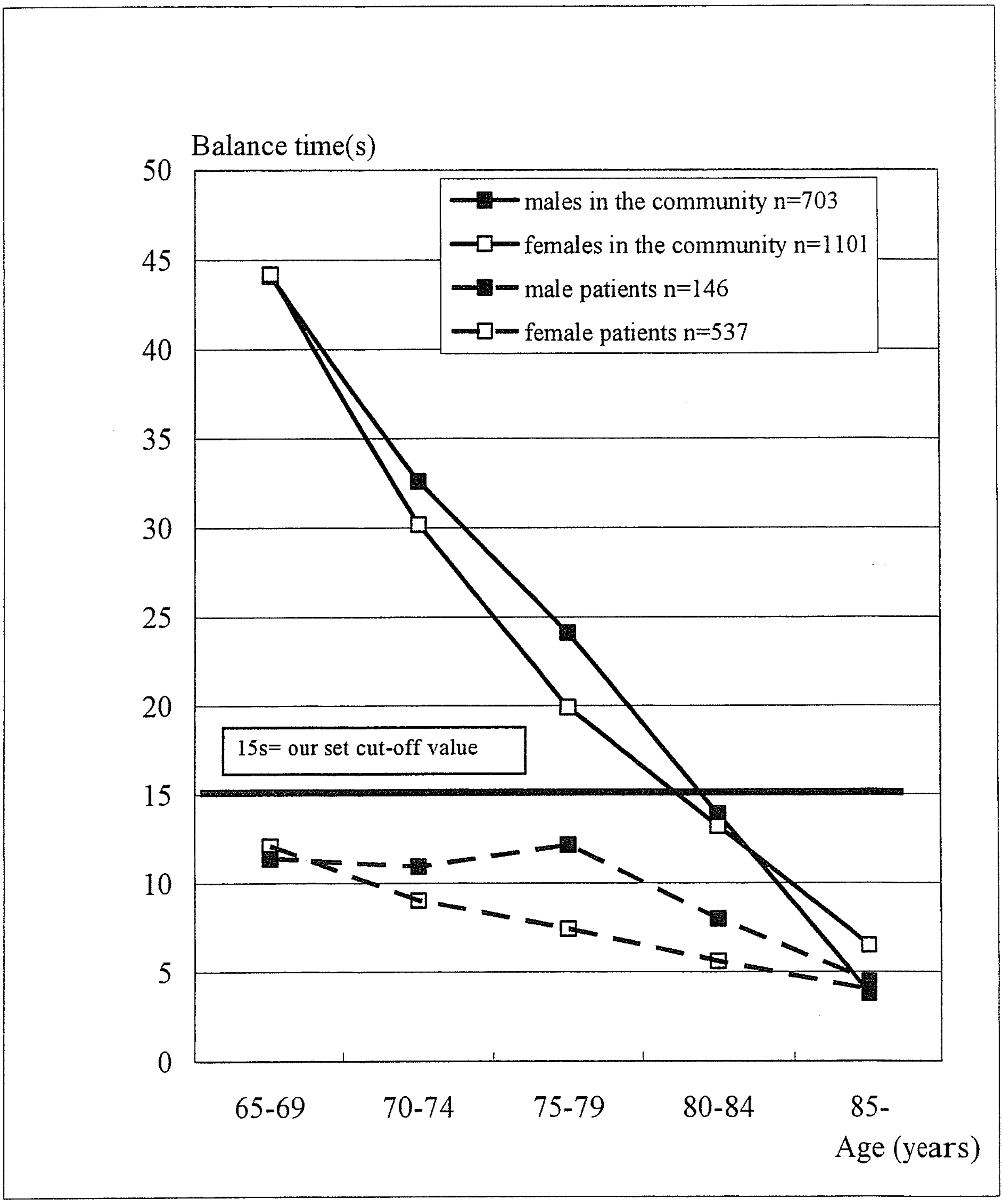
Figure 2: Results of timed one-leg balance test with eyes open for community-dwelling elderly individuals in Japan[11] and our patients.



INTRODUCTION

A long-term care insurance system was implemented in Japan in 2000. At the same time, long-term care prevention measures were specified, and community-based rehabilitation programs have subsequently been developed to improve physical strength in the elderly. A study investigating chronological changes in the level of required care has shown that the level of required care increases markedly for older patients requiring mild or severe long-term care [1]. In other words, community-based rehabilitation programs have proven ineffective in preventing older patients from requiring long-term care. Furthermore, the number of patients requiring mild long-term care has increased rapidly, and as the benefit expense for patients requiring severe care increases, costs for long-term nursing care also increase [1]. In addition, many patients requiring mild long-term care are diagnosed with disuse syndrome due to bone and joint diseases. Older patients thus need to seek medical help from orthopedists specializing in musculoskeletal diseases, to prevent the need for long-term care. One reason for this rapid increase in the number of patients requiring mild long-term care is reduced physical strength of the elderly, and falls markedly compromise activities of daily living in frail older patients and cause the need for long-term care.

Numerous randomized studies have analyzed fall-related risks and assessed fall prevention. However, past analyses of fall-related risks have mainly identified high-risk factors, and nearly all previous randomized studies have involved small numbers of patients. To the best of our knowledge, no studies have investigated the results of exercise therapy with proven efficacy using stratified analysis. The objectives of this prospective cohort study were to conduct a stratified analysis of the fall prevention effects of exercise therapy by increasing the number of cases, and to determine the fracture prevention effects of exercise therapy.

We have been developing cost-effective programs to prevent long-term nursing care as part of the "Bone and Joint Decade" campaign of the World Health Organization [2]. The Japanese Clinical Orthopedic Association prepared a safe, compact and cost-effective protocol that can be prescribed at clinics, and then conducted a study with two objectives: 1) early detection of frail older patients based on balance test findings; and 2) stratified analysis of the preventative effects of balance and muscle-strengthening exercises with proven efficacy against falls and fractures.

Given this background, we hypothesized that the combination of balance exercises and quadriceps femoris exercises that are effective for knee osteoarthritis may give rise to a fall prevention effect in frail patients with musculoskeletal disease.

MATERIALS AND METHODS

Design

The present prospective cohort study was approved by the administrative board of the Japanese Clinical Orthopedic Association. Study methods were mailed and e-mailed to recruit member orthopedists. For the first 2 months after the start of intervention, changes in timed one-leg balance test with eyes open were assessed, then participants were asked to participate in an investigation on fall prevention. Participants continued to perform the exercises, and fall prevention was monitored for 8 months after the start of intervention. Furthermore, fall prevention was assessed 12 months after the start of intervention. The survey period started in April 2003 and ended in March 2005.

Participants and setting

Subjects met the following criteria: 1) patients ≥65-years-old being treated at clinics; 2) patients with persistent chronic pain in a musculoskeletal organ (extremities or spine); and 3) patients with results of ≤15 s for the timed one-leg balance test with eyes open for either leg.

Patients excluded were: 1) those unable to walk due to complications; 2) those unable to perform one-leg standing balance exercise due to complications; 3) those for whom exercise was not recommended due to acute inflammation; 4) asymptomatic patients with osteoporosis or other conditions (i.e. patients with osteoporosis, etc, who are asymptomatic), and 5) those with infectious or neoplastic disease.

Fall prevention was assessed by excluding individuals who fell ≥5 times over the previous year or during the study period (chronic fallers) [3]. The following baseline values were ascertained: age; gender; numbers of falls and fractures over the previous year; and timed one-leg balance test with eyes open. Values were directly gathered or measured by orthopedists.

Intervention

The intervention program was explained by orthopedists, and participants were instructed to perform daily balance and quadriceps femoris exercises (Fig. 2). Subsequent clinical examinations were conducted by orthopedists once or twice a month. Balance exercise adopted a new exercise method called dynamic flamingo therapy [4]. In dynamic flamingo therapy, the patient stands on 1 leg for 1 min 3 times/day. Participants in the present study were all frail older patients, and so were instructed to firmly hold on to a desk or something stable during exercise. When holding up the right leg with the right hand, a greater mechanical load is applied to the left femoral head, thus facilitating increased bone mass in the femoral neck. In the quadriceps femoris exercise, participants were instructed to sit in a chair, and then to extend the knee fully, bend the hip until the heels were about 10 cm above the floor, and hold this position for 2-3 s. A single set consisted of 20 repetitions, and 2 sets/day were performed. The effectiveness of both exercises has been confirmed in randomized studies conducted in collaboration with the Japanese Orthopedic Association [5,6].

Outcome assessment

The main outcome was fall rate, while secondary outcomes were results for the timed one-leg balance test with eyes open and fracture rate. These parameters were assessed before the start of intervention and 8 and 12 months after the start of intervention. The timed one-leg balance test with eyes open was measured by instructing participants to put their hands on their hips and raise one leg, then measuring the amount of time until the raised leg touched the floor using a stopwatch measuring to the nearest tenth of a second. Subjects practiced the task once on each leg prior to measurement, then performed the task twice on each leg and the best of the two trials was recorded.

Training frequency, which was confirmed by an interview with the doctor, was classified into 4 levels as follows: Level 1 (exercise on an almost daily basis); Level 2 (exercise 3-4 days/week); Level 3 (exercise 1-2 days/week); and Level 4 (other).

Adverse events that occurred after the start of intervention were reported to collaborators via mail and e-mail. Missing data were gathered to the fullest extent possible by contacting orthopedists via mail, fax or telephone.

Statistical analysis

Statistical analysis was performed using SAS 9.1.3 software (SAS Institute, Cary, NC, USA), and all usable data were analyzed. At the start of intervention, a □^{2} test and Kruskal-Wallis test were used for intergroup comparisons. Fall rate was calculated by dividing total number of falls during the intervention period by total length of follow-up. Fall proportion was calculated by dividing total number of patients who fell during the intervention period by total participant population. Fracture rate and fracture proportion were calculated in the same manner. We compared fall rate, fracture rate and the timed one-leg balance test with eyes open before and after intervention using the Wilcoxon signed rank test. Chronic fallers who fell ≥5 times during the study period or over the previous year were excluded from all analyses of fall and fracture prevention [3]. Table 4 lists chronic fallers. Subgroup analysis was executed to compare fall and fracture status in different age group, numbers of fall over previous year and frequency of exercise. Among participants who were followed for 1 year, missing data for falls and fractures at 8 months after the start of intervention were handled by assuming the worst-case scenario. Values of $p<0.05$ were considered statistically significant.

RESULTS

A total of 68 institutions collaborated in this study. At the start of intervention, subjects included 146 men with a mean age of 77.0±5.9 years (range: 65.5-88.9 years) and 537 women with a mean age of 77.5±6.3 years (range: 65.0-98.0 years). Over the 1-year period before the start of intervention, fall proportion was 36.5% (exact binomial 95% confidence interval: 32.86-40.28%) and fracture proportion was 9.3% (6.1-12.1%). Over the 1-year period before the start of intervention, fall and fracture rates were 0.84 and 0.10, respectively. Since the mean number of falls was 0.84±2.13, based on the 95% critical interval, chronic fallers were defined as those patients who fell ≥5 times over the 1-year period before the start of intervention or during the study period.

At 8 months after the start of intervention, 565 of the 683 patients (83%) at the 68 participating institutions could be followed. Reasons that were reported for the 51 withdrawal cases included: "improved symptoms" (n=3); "stopped making scheduled visits" (n=21); "leg or lumbar pain" (n=6); "changed program" (n=6); "other complications" (n=8; including 1 death); and "reduced motivation" (n=10). Reasons for transient discontinuation or reduced frequency of exercises were: "leg and lumbar pain" (n=6); "complications" (n=8); and "reduced motivation" (n=4). At 12 months after the start of intervention, 377 of the 466 patients (81%) at 52 participating institutions could be followed.

First, while excluding chronic fallers, at 8 months after the start of intervention (main assessment period for fall and fracture prevention for the entire participant population), fall rate decreased by 44% from 0.597 to 0.334 ($p<0.01$, Wilcoxon signed rank test), and fracture rate decreased by 47% from 0.096 to 0.051 ($p<0.05$, Wilcoxon signed rank test).

Table 1 shows baseline values for each age group. While no significant intergroup differences were noted in gender or past history of fractures among different age groups, significant differences were seen in past history of falls, with higher age associated with increased number of falls.

Table 2 shows chronological changes in falls, fractures and timed one-leg balance test with eyes open for each age group. Exercises markedly decreased fall rate. For 70- to 84-year-old patients, intervention was significantly effective at 8 and 12 months after start of intervention. While a similar tendency was seen for fracture rate, only one stratum at 8 months was significantly different, due to the low incidence of fractures. Table 3 shows the numbers of falls and fractures in relation to the number of falls occurring over the 1-year period before the start of intervention. While no significant differences were seen in gender or left leg balance, significant differences in age or right leg balance were identified between groups. Fall rate decreased at 8 and 12 months after the start of intervention, and an investigation of fall rate by Kruskal-Wallis testing during follow-up showed that a greater number of falls over the previous year was significantly associated with a greater fall rate ($p<0.001$). Fall rate for chronic fallers did not decrease significantly (Wilcoxon signed rank test).

Prevalence of chronic fallers was 19 cases out of a total of 671 cases (2.8%) at the start of the study period, and 12 cases out of a total of 554 cases (2.2%) during follow-up. A total of 5 new cases (0.9%) of chronic fallers were identified. Among the 14 chronic fallers at the start of the study period for whom follow-up was possible, 5 patients remained chronic fallers during the follow-up period.

Table 4 shows fall and fracture prevention in relation to frequency of exercise. This data represents cases for which 1 year of follow-up was possible. Baseline values were comparable for all groups. Fall rate for participants who exercised (Levels 1-3) was significantly decreased by 48-59%. For participants who did not exercise (Level 4), fall and fracture rates did not decrease significantly. As the number of fractures decreased in all exercise groups (Level 1-3), these results may indicate a fracture prevention effect of the applied exercises.

Mean result for the timed one-leg balance test with eyes open was 6.3±7.8 s for the right leg and 5.8±5.4 s for the left leg. At 8 months after the start of intervention, results were significantly improved to 14.7±18.2 s and 15.0±20.6 s, respectively ($p<0.001$). This tendency was seen 12 months after the start of intervention. Among the 346 patients who could be followed at 12 months after the start of intervention, impaired one-leg standing balance at baseline as defined by Tinetti [7] normalized for both legs in 61% of cases.

DISCUSSION

In 1953, Hirshberg prescribed exercises to disabled persons and then proposed disuse syndrome [8]. In recent years, the number of frail older patients with disuse syndrome has been rapidly increasing. For orthopedists, this poses an important clinical challenge. Since the majority of patients with disuse syndrome display osteoarthrosis of the knee, interventions should be designed with this disease firmly in mind. Gardner et al. [9] reported that because orthopedists often treat patients with femoral neck fractures, primary care by orthopedists plays an important role. They prescribed instructive intervention for osteoporosis to inpatients with femoral neck fractures and proved the effectiveness of this approach in a randomized study. In this manner, in the field of orthopedics that treats numerous high-risk patients, properly identifying frail older patients and prescribing proper exercise programs is crucial.

The present study identified frail older patients based on balance test findings from among patients ≥65-years-old with chronic pain who saw orthopedists. As an indicator of balance function, we measured the timed one-leg balance test with eyes open, a parameter that is thought to be useful for measurements of relatively healthy individuals [10] and for early detection of declining physical strength in older individuals, as scores decrease rapidly with age. According to a study by Shimada et al. [11], the ratio of people who lead independent lives markedly decreases after 75-years-old and drops below 50% after 85-years-old. They reported that dysfunction markedly worsens around 75- to 80-years-old. Chronological changes in timed one-leg balance test with eyes open among elderly individuals living in the community have also been assessed in the United States [12], China [13] and Japan (Saitama Prefecture, Fig. 2) [14,15], and while measurement methods have varied, this parameter dropped below 15 s from around 75- to 85-years-old. Hence, in the present study, frail older patients were defined as those with a result of ≤15 s on the timed one-leg balance test with eyes open. Results for the timed one-leg balance test with eyes open for frail older patients ranged from 5.8 to 6.3 s, comparable to the upper limit of the one-leg balance test of 5 s as reported by Tinetti [7]. With regard to age group-stratified results for the timed one-leg balance test with eyes open, our cases uniformly showed markedly decreased balance function in comparison to community-dwelling elderly individuals capable of independent gait as reported by Sakata et al. (Fig. 2)[14]. In the present study, over the 1-year period before the start of intervention, fall proportion was 36.5%. Yasumura [16] reported that the fall proportion among the elderly living in the community was 18%. The figure obtained in the present study was about 18% higher. In other words, participants in the present study were more frail. From the perspective of early prevention of falls and fractures, setting the upper limit for the timed one-leg balance test with eyes open at 15 s is appropriate. As in the study by Vellas et al. [17], we identified frail older patients based solely on balance test findings. The present program was designed so that patients and doctors could easily understand assessments and exercises. Balance function is also easily measured in clinics, and the program can be safely prescribed for long periods of time [17,18].

The characteristics of the elderly individuals reported in the meta-analysis on fall prevention by Province et al. [3] were similar to those of patients in the present study, in terms of the proportion of women, which was 42-81% depending on the region in the meta-analysis, and mean age, which was 73-80 years among community-dwelling elderly individuals in the United States. In general, the majority of visitors to orthopedics clinics in Japan are women, but this may be attributable to the fact that the average life expectancy of women in Japan is 7 years longer than that of men, and prevalence is thus higher among women. A survey on underlying disease in our subjects (n=553) revealed osteoarthritis (knee, 61%; hip, 3%) in 64% of patients, spondylosis deformans (including spinal canal stenosis, radiculopathy and myelopathy) in 62% of patients, osteoporosis in 31% of patients and compression fractures in 9% of patients. Considering that subclinical osteoporosis also occurs frequently, most subjects appear likely to suffer from multiple musculoskeletal diseases.

In 1995, the Frailty and Injuries: Cooperative Studies of Intervention Technique (FICSIT) study found that the fall prevention effect of exercise intervention including balance exercise was particularly high [3]. Analysis of fall-related risks has shown that balance is an important factor. The fall prevention guidelines published by Moreland et al. in 2003 [19] state, "Balance exercises are recommended for all individuals who have had a fall and there is evidence for a program of home physiotherapy for women over 80 years of age regardless of risk factor status". In a 2004 review published by Gillespie et al. [20], a program consisting of muscle strengthening and balance retraining, individually prescribed at home by a trained health professional, was found to be effective, while group-delivered exercise and individual lower limb strengthening training were ineffective. In fact, Lathman et al. [21] prescribed only quadriceps femoris exercise to elderly individuals living at home and reported that such exercise exerted no beneficial effect on fall prevention. Means [22] prescribed balance and mobility exercises with higher intensity than a 1996 program and proved the efficacy of this in fall prevention.

Our intervention program comprised dynamic flamingo therapy and quadriceps femoris exercise. Prior to the present study, in collaboration with the Japanese Orthopedic Association, we conducted randomized studies to ascertain the preventative effects of dynamic flamingo therapy on falls [6] and the effects of quadriceps femoris exercise on osteoarthrosis of the knee [5] at elderly care facilities. Dynamic flamingo therapy decreased falls by 34% [6] (personal communication, July 6, 2006), while quadriceps femoris exercise improved function and alleviated pain to a degree comparable to non-steroidal anti-inflammatory drugs [5]. Our intervention program should thus alleviate pain and prevent falls in patients with disuse syndrome and chronic pain. In addition, the amount of dynamic load applied to the femoral neck by dynamic flamingo therapy is equivalent to approximately 54 min of walking [3)], and since this therapy is easily accepted by patients with gait disorders, many patients can continue to perform the exercise.

The results of stratified analysis showed that although intervention prevented falls for patients with a past history of falls, fall rate during the follow-up period was high, and falls could not be prevented for chronic fallers and patients who did not exercise frequently. This indicates the limits to our intervention program, and designing new exercise programs and establishing comprehensive fall risk management for patients with a past history of fall will be important in future. To further improve compliance, patients need to understand the correlation between osteoporosis and falls. Fracture prevention was one of the secondary outcomes, and given that the intervention program lowered the frequency of fractures, these results can be considered the first to suggest a possible fracture prevention effect of exercise. However, number of fractures was not reported at the start of intervention for 165 patients (24%), and a study focusing solely on fracture prevention is thus necessary.

Few previous studies investigating the effects of exercise on the timed one-leg balance test with eyes open have documented improvements in this test [23,24,25,26,27]. Li et al [27] conducted a tai chi intervention, 12 months after which test results had improved from 6.8 s to 13.0 s for the right leg and from 7.0 to 12.5 s for the left leg, indicating a significant difference from the control group. In our study on exercise intervention, significant improvements were noted, and the results of timed one-leg balance test with eyes open for frail older patients improved to the level of healthy older individuals. Since the present study was not a randomized study, learning effects with exercise must be taken into account, but the degree of improvement was comparable to or better than that in the exercise group in the study by Li [27]. As our intervention program prevented falls, dynamic flamingo therapy appears to improve balance function to the same extent as tai chi.

In and outside of Japan, few studies have examined withdrawal and adverse events related to exercise therapy. Latham et al. [21] conducted a randomized study on resistance exercise and clarified the frequency of musculoskeletal disorders at 8%. They found that reporting of adverse events had been poor in studies of elderly exercise therapy. In our study, 7 patients discontinued exercise due to pain. Pain management thus represents a key issue. Pain management by specialists is essential, and if exercise intensity is adjusted under the guidance of specialists, an intervention program consisting of dynamic flamingo therapy and quadriceps femoris exercise can be continued relatively safely for long periods of time.

Regarding points of caution, some patients may discontinue exercise due to physical ailments caused by exercises, fall if a supporting chair slips, or stand on one leg while having both hands on the hips during exercise .While the present study did not include such cases, safety must be ensured by preventing falls and physical ailments while exercising.

Finally, the most cost-effective and safe method of spreading this protocol may be implementation at clinics. This is because exercise must be performed with utmost caution with regard to fractures (which may occur simply from gait unsteadiness in patients with severe osteoporosis), and the individualized guidance indicated by Gillespie et al [20] is effective for the continuation of exercise under appropriate guidance, even in cases where pain may exacerbate during training. Large-scale implementation at clinics of this protocol may reduce the number of fractures by approximately 45%. The estimated number of patients with hip fractures in 2000 was 92,000. Mean medical expenses were $11,500 per patient, which amounts to $1.06 billion a year, in addition to the costs associated with fracture-related care, which is estimated to be $4.73 billion a year [28]. The total population of Japan was 120 million in 2005, and with the aging of society, the number of cases of hip fractures is estimated to have increased to 120,000 [29]. With the number of frail older individuals who are capable of walking at an estimated 2.5-3 million, fall and fracture prevention will become particularly effective in primary care clinics. Effective April 2006, frail elderly with musculoskeletal instability who take part in fall prevention are eligible for benefits under the Musculoskeletal Rehabilitation section of the National Health Insurance system. The accepted rehabilitation period is 150 days following diagnosis, with an estimated consultation frequency of 2-3 times weekly. For reference, the two most representative examples of medical costs for training 2-3 times weekly for 3 months (total, 30 times) are listed below:

1) Implementation of 20 min exercises in clinics administered by certified nurses using the present protocol under the direction of certified doctors: benefits of a total of about 380 dollars over 3 months. 2) Implementation of 20 min comprehensive rehabilitation consultations based on the present protocol administered by physical or occupational therapists under a comprehensive plan jointly developed by a certified doctor and a co-medical: benefits of a total of about 650 dollars over 3 months. Unfortunately, guidance for "home exercise" by doctors is currently included in general consultation fees in Japan, and is not covered by any special medical fees.

In conclusion, among chronic pain patients being treated by orthopedists, frail older patients with a result of ≤15 s on the timed one-leg balance test with eyes open were identified, and the effects of exercise therapy were ascertained by stratified analysis. Dynamic flamingo therapy and quadriceps femoris exercise were prescribed with pain management to these frail older patients, and the results confirmed improvement in balance function ($p<0.01$). At 8 months after the start of intervention, fall rate decreased by 44% ($p<0.001$) and fracture rate decreased by 47% ($p<0.05$). These findings suggest that exercise intervention can prevent frail older patients who are being treated at a large number of clinics from requiring long-term care.

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Table 1: Characteristics at baseline by age

Age (years)	65-69	70-74	75-79	80-84	85-
n	75	186	201	132	89
Sex (%)*					
male	20 (26.7)	36 (19.4)	41 (20.4)	33 (25.0)	16 (18.0)
female	55 (73.3)	150 (80.6)	160 (79.6)	99 (75.0)	73 (82.0)
History of falls (%)†					
history of falls	16 (21.9)	64 (35.0)	71 (36.2)	60 (45.8)	34 (38.6)
no history of falls	57 (78.1)	119 (65.0)	125 (63.8)	71 (54.2)	54 (61.4)
History of fractures (%)‡					
history of fractures	5 (10.0)	9 (6.9)	17 (10.2)	5 (5.0)	12 (17.4)
no history of fractures	45 (90.0)	122 (93.1)	150 (89.8)	96 (95.0)	57 (82.6)

* A χ^2 test for gender and age showed no significant difference between groups ($p=0.484$)

† All respondents. A χ^2 test showed a significant difference between groups ($p=0.018$).

‡ All respondents. A χ^2 test showed no significant difference between groups ($p=0.677$).

Table 2: Differences in fall and fracture prevention by age

Age (years)	65-69	70-74	75-79	80-84	85-
Falls					
in previous year	0.33	0.57	0.5	0.82	0.59
(n)	(73)	(173)	(188)	(128)	(85)
after 8 months	0.28	0.30*	0.27*	0.36*	0.50
(n, p value†)	(58, 0.216)	(136,	(166, 0.001)	(100, <0.001)	(75, 0.599)
after 1 year	0.24	0.33*	0.30*	0.47*	0.22
(n, p value†)	(42, 0.437)	(90, 0.003)	(118, 0.008)	(62, <0.001)	(46, 0.063)
Fractures					
in previous year	0.10	0.08	0.11	0.06	0.19
(n)	(50)	(131)	(167)	(101)	(69)
after 8 months	0.00	0.03	0.045*	0.06	0.10
(n, p value†)	(55, 0.125)	(132, 0.449)	(168, 0.023)	(98, 0.469)	(78, 0.169)
after 1year	0.02	0.06	0.03	0.05	0.09
(n, p value†)	(42, 0.250)	(96, 1.000)	(118, 0.109)	(62, 1.000)	(46, 0.148)

* p<0.05

† Wilcoxon signed rank test was used to compare fall rate and fracture rate among patients before and after intervention.

Table 3. Fall and fracture prevention in relation to past history of falls

History of falls	0 falls	1 fall	2-4 falls	≥5 chronic faller
Male:female†	92:333	23:100	12:87	8:16
Age (years)‡	77.0±6.4	77.9±6.1	78.6±5.7	77.5±25.3
Right-leg balance§	6.5±7.1	5.7±5.0	5.9±6.1	3.5±3.3
Left-leg balance‖	6.1±5.7	5.5±4.8	5.8±5.1	3.3±2.8
Fall rate				
in previous year	0	1	2.52	7.96
(n)	(425)	(123)	(90)	(24)
after 8 months	0.20*	0.38*	0.81*	6.16
(n, p value¶)	(340, <0.001)	(102, <0.001)	(83, <0.001)	(19, 0.268)
after 1 year	0.23*	0.36*	0.62*	13.31
(n, p value¶)	(215, <0.001)	(74, <0.001)	(60, <0.001)	(8, 0.398)
Fracture rate				
in previous year	0.03	0.20	0.23	0.35
(n)	(324)	(91)	(79)	(17)
after 8 months	0.04	0.06*	0.07	0.09
(n, p value¶)	(322, 0.272)	(100, 0.004)	(82, 0.234)	(17, 0.461)
after 1 year	0.03	0.10	0.07	0.14
(n, p value¶)	(214, 0.750)	(73, 0.405)	(61, 0.132)	(7, 0.317)

† A χ^2 test for gender and number of falls showed no significant difference between groups (p=0.671)

‡ Kruskal-Wallis test for age and past history of falls showed a significant difference between groups (p=0.046).

§ Kruskal-Wallis test for right-leg balance and number of falls showed a significant difference between groups (p=0.039)

‖ Kruskal-Wallis test for left-leg balance and the number of falls showed no significant difference between groups (p=0.064).

¶ A Wilcoxon signed rank test was used to compare fall rate and fracture rate before and after intervention among patients with data available for both before and after intervention.

Table 4: Prevention of falls and fractures by exercise frequency				
Exercise frequency	Level 1	Level 2	Level 3	Level 4
Baseline characteristics				
Male:female	15:58	16:81	14:62	16:46
Age	76.6±5.5	78.1±5.2	76.3±5.9	77.3±6.6
Right leg balance, s (mean ±SD)	6.8±7.2	5.9±5.2	5.3±4.2	8.1±10.4
Left leg balance, s (mean ±SD)	6.3±6.1	5.0±4.2	6.4±5.4	6.7±5.0
Rate of falls				
in previous year	0.64	0.79	0.65	0.58
(n)	(73)	(97)	(76)	(62)
after 8 months	0.27*	0.34*	0.30*	0.48
(n, p value¶)	(74, 0.003)	(97, <0.001)	(76, 0.004)	(62, 0.473)
after 1 year	0.33*	0.34*	0.26*	0.45
(n, p value¶)	(73, 0.009)	(97,<0.001)	(76, 0.006)	(62, 0.409)
Rate of fractures				
in previous year	0.13	0.10	0.09	0.07
(n)	(63)	(89)	(66)	(58)
after 8 months	0.02	0.05	0.02	0.03
(n, p value¶)	(63, 0.107)	(89, 0.125)	(66, 0.206)	(58, 0.285)
after 1 year	0.03	0.03	0.03	0.10
(n, p value¶)	(63, 0.083)	(89, 0.058)	(66, 0.157)	(58, 0.480)

This data represents cases for which 1 year of follow-up was possible.

† A χ^2 test for gender and number of falls showed no significant difference between groups ($p=0.533$)

‡ Kruskal-Wallis test for age and exercise-dosage showed no significant difference between groups ($p=0.154$).

§ Kruskal-Wallis test for right-leg balance and exercise-dosage showed no significant difference between groups ($p=0.371$)

|| Kruskal-Wallis test for left-leg balance and the number of falls showed no significant difference between groups ($p=0.146$).

¶ A Wilcoxon signed rank test was used to compare number of falls per person per year and number of fractures per person per year before and after intervention among patients with data available for both before and after intervention.* $p<0.05$.