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Effectiveness of the Capture the Fracture Program for Patients with Hip Fractures at Phrae Hospital: A 2-Year Follow-up After Surgery

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Purpose: To determine the effectiveness of the Capture the Fracture (CTF) program in preventing refractures, improving Barthel index scores for activities of daily living (ADL), and reducing mortality rates in patients with hip fractures.
Methods: This study enrolled patients with fragile hip fractures aged ≥50 years who underwent hip fracture surgery. The participants were classified into the intervention and control groups, each consisting of 46 patients. The intervention group underwent the CTF program with a multifactorial approach, whereas the control group received routine care. Participants were followed up 1 and 2 years postoperatively to assess outcomes, including the Timed Up and Go test, balance test, Barthel index scores for ADL, fall risk assessment, refracture, and mortality rate.
Results: In the intervention group, no recurrent fractures occurred within 1 year, compared to 6.5% in the control group (p=0.106). At the 2-year postoperative follow-up, 4.9% of the intervention group experienced recurrent fractures, whereas the control group had no fractures (p=0.508). The 2-year postoperative mortality rate was 18.0% and 37.0% in the intervention and control groups, respectively (p=0.042).
Conclusions: Multidisciplinary teams should implement the CTF program using a multifactorial approach to physical rehabilitation in patients with hip fractures. This program improved participants' quality of life and reduced the mortality rate 2 years postoperatively.

Keywords: the CTF program, hip fracture patients, recurrent fractures, mortality rate, Multidisciplinary teams

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Thailand's population is aging, and the number of patients with hip fractures is expected to increase from 180 cases per year to 450–750 cases per 100,000 older people by 2025[(1)]. The treatment-related economic burden to the government is estimated at 120,000 baht per case, with the cost of care post-discharge to the community reaching approximately 1.2 million baht per case[(2)]. The recurrence rate of hip fractures is 10%, with other fractures occurring at a rate of 12–20%. Hip

fractures pose a major challenge for patients and hospitals as 25% of patients die within 1 year, 40% experience reduced mobility, and over 80% require assistance with activities of daily living (ADL)[3]. Additionally, 10–20% of patients become bedridden within a year[4-7]. The International Osteoporosis Foundation (IOF) has reported a global gap in preventing recurrent fractures[8]. To address this, the IOF developed the Capture the Fracture® (CTF) program, which implements the Fracture Liaison Service (FLS) as an effective model to reduce the incidence of recurrent fractures[9]. The FLS consists of six components, including osteoporosis treatment, fall risk assessment, exercise program, nutrition education program, environmental modification, and community referral[10].

The FLS standards by the IOF focus on identifying target groups (men and women aged ≥50 years with osteoporotic fractures) to prevent recurrent fractures. This purpose employs instruments such as FRAX or the Garvan fracture risk assessment tool[10], bone density measure-ments, and fall risk assessment. Recommendations include promoting lifestyle and nutritional improvement, osteoporosis treatment, ensuring ongoing coordination of care between specialists and general practitioners, regular quality assessment, and preventing recurrent fractures[11]. In a 2011 study, patients enrolled in the FLS program had a refracture rate of 7.3% compared to 17% in the control group, indicating a significant 57% reduction in refractures[12]. Therefore, patients should be evaluated for osteoporosis and receive appropriate treatments such as calcium and vitamin D supplementation, strategies to increase bone density, and measures to reduce fall risk to decrease the incidence of hip and non-hip fractures. Measures to reduce the risk of falls, including home modifications and exercise programs, are recommended. Additionally, medications to treat osteoporosis, such as bisphosphonates, teriparatide, or denosumab are crucial. Multifactorial management in CTF clinics has been shown to significantly reduce refracture rate in patients with hip fractures[13,14].

Thailand became a completely aged society by 2023, with at least 20% of the population aged ≥60 years[15]. This demographic change affects the economic and social aspects, including the organization of welfare state systems, the quality of life for older adults, and the annual increase in healthcare expenditure. The high proportion of older people leads to age-related diseases such as osteoporosis and hip fractures, posing major challenges for the local healthcare system and social services.

In 2018, the CTF team established a CTF clinic to provide comprehensive care through a multidisciplinary team. This team provides assessment and treatment of osteoporosis by physicians, including calcium and vitamin D, fall risk assessment by nurses, education on environmental changes, and exercise programs for skills development. Physiotherapists perform follow-ups with Time Up and Go (TUG) and balance tests, whereas nutritionists assess and monitor nutritional status using body mass index (BMI) and albumin measurements, all within a multifactorial intervention framework.

Therefore, this study aimed to investigate the over 2 years postoperative effectiveness of the CTF program in reducing the incidence of recurrent fractures, improving functional capacity, and decreasing mortality in patients with hip fractures; the ultimate goal is to improve the care process for patients with hip fractures and expand the program to community hospitals.

METHODS

Study Design

Efficacy (Therapeutic) Research, non-randomized Controlled Trial.

Setting

Orthopedic Surgery and Orthopedic Clinic Outpatient Departments.

Study Population

Patients aged ≥50 years who underwent hip fracture surgery for fragility hip fractures.

Inclusion Criteria

1. Patients aged ≥50 years with hip fractures resulting from falls who were surgically

treated and discharged from the orthopedic department.

2. Patients with a BARTHEL Index score for ADL >16.

Exclusion Criteria

1. Patients with hip fractures who have an underlying disease that impairs ADL, including end-stage renal disease, congestive heart failure, a history of brain disease that impairs communication (such as Alzheimer's disease), previous cerebrovascular accidents (CVA) with weakness less than GRADE 4, pathologic fractures, or cancer with bone metastases.

2. Patients who experienced postoperative falls in the hospital and CVA readmission.

3. Patients with multiple fractures

Sample Size

The study used the TUG test to measure balance. A pilot study reported a mean TUG value of 30 ± 15.0 s in the control group and 19.8 ± 15.1 s in the intervention group. With a two-tailed test, a significance level of 5%, and a power of 90%, the calculated sample size was 46 patients per group.

Intervention Group

Patients received the CTF program with a multifactorial intervention approach.

Control Group

Patients received standard care, including

- X-ray follow-up for union fracture.
- Clinical follow-up (fracture union, walking ability, calcium, and vitamin D supplement).

Definition of Terms

Fragility fracture: Fractures resulting from low-energy trauma, such as a fall from standing height or less, indicated an underlying osteoporosis.

Variables

Independent variables: The CTF program incorporates a multifactorial intervention approach, including:

1. Physician: FRAX assessment, osteoporosis treatment, and albumin and TUG assessment.

2. Nurse: environmental change education and fall risk assessment.

3. Physiotherapists: exercise program.

4. Nutritionist: education on proper nutrition

Dependent Variables

TUG test, balance test (tandem standard), Barthel index, fall risk assessment tool (Thai falls risk assessment test [FRAT]), refracture, and mortality rate.

Data Collection Methods and Instruments

Patients attending the fracture prevention clinic who underwent the FLS program, including:

1. Osteoporosis assessment and treatment.

2. Fall risk assessment and environmental modification education by nurses.

3. Exercise program and TUG balance test follow-up by physiotherapists.

4. Nutrition education and follow-up with BMI and albumin assessment by nutritionists.

Patients were followed up at 1 and 2 years postoperatively at the Fracture Prevention Clinic, Orthopedic Clinic, and Department of Orthopedic Surgery every third Wednesday of the month.

Data Analysis

Data were analyzed using descriptive statistics, t-tests, and the exact probability test.

Institutional Review Board Statement

This study was approved by the Ethics Committee for Research Involving Human Subjects with approval number 23/2566.

RESULTS

The baseline characteristics of the intervention and control groups were not significantly different. In both groups, the majority of participants were women, accounting for 96.0% and 87.0% in the intervention and control groups, respectively (p=0.147). In the intervention group, 36.0% of the participants were aged >80 years, whereas 45.7% in the control group were aged 71–

80 years (p=0.146). BMI was <18.5 kg/m² in 40.0% and 43.5% of the intervention and control groups, respectively (p=0.964). (Table 1)

Clinical characteristics were similar in the intervention and control groups, with hip injuries predominantly in the intertrochanteric region (74.0% and 76.1%, respectively) (p=1.000). Most surgeries were performed with fixation devices, such as proximal femoral nail anti-rotation and G-nail, in 74.0% and 73.9% of the intervention and control groups, respectively (p=0.811).

In the intervention group, 40.0% had two comorbid medical conditions, and 70% were classified as the American Society of Anesthesiologists (ASA) class I or II, with 58.0% having Charlson comorbidity index (CCI) scores of 1 or 2. In the control group, 30.4% had a single geriatric disease, 60.9% were classified as ASA class I or II, and 58.7% had CCI scores of 1 or 2 (p=0.321, 0.394, and 0.138, respectively).

The lengths of stay ≤5 days were 76.0% and 50.0% in the intervention and control groups, respectively (p=0.011). In addition, 70.0% and 43.5% of the intervention and control groups, respectively, underwent surgery within 48 h and had length of stay ≤5 days (p=0.013).

FRAX (Hip fracture) scores ≥3% were observed in 74.0% and 82.6% of the intervention and control groups, respectively (p=0.335). In the intervention group, 62.0% had an albumin level <3.5 g/dL at baseline, while at the 1-year postoperative follow-up, 74.0% had an albumin level ≥3.5 g/dL. In the control group, 69.6% had an albumin level <3.5 g/dL at baseline, whereas at 1-year postoperative follow-up, 50.0% had an albumin level ≥3.5 g/dL. At 1-year follow-up, albumin levels were significantly different between the two groups (p=0.020).

Calcium and vitamin D supplementation was implemented in 88.0% and 67.4% of the intervention and control groups, respectively (p<0.001) (Table 2).

The 1-year postoperative fall scores differed significantly between the two groups (p=0.020). In the intervention group, 90% of patients had a fall score ≥4 pre-discharge, while 26% had a fall score ≥4 1 year postoperatively. Conversely, in the control group, 83.0% had a fall score ≥4 pre-discharge, and 50.0% had a fall score ≥4 1 year postoperatively.

Table 1 Baseline characteristics.

Baseline characteristics	Intervention group		Control group		p-value
	N	%	n	%	
Sex					
Male	2	4.0	6	13.0	0.147
Female	48	96.0	40	87.0	
Age (years)					
50–60	6	12.0	3	6.5	
61–70	10	20.0	4	8.7	
71–80	16	32.0	21	45.7	
> 80	18	36.0	18	39.1	
mean (SD)	74.6	(9.3)	77.2	(8.0)	0.146
Body mass index (kg/m²)					
< 18.5	20	40.0	20	43.5	
18.5–22.9	15	30.0	18	39.1	
≥ 23	15	30.0	8	17.4	
mean (SD)	20.0	(3.8)	19.9	(4.0)	0.964

SD, standard deviation

Table 2 Clinical characteristics.

Clinical characteristics	Intervention group		Control group		p-value
	N	%	n	%	
Diagnosis					
Femoral neck	13	26.0	11	23.9	1.000
Intertrochanteric	37	74	35	76.1	
Surgery					
Dynamic hip screw	0	0	1	2.1	0.811
PFNA, G-nail	37	74.0	34	73.9	
Austine Moor, Bipolar	13	26	11	23.9	
Comorbidity					
No	14	28.0	11	23.9	0.321
1	10	20.0	14	30.4	
2	20	40.0	11	23.9	
3	5	10.0	7	15.2	
>3	1	2.0	3	6.5	
ASA classification					
Ⅰ–Ⅱ	35	70.0	28	60.9	0.394
Ⅲ–Ⅳ	15	30.0	18	39.1	
Charlson Comorbidity Index score					
0	16	32.0	12	26.1	0.840
1–2	29	58.0	27	58.7	
3–4	4	8.0	6	13.0	
>4	1	2.0	1	2.2	
mean (SD)	1.1	(1.2)	1.5	(1.3)	0.138
Waiting time for surgery (hours)					
≤48	43	86.0	35	76.1	0.296
>48	7	14.0	11	23.9	
LOS (days)					
≤ 5	38	76.0	23	50.0	0.011
>5	12	24.0	23	50.0	
Surgery within 48 h and LOS ≤5 days					
Yes	35	70.0	20	43.5	0.013
No	15	30.0	26	56.5	
FRAX (Hip Fracture %)					
<3	13	26.0	8	17.4	0.335
≥3	37	74.0	38	82.6	
Preoperative albumin level (g/dL)					
<3.5	31	62.0	32	69.6	0.521
≥3.5	19	38.0	14	30.4	
Postoperative albumin level at 1-year follow-up (g/dL)					
<3.5	13	26.0	23	50.0	0.020
≥3.5	37	74.0	23	50.0	

Table 2 Clinical characteristics. (Cont.)

Clinical characteristics	Intervention group		Control group		p-value
	N	%	n	%	
Medication use					
No	0	0.0	11	23.9	<0.001
Ca, vit D	44	88.0	31	67.4	
Vit D, bisphosphonate	0	0.00	1	2.2	
Ca, vit D, bisphosphonate	6	12.0	3	6.5	

ASA, American Society of Anesthesiologists; LOS, length of stay; PFNA, proximal femoral nail anti-rotation

Quality of life before falls (measured by the Barthel Index) showed no significant difference between the groups (p=0.707), with both groups having scores of ≥19–20 (94.0% and 91.3%, respectively). At 1-year postoperative follow-up, 76.0% and 43.5% of the intervention and control groups, respectively, had Barthel Index scores ≥19–20 (p<0.001). At 2-year postoperative follow-up, 65.9% and 75.9% of the intervention and control groups, respectively, had Barthel Index scores ≥19–20 (p=0.275).

One year postoperatively, TUG was ≤30 s in 68% of the intervention group, compared to 41.3% in the control group (p<0.001). At 2-year postoperative follow-up, TUG was ≤30 s in 87.8% and 72.4% of the intervention and control groups, respectively (p=0.126).

One year postoperatively, the balance test time was ≥20 s in 62.0% of the intervention group, compared to 32.6% in the control group (p=0.002). At 2-year postoperative follow-up, the balance test time in both groups was ≥20 s in 63.4% and 24.1%, respectively (p=0.003) (Table 3).

No recurrent fractures occurred in the intervention group within the first year, while the control group had a 6.5% recurrent fracture rate (p=0.106). At 2-year postoperative follow-up, no recurrent fractures occurred in the control group, while the intervention group had a 4.9% recurrent fracture rate (p=0.508).

In the intervention group, an 18.0% mortality rate was reported 2 years postoperatively, compared to 37.0% in the control group (p=0.042) (Table 4).

Table 3 Outcomes at 1- and 2-year postoperative follow-up.

Outcomes	Intervention group		Control group		p-value
	N	%	N	%	
Pre-discharge fall score (points)					
≥4	45	90	38	82.6	0.375
<4	5	10	8	17.4	
1-year postoperative fall score (points)					
≥4	13	26.0	23	50.0	0.020
<4	37	74.0	23	50.0	
Pre-fall Barthel index (points)					
16–18	3	6.0	4	8.7	0.707
19–20	47	94.0	42	91.3	
Pre-discharge Barthel index (points)					
≤15	48	96.0	46	100.0	0.496
16–18	2	4.0	0	0.0	

Table 3 Outcomes at 1- and 2-year postoperative follow-up. (Cont.)

Outcomes	Intervention group		Control group		p-value
	N	%	N	%	
1-year postoperative Barthel index (points)					
≤15	0	0.0	7	15.2	<0.001
16–18	12	24.0	19	41.3	
19–20	38	76.0	20	43.5	
2-year postoperative Barthel index (points)					
<16	2	4.9	3	10.3	0.275
16–18	12	29.2	4	13.8	
19–20	27	65.9	22	75.9	
1-year postoperative TUG (seconds)					
≤30	34	68.0	19	41.3	0.013
>30	16	32.0	27	58.7	
2-year postoperative TUG (seconds)					
≤30	36	87.8	21	72.4	0.126
>30	5	12.2	8	27.6	
1-year postoperative balance test (seconds)					
≤10	11	22.0	26	52.5	0.002
11–19	8	16.0	5	10.9	
≥20	31	62.0	15	32.6	
2-year postoperative balance test (seconds)					
≤10	12	29.3	17	58.6	0.003
11–19	3	7.3	5	17.3	
≥20	26	63.4	7	24.1	

TUG, Time Up and Go

Table 4 Comparison of recurrent fracture and mortality rates at 2-year postoperative follow-up.

Recurrent Fracture and Mortality Rates	Intervention group		Control group		p-value
	n	%	n	%	
Recurrent fracture 1 year after surgery					
Yes	0	0.0	3	6.5	0.106
No	50	100.0	43	93.5	
Recurrent fracture 2 years after surgery					
Yes	2	4.9	0	0.0	0.508
No	39	95.1	29	100	
Mortality 2 years after surgery					
Yes	9	18.0	17	37.0	0.042
No	41	82	29	63.0	

DISCUSSION

The Recurrent Fracture Prevention Clinic at the Hospital implements the CTF program with a multidisciplinary team, including doctors who diagnose osteoporosis using techniques such as dual-energy X-ray absorptiometry scans to determine bone mineral density and vertebral fracture assessment. Treatment for osteoporosis was guided

by the Thai and international clinical practice guidelines, which categorize patients into high- and very-high-risk groups, with treatment plans tailored accordingly. According to previous studies, all patients received vitamin D supplementation to reduce the fall risk[16]. The recommendations emphasize vitamin D supplementation, medication use assessment, and comorbidities management to prevent falls, addressing health risk factors through a multifactorial approach[17-20]. Studies evaluating vertebral fractures have shown that fractures can manifest with or without symptoms, necessitating spine X-ray evaluation and treatment, as they are associated with frailty and lead to reduced quality of life and increased disability and mortality[21-23].

In this study, after 1 year of follow-up in the CTF program, no recurrent fractures or mortality was recorded among the participants. In contrast, the control group had a 6.5% incidence of refractures. During the 2-year postoperative follow-up, the intervention group had a 4.9% incidence of refractures, while the control group had no recurrent fractures due to discontinuation of the program after the first year. The control group did not attend follow-up appointments after 1 year, and patients with poor TUG scores did not follow up after 1 year. These results are consistent with those of the FLS study[24], which also demonstrated a lower mortality rate. Additionally, meta-analyses have shown that vitamin D supplementation with or without calcium does not reduce the incidence of falls in older adults[25]. Similarly, a meta-analysis found that vitamin D supplementation with or without calcium did not prevent hip fractures in older individuals residing in hospitals or care facilities[25]. Nurses provide education and assess risk factors for falls to prevent recurrent falls, promote proper self-care, and improve home safety to reduce risk factors. In this study, tailored and intensive training was provided in various ways that were suitable for both individuals and their primary caregivers. It was found that older people with hip fractures can improve home safety in practice.

After completing the CTF program for 1 year, the percentage of participants with a high risk of falling (fall score ≥4) decreased from 90% to 26%, with no fracture recurrence within 1 year. However, some individuals still required government support for home improvements. This finding is consistent with that of a previous study, which showed that assessing and improving home safety reduced the risk and incidence of falls by 19% and 12%, respectively[26]. Older individuals are recommended to undergo a home safety assessment and receive individualized guidance. However, previous studies have shown that individualized risk factor assessment and multifactorial intervention over a 1-year follow-up period did not significantly affect hip fracture rate, fall average, or mortality rate. These results are not consistent with those reported in this study.

Nutritionists provide education and guidance on behavioral modification and nutritional care for patients, family members, and caregivers. The impact of the CTF program on albumin levels, nutritional knowledge, and dietary recommenddations for patients and their families was monitored for 1 year. Monitoring blood albumin levels revealed that 31 cases in the intervention group had levels below 3.5 g/dL preoperatively. Upon re-examination, 18 older patients showed improved albumin levels exceeding 3.5 g/dL, indicating better nutritional status in the intervention group compared to the control group. Nutritional counseling for older patients with hip fractures participating in the program included recommendations such as adding one egg per meal, increasing consumption of high-fiber foods (e.g., fruits), and maintaining dietary logs to identify beneficial foods. For cases of malnutrition diagnosed by the physician, where serum albumin levels were <3.5 g/dL, pre-serum albumin levels were <157 mg/L, and lymphocyte counts were <2,000 /mm^3, a nutritional assessment and therapy are crucial to ensure patients receive adequate energy and nutrients. This approach can mitigate malnutrition-associated risk of complications and mortality, enhance immunity, and empower older adults to manage their nutritional status. Effective nutritional care promotes sufficient nutrient intake, facilitates patient recovery, and expedites the return to normalcy[27].

Physical therapists use exercise programs to assess physical abilities, mobility, posture, and muscle strength. This study found that within 1 year postoperation, 76.0% of the intervention group had a Barthel Index score of ≥19–20 compared to 42.6% in the control group[28]. This difference persisted at the 2-year postoperative follow-up, with 54.0% and 47.8% of the intervention and control groups having Barthel Index scores ≥19–20, respectively. These findings suggest that the continuous exercise stimulation after the CTF program improved postural control, flexibility, and muscle strength recovery. At the 1-year postoperative follow-up, 68% of the intervention group completed the TUG Test in ≤30 s, compared to 41.3% in the control group. At the 2-year postoperative follow-up, an increased proportion of both groups achieved this time, with 87.8% and 73.3% in the intervention and control groups, respectively. Regarding the balance test, 62.0% and 32.6% of the intervention and control groups achieved a test time ≥20 s at the 1-year follow-up, respectively; the proportion was 63.4% and 26.7%, respectively, at the 2-year follow-up. A mortality rate of 18.0% and 37.0% was reported in the intervention and control groups, respectively. Thus, older patients with hip fractures who received the CTF program to treat osteoporosis and improve nutrition could recover physically, regain near-normal function, and develop stronger leg muscles. The intervention group had a significantly lower mortality rate compared to the control group 2 years after hip fracture surgery. This is consistent with the results of the FLS programs, which have demonstrated a 35% reduction in mortality rates compared to those who did not participate in the program[29]. However, the lack of continuity in the postoperative care provided by the CTF program over 1–2 years could negatively affect the ability to perform ADL, muscle strength, and flexibility and increase the risk of recurrent fractures.

Patients with hip fractures who participated in the CTF program, a multifactorial intervention, for 1 year and were subsequently followed up for 2 years in the Osteoporosis Prevention Clinic showed promising results. Among the 50 patients enrolled in the CTF program, none experienced recurrent fractures, whereas 6.5% of the 46 patients in the control group did. Moreover, 76.0% of the intervention group demonstrated near-normal abilities to perform daily activities compared to 43.6% in the control group. At the 2-year postoperative follow-up, nine out of the 50 patients in the intervention group had died, compared to 17 out of 46 patients in the control group. The mortality rate in the control group was 37.0%, aligning with the previous study, which also reported a 35% reduction in mortality[29]. These results indicate the effectiveness of the CTF program in reducing the risk of recurrent fractures and mortality in patients with hip fractures.

The CTF program follows the principles outlined in the Type A FLS by Ganda et al., which emphasizes clear identification of target populartions, assessment, diagnosis of osteoporosis, and treatment provision, resulting in a 35% reduction in mortality[30]. This approach is consistent with the UK National Osteoporosis Society FLS clinical trial, which is based on the 5IQ principles and effectively covers the care of older patients with hip fractures.

The strength of the CTF program lies in its interdisciplinary approach, with a team continuously addressing individual risk factors. This includes nutritionists who tailor the diet and physicians who provide vitamin D and calcium supplementation.

However, the CTF program has some limitations, particularly regarding patient accessibility to the Fracture Prevention Clinic. Transportation challenges for patients and their families may lead to discontinuity in postoperative follow-up assessments and exercises. Therefore, expanding the establishment of Fracture Prevention Clinics in community hospitals with potential capabilities is recommended to improve accessibility.

Recommendations

1. Continuity of care: Encourage continued participation in the CTF program beyond the initial 1 year and facilitate referrals to geriatric clinics, family medicine centers, and community-based long-term care or Home Health Care services for ongoing care.

2. Comprehensive care: Further studies on the impact of social support and environmental modifications on recovery, including enhancing home safety and assisting with daily activities for patients after hip fracture surgery, are required.

3. Program expansion: Consider expanding fracture prevention clinics to community hospitals within the Ministry of Public Health with suitable resources to ensure broader access to care.

CONCLUSIONS

The CTF program is an effective multi-disciplinary model for optimizing care in patients with hip fractures to prevent recurrent falls and refractures. This approach involves assessing fall and fracture risk factors using the Thai FRAT self-assessment questionnaire and implementing interventions such as exercise, nutritional optimization, and vitamin D and calcium supplementation. Therefore, healthcare teams should consider adopting the CTF program, which has been shown to facilitate patients' return to normal activities and reduce postoperative mortality rates in patients with hip fractures when monitored over 2 years.

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