Article

Therapeutic Efficacy of Anterior-Middle-Posterior Approach Strengthened With ERAS and Internet+ in Elderly Patients With Hip Fractures: A Clinical Analysis

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AIM: This study aims to investigate the therapeutic efficacy of combined anterior-mid-posterior approaches integrated with Enhanced Recovery After Surgery (ERAS) and enhanced management through Internet+ in elderly patients with hip fractures through clinical analysis.

METHODS: This study employed a prospective quasi-experimental design. The research protocol was developed in December 2024, and complete clinical data were collected from the time of patient admission. A total of 166 cases of elderly patients with hip fractures who received surgical treatment in Dongying People's Hospital were selected. Patients who underwent surgical treatment from January to February 2025 were assigned to the control group (n = 90), whereas those receiving surgical treatment from March to April 2025 were designated to the intervention group (n = 76). Conventional diagnosis and treatment approaches were applied to the control group, while the anterior-middle-posterior approach strengthened with ERAS and Internet+ was applied to the intervention group. Between-group comparative analyses were performed for preoperative waiting time, incidence of complications at 3 months after discharge, quality-of-life scores, functional recovery scores, satisfaction, and self-care ability at 1 and 3 months after discharge.

RESULTS: There was a statistically significant difference in preoperative waiting time between the two groups ($p < 0.001$). At 3 months after discharge, the complication rate in the intervention group was significantly lower than that in the control group (13.16% [10/76] vs 31.11% [28/90]; $\chi^2 = 13.284$, $p < 0.05$). At 1 month and 3 months post-discharge, the intervention group demonstrated significantly higher quality of life scores, functional recovery scores, and self-care abilities compared to the control group (all $p < 0.05$). Additionally, the overall satisfaction of patients in the intervention group was significantly higher than that of the control group.

CONCLUSIONS: Enhanced with the ERAS concept and Internet+, the anterior-middle-posterior approach shortens preoperative waiting time, reduces complication incidence, improves quality of life, accelerates recovery of hip joint function, and enhances satisfaction levels in elderly patients with hip fractures, showing the potential for clinical applications.

CLINICAL TRIAL REGISTRATION: Chinese Clinical Trial Registry (ChiCTR2500095730).

Keywords: elderly; hip fractures; anterior-middle-posterior approach; in-hospital; accelerated recovery surgery; multidisciplinary team

Introduction

Hip fracture is a common condition among elderly individuals, who are also highly susceptible to osteoporosis; hip fracture is caused by falls, with high disability and mortality rates in elderly patients, posing a serious threat to their quality of life and life expectancy [1]. Hip fractures primarily encompass femoral neck fractures and intertrochanteric femoral fractures. In clinical practice, surgery is the major treatment method for elderly patients with hip fractures, and artificial joint replacement and internal fixation are therapeutic regimens that have great potential for limb function recovery and prognosis improvement, typically selected for patients with specific conditions [2]. Therefore, several clinical conundrums in the management of elderly patients with hip fracture remains, including exploration of effective ways to prevent complication occurrence, improve their quality of life, and accelerate recovery of hip joint function. The Enhanced Recovery After Surgery (ERAS) concept

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refers to a perioperative care pathway that employs optimized, evidence-based interventions to promote rapid postoperative recovery. In recent years, ERAS has been gradually applied to the treatment of elderly patients with hip fractures, and it has been reported that the case management model combined with ERAS-based nursing care has proved useful to a certain extent in reducing postoperative complications [3].

Hip fracture surgery in geriatric patients should be performed as early as possible, with concurrent aggressive management of comorbid medical conditions [4]. The "green channel" for hip fractures [5] aims to shorten the preoperative waiting time for hip fracture surgery, the occurrence of complications and postoperative mortality. However, the majority of elderly patients with hip fractures also suffer from underlying diseases that require consultations with multiple related departments, which substantially prolongs the preoperative waiting time and delays rapid rehabilitation treatment. To address these issues, a multidisciplinary team (MDT) approach—an increasingly recognized strategy—is adopted. An MDT is a fixed working group of experts from multiple related medical specialties, which is assembled to facilitate discussion of a disease in order to formulate and administer the best possible treatment for patients. Elderly patients with hip fractures are usually accompanied by a variety of chronic diseases, such as hypertension and heart disease, and are prone to complications such as pulmonary infection and pulmonary embolism after surgery [6]. The MDT approach for hip fractures provides a holistic treatment plan from a multidisciplinary perspective, with a focus on the overall corporal and physiological changes in the patients following the incidents [7]. The integration of the ERAS concept into an MDT approach indicates the availability of hospital-level resources for the clinical treatment teams, clinical nursing teams, and administrative teams. Because geriatric patients with hip fractures commonly present with multiple medical conditions, cognitive impairment/delirium, and limited or variable family and social support, their adherence to the prescribed postoperative rehabilitation is somewhat suboptimal, reducing the effectiveness of the rehabilitation programs and slowing their functional recovery [8]. Therefore, improving the effectiveness of postoperative rehabilitation in elderly patients with hip fractures remains an urgent clinical challenge.

Community medical groups represent a key model of close medical alliances, integrating regional medical resources, promoting hierarchical diagnosis and treatment, and providing high-quality services. Through technological empowerment, the Internet+ model expands the service coverage of medical groups and improves their operational efficiency. Through a management model based on Internet+, physicians can remotely assess patients' conditions and adjust rehabilitation training plans, thereby improving the effectiveness of postoperative rehabilitation for elderly patients with hip fractures. It is postulated that a sequential treatment model involving urban medical groups as the framework and Internet+ as the supporting platform for elderly patients with hip fractures can enhance the effectiveness of postoperative rehabilitation training, thereby improving their quality of life.

The anterior-middle-posterior approach originated in modern trauma medicine and was initially developed to serve trauma emergency patients. Its goal is to facilitate coordinated interactions among the public, patients, hospitals, pre-hospital emergency services, and rehabilitation institutions through measures such as safety education, first-aid training, pre- and in-hospital information sharing, and home-based rehabilitation nursing care, thereby forming a people-centered comprehensive trauma prevention and treatment system that spans the entire care continuum [9]. Specifically, the sequential medical care is a trauma prevention and treatment service system centered on emergency patients, spanning the entire process from prevention, pre-hospital emergency care, in-hospital treatment, in-hospital enhanced recovery after surgery, to post-hospital rehabilitation training enhanced with Internet+.

At present, there are few reports on the use of the treatment of the anterior-middle-posterior approach in elderly patients with hip fractures. This study enrolled elderly hip fracture patients admitted to Dongying People's Hospital from January 2025 to April 2025 and evaluated the therapeutic efficacy of the anterior-middle-posterior approach enhanced with ERAS and Internet+ in elderly patients with hip fractures.

Methods

Study Participants

A total of 166 elderly patients with hip fractures who received surgical treatment in Dongying People's Hospital from January 2025 to April 2025 were included and divided into two groups based on the time of treatment. Patients who underwent surgical treatment from January to February 2025 were assigned to the control group (n = 90), which received conventional medical care. Patients receiving surgical treatment from March to April 2025 were designated to the intervention group (n = 76), and the subjects were managed using the anterior-middle-posterior approach strengthened with ERAS and Internet+. The study was approved by the Ethics Committee of Dongying People's Hospital (2024-070) and registered with the Chinese Clinical Trial Registry (https://www.chictr.org.cn; registration number: ChiCTR2500095730). Informed consent was obtained from every study participant.

Inclusion criteria are as follows: (1) age $\geq$65 years; (2) hip fracture type: femoral neck fracture or intertrochanteric femoral fracture; (3) closed fracture with time from injury to admission $\leq$24 hours; (4) unilateral limb fracture; (5) treated with artificial femoral head replacement or intramedullary nailing; (6) accompanied and supported by a family member who was capable of understanding and cooperating with the study requirements.

Exclusion criteria include: (1) high-energy injury, multiple trauma, open fractures, or multiple fractures; (2) American Society of Anesthesiologists classification IV–V, or severe cardiovascular and cerebrovascular disease, respiratory disease, or renal dysfunction; (3) severe mental disorder or cognitive impairment; (4) other conditions affecting rehabilitation, combined with ipsilateral hip osteoarthritis, rheumatoid arthritis, or hip dysplasia; (5) postoperative recurrent fracture.

Surgical Methods

(1) Intertrochanteric femoral fractures were treated with Proximal Femoral Nail Antirotation (PFNA) internal fixation. Following closed reduction, the main nail was inserted from the apex of the greater trochanter, a spiral blade of appropriate length was implanted, distal locking screws were placed, and the tail cap was installed.
(2) Intertrochanteric fractures were treated with Intertan Intramedullary Nail (InterTAN) internal fixation. After closed reduction, the main nail was inserted from the apex of the greater trochanter, interlocking combination screws were placed, distal locking screws were secured, and the tail cap was installed.
(3) Femoral neck fractures were treated with hemiarthroplasty (HA) or total hip arthroplasty (THA). Patients in the HA and THA groups were implanted with suitable models of bipolar femoral head and acetabular prostheses, respectively. Biologic prostheses were mostly used for fixation on the femoral side, and bone-cemented prostheses were selected based on bone quality when necessary.

Perioperative Management Plan

Intervention Group

Strengthened with the ERAS concept and the Internet+ model, the anterior-middle-posterior approach integrates pre-hospital and in-hospital care. Pre-hospital emergency doctors transmitted the patient's key information to the emergency department team in real time during transport, allowing the doctors to be informed of the patient's condition before arrival. Upon arrival at the emergency department, a complete evaluation was performed, followed by an ultrasound-guided iliac fascial plane block to provide early pain relief. After hospitalization, the patient's functional status was assessed by an internist, who provided targeted interventions. The anesthesiologist conducted an American Society of Anesthesiologists (ASA) classification assessment of the patient, and the surgeon developed a surgical plan and proceeded with surgery as soon as possible. Postoperatively, rehabilitation therapists implemented physical therapy, functional training, and psychological interventions for the patients as early as possible. After discharge, a home-based rehabilitation training program was implemented for patients based on the knowledge translation model. The steps of this model for home-based rehabilitation are as follows: (1) Knowledge transfer: Doctors provide patients and their family members with information on the importance of rehabilitation, including the goals, content, methods, and precautions of family-based rehabilitation training. (2) Knowledge application: The MDT regularly conducted telephone or video follow-ups to guide and supervise patients and their family members in home-based rehabilitation training. Personalized training plans were developed, with the intensities determined based on the patients' specific conditions. (3) Knowledge assessment: Doctors regularly evaluated patients' quality of life, functional recovery, complication incidence, and satisfaction using questionnaires, functional tests, and complication checks. Based on these assessments, appropriate interventions and adjustments were provided to the patients and their families.

Control Group

In the control group, patients were admitted after a hip fracture diagnosis and underwent routine preoperative examinations and laboratory tests. Necessary consultations were arranged to evaluate comorbidities and surgical risks, and surgery was performed if no contraindications were present. Basic rehabilitation exercises, including early mobilization and functional training under the guidance of nursing or rehabilitation staff, were initiated on the first postoperative day.

Efficacy Indicators

Primary Observation Endpoint

Hip function was assessed using the Harris Hip Score (HHS) [10]. The HHS evaluates four dimensions: pain (44 points), function (47 points), absence of deformity (4 points), and range of motion (5 points), with higher scores indicating better hip function recovery. Hip function was compared at three time points: before discharge, and at 1 month and 3 months post-discharge.

Secondary Observation Endpoints

(1) Preoperative waiting time: Defined as the interval from hospital arrival to the start of surgery. Preoperative waiting time was compared between the groups prior to discharge.
(2) Quality of life: Assessed using the Short Form-36 (SF-36) questionnaire [11]. An overall score (0–100) was calculated based on the mean of the eight domain scores, with higher scores indicating better health status. Quality of life was compared at three time points: before discharge, and at 1 month and 3 months post-discharge.
(3) Self-care ability: Evaluated using the Barthel Index [12], which assesses 10 basic activities of daily living: eating (10 points), bathing (5 points), grooming (5 points), dressing (10 points), bowel control (10 points), bladder control (10 points), toileting (10 points), bed-chair transfer (15 points), walking on flat ground (15 points), and stair climbing (10 points). Higher total scores indicate greater self-care ability. Self-care ability was compared at three time points: before discharge, and at 1 month and 3 months post-discharge.

Table 1. Baseline characteristics of the control and intervention groups.

Group	Number of cases	Gender		Age (years)	Fracture type		Comorbidities	Type of anesthesia		ASA grade	
		Man	Woman		Femoral neck fracture	Intertrochanteric femoral fracture		General anesthesia	Neuraxial canal	I–II	III
Control group	90	31	59	78.4 ± 15.9	48	42	69	26	64	67	23
Intervention group	76	28	48	78.2 ± 14.2	44	32	58	19	57	58	18
χ^2/t value		0.069		0.418	3.028		0.662	1.282		2.584	
p-value		0.406		0.704	0.682		0.368	0.642		0.726	

ASA, American Society of Anesthesiologists.

Table 2. Comparison of complications between the two groups at 3 months after discharge.

Group	Number of cases	Pulmonary infection	Delirium	Pulmonary embolism	Cerebral infarction	Deep vein thrombosis	Pressure ulcers	Any complication, n (%)
Control group	90	10	6	4	3	2	3	28 (31.11%)
Intervention group	76	6	2	1	1	0	0	10 (13.16%)
χ^2 value								13.284
p-value								0.001

(4) Patient satisfaction was assessed using a hospital-developed questionnaire based on previously published scales (including the Health Care Satisfaction Questionnaire, HCSQ) [13]. This questionnaire comprises four dimensions: hospital services, family support, perceived treatment effectiveness, and overall recovery status. Each dimension is scored on a scale of 0–100, with higher scores indicating greater satisfaction.

Safety Indicators

Complication rate: Complications during the perioperative period and after discharge within 3 months post-surgery were recorded, including pulmonary infection, deep vein thrombosis, pulmonary embolism, pressure ulcers, and hospital delirium.

Data Collection

All functional and quality-of-life assessments were conducted by two trained clinicians and a rehabilitation therapist, who were blinded to patient group assignments. Evaluators received standardized training on scoring procedures prior to the study. Assessment results were recorded using standardized data collection forms. Data were independently double-entered by two trained researchers, with any discrepancies resolved by consulting the original data source. The completeness and accuracy of the data were verified before analysis. Uniform training was provided to all personnel participating in the research to ensure consistent techniques and evaluation methods, thereby minimizing measurement bias due to inter-individual variations.

Statistical Analysis

Statistical analyses were performed using SPSS software (version 22.0, IBM SPSS Statistics, Chicago, IL, USA). A post hoc power calculation was conducted to justify the sample size: detecting a reduction in complication rate from 30% to 10% with a two-sided α = 0.05 and 80% power required approximately 62 participants per group. Our analytic sample (control n = 90; intervention n = 76) exceeded this threshold, providing adequate statistical power. Normality of continuous variables was assessed using the Shapiro–Wilk test, and homogeneity of variances was evaluated with Levene's test. When variance homogeneity was violated, Welch's t-test with Satterthwaite degrees of freedom was used, and effect sizes with 95% confidence intervals were reported. Mann–Whitney U tests were conducted as sensitivity analyses. As an additional robustness check, covariate-adjusted models were fitted, controlling for age, sex, fracture type, ASA class, anesthesia type, and surgery type. Inferences from covariate-adjusted analyses were consistent with the primary results. The Welch's t-test was used to compare preoperative waiting time. Age, quality-of-life scores, hip function scores, satisfaction scores, and self-care ability scores were normally distributed, and their homogeneity of variance is reported as mean ± standard deviation (SD). Comparisons of quantitative data between the two groups of patients were conducted using independent-sample t-tests. HHS, SF-36 total, and Barthel Index were measured at discharge, 1 month, and 3 months post-discharge, were analyzed using repeated-measures analysis of variance (ANOVA), with Time as a within-subjects factor (3 levels) and Group as a between-subjects factor (intervention vs control). Mauchly's test was used to evaluate the sphericity assumption. When sphericity was violated ($p < 0.05$), Greenhouse–Geisser (GG) corrections were applied. Categorical variables, including gender, fracture type, basis of combination, type of anesthesia, and ASA grade, as well as postoperative complications, are expressed as counts or percentages, and their comparisons between the two groups of patients were performed using

Table 3. ANOVA results of hip function test (HHS, points; mean ± SD).

Descriptive by Time and Group			
Group	Before discharge	1 month after discharge	3 months after discharge
Control (n = 90)	57.2 ± 14.8	71.4 ± 10.8	84.6 ± 9.5
Intervention (n = 76)	59.3 ± 12.4	74.6 ± 9.6	87.2 ± 9.3
Repeated-measures ANOVA (Time: within-subjects; Group: between-subjects)			
Effect	df (uncorrected)	F	p
Time (within)	2, 328	182.42	<0.001
Group (between)	1, 164	4.68	0.032
Time × Group	2, 328	2.49	0.085

ANOVA, analysis of variance; HHS, Harris Hip Score; SD, standard deviation.

Table 4. Repeated-measures ANOVA results of quality of life (SF-36, total points; mean ± SD).

Descriptive by Time and Group			
Group	Before discharge	1 month after discharge	3 months after discharge
Control (n = 90)	36.4 ± 3.5	62.2 ± 5.8	73.3 ± 5.1
Intervention (n = 76)	36.2 ± 4.8	70.8 ± 8.2	82.8 ± 4.4
Repeated-measures ANOVA (GG-corrected where applicable)			
Effect	df (GG-corrected for within-subjects effects, ε = 0.86)	F	p
Time (within)	1.72, 282.10	259.72	<0.001
Group (between)	1, 164	15.30	<0.001
Time × Group	1.72, 282.10	8.61	<0.001

SF-36, Short Form-36; GG, Greenhouse–Geisser.

the chi-square test. A $p < 0.05$ indicates that the difference was statistically significant.

Results

Comparison of Baseline Characteristics Between the Two Groups

Comparative analyses showed that baseline characteristics, such as gender, age, fracture type, comorbidities, type of anesthesia, and ASA grade, between the two groups of patients were not statistically significant ($p > 0.05$, Table 1).

Comparison of Preoperative Waiting Time Between the Two Groups

The preoperative waiting time in the intervention group was significantly shorter than that in the control group (12.4 ± 8.2 h vs. 52.6 ± 22.4 h). Since the Levene test indicated unequal variances, Welch's t-test was employed, confirming a statistically significant difference between the two groups ($p < 0.001$).

Comparison of Complications Between the Two Groups

At 3 months after discharge, the complication rate in the intervention group was significantly lower than that in the control group (13.16% [10/76] vs 31.11% [28/90]; χ^2 = 13.284, p = 0.001) (Table 2).

Comparison of HHS Between the Two Groups

A two-factor repeated-measures ANOVA was conducted with Time (before discharge, at 1 month and 3 months after discharge) as the within-subjects factor and Group (intervention vs control) as the between-subjects factor. Mauchly's test did not indicate a violation of sphericity (W = 0.97, p = 0.093); therefore, uncorrected degrees of freedom are reported. For each effect (Time, Group, Time × Group), the F-statistic, degrees of freedom, and two-sided p-value are presented. A significant Group effect was observed (F(1, 164) = 4.68, p = 0.032), indicating higher overall HHS scores in the intervention group. There was also a significant Time effect (F(2, 328) = 182.42, $p < 0.001$), reflecting improvement over follow-up. The Time × Group interaction did not reach statistical significance (F(2, 328) = 2.49, p = 0.085) (Table 3).

Comparison of SF-36 Between the Two Groups

The same model was applied to SF-36 total scores. Mauchly's test indicated a violation of sphericity (W = 0.84, p = 0.004); therefore, Greenhouse–Geisser (GG) corrections are reported (ε = 0.86). There was a significant Group effect (F(1, 164) = 15.30, $p < 0.001$), with higher SF-36 scores in the intervention group, and a significant Time effect (F(1.72, 282.10) = 259.72, $p < 0.001$), reflecting robust improvement across visits. The Time × Group interaction was also significant (F(1.72, 282.10) = 8.61, $p < 0.001$), indicating differences in temporal trajectories between the two groups (Table 4).

Table 5. Repeated-measures ANOVA results of activities of daily living (Barthel Index, points; mean ± SD).

Descriptive by Time and Group			
Group	Before discharge	1 month after discharge	3 months after discharge
Control group (n = 90)	67.94 ± 4.02	74.38 ± 9.62	79.94 ± 7.02
Intervention (n = 76)	68.84 ± 3.84	78.82 ± 7.08	86.58 ± 5.28
Repeated-measures ANOVA (GG-corrected where applicable)			
Effect	df (GG-corrected for within-subjects effects, ε = 0.79)	F	p
Time (within)	1.58, 259.10	312.52	<0.001
Group (between)	1, 164	28.70	<0.001
Time × Group	1.58, 259.10	22.90	<0.001

Table 6A. Descriptive statistics of satisfaction domain scores (mean ± SD).

Outcome (Domain)	Intervention (n = 76)	Control (n = 90)
Hospital services	93.6 ± 3.8	84.6 ± 5.2
Family services	88.4 ± 7.1	79.2 ± 7.8
Healing effect	86.9 ± 5.4	80.4 ± 9.2
State of life	86.2 ± 5.8	70.6 ± 8.6
Total score (composite)	360.2 ± 11.3	302.7 ± 15.7

Table 6B. Repeated-measures ANOVA examining effects of Domain and Group on satisfaction scores.

Effect	df (GG-corrected, ε = 0.87)	F	p	Notes
Mauchly's sphericity (Domain)	\	\	\	W = 0.83, p = 0.004, GG applied
Domain (within)	2.61, 427.9	56.3	<0.001	Differences among domains
Group (between)	1, 164	38.7	<0.001	Intervention > Control overall
Domain × Group	2.61, 427.9	7.4	0.001	Larger advantage in 'state of life' and 'hospital services'

Table 6C. Between-group comparison of total satisfaction score.

Outcome	df	F	p	Direction
Total score (composite)	1, 164	112.4	<0.001	Intervention > Control

Note: Two-sided α = 0.05.

Comparison of the Barthel Index Between the Two Groups

For the Barthel Index, Mauchly's test again indicated non-sphericity (W = 0.78, p = 0.001); GG-corrected results are reported (ε = 0.79). The Group effect was significant (F(1, 164) = 28.70, p < 0.001), demonstrating higher overall activities-of-daily-living scores in the intervention group, and the Time effect was significant (F(1.58, 259.10) = 312.5, p < 0.001), showing marked improvement over time. The Time × Group interaction was significant (F(1.58, 259.10) = 22.90, p < 0.001), indicating the differences in patterns of change between the two groups over time (Table 5).

Comparison of Satisfaction Scores Between the Two Groups

To account for the correlation among satisfaction dimensions and avoid inflating type I error across parallel tests, we analyzed the four domain scores (hospital services, family services, healing effect, and state of life) using a twofactor repeated-measures ANOVA, with Domain (4 levels) as the within-subjects factor and Group (intervention vs control) as the between-subjects factor. Mauchly's test was employed to evaluate the sphericity assumption for Domain; when violated (p < 0.05), Greenhouse–Geisser (GG) corrections were applied, with corrected degrees of freedom and p-values reported. The Domain main effect, the Group main effect, and the Domain × Group interaction were summarized. Because the Total satisfaction score is the composite of domains, it was analyzed with a separate between-groups univariate ANOVA. Where pairwise domain contrasts were explored, Holm–Bonferroni adjustment was used to control the family-wise error rate (α = 0.05). The repeated-measures ANOVA revealed a significant main effect of Group, indicating overall higher satisfaction in the intervention group; a significant main effect of Domain, reflecting differences in satisfaction levels across the four dimensions; and a significant Domain × Group interaction, indicating that the intervention advantage was more pronounced for the aspects of 'state of life' and 'hospital services' (Table 6A). Mauchly's test indicated that sphericity was violated for Domain; therefore, GGcorrected results are reported. In a complementary univariate analysis, the total satisfaction score was higher in the intervention group (Tables 6B,6C).

Discussion

With population growth and the progression of societal aging, the incidence of hip fractures among elderly adults has increased significantly, and it is projected that by 2050, China will experience approximately 1.3 million new cases of hip fractures annually in the elderly population [14]. Elderly patients experience age-related degeneration of various tissues and organ systems, and often suffer from a variety of comorbid internal diseases involving the respiratory, cardiovascular and cerebrovascular, and endocrine systems. Approximately 70% of patients are classified as ASA grade III and higher, indicating that elderly patients face higher and more complex risks than younger adults when exposed to comparable trauma [15,16]. Surgical treatment is currently the preferred choice for elderly patients with hip fractures, showing the promise to achieve a favorable prognosis [17]. A substantial proportion of older patients with hip fractures (frequently 30–50% or higher) fail to regain their pre-fracture hip function, mobility, or full independence in basic, and particularly instrumental, activities of daily living within one year after surgery. Poorer recovery is strongly associated with advanced age, cognitive impairment or delirium, and limited family or social support [18], resulting in a low quality of life following surgery. Therefore, to enhance surgical safety, reduce mortality and disability, and improve quality of life in elderly patients with hip fractures, it is necessary to construct a more comprehensive, advanced, appropriate, and effective clinical care model.

According to the American Academy of Orthopaedic Surgeons (AAOS) guidelines, it is recommended to administer surgical treatment within 48 hours following an incident causing hip fractures [19]. In several developed countries, this helps with minimizing waiting time in the emergency department [20]. A previous study showed that early surgical intervention for hip fractures can improve prognosis and reduce postoperative complications [21]. The results of the current study showed that the preoperative waiting time in the intervention group was significantly shorter than that in the control group. This may be attributed to the adoption of early intervention measures, such as "fast-track channels" in the emergency department, to immediately administer necessary tests and treatments for the subjects in the intervention group.

Both the MDT model and the ERAS concept are products of the development of the bio-psycho-social model, representing an advanced medical model [22]. The application of the MDT model and the ERAS concept in elderly patients with hip fractures requires a holistic approach to clinical management that spans the entire continuum of care from emergency admission through preoperative, intraoperative, and postoperative phases to follow-up. This approach encompasses analgesia administration, perioperative blood management, patient education and nursing care, hypothermia prevention, and early rehabilitation [23]. The results of this study indicate that, in the intervention group, rapid MDT assessment, enhanced communication and coordination, and early psychological intervention by medical staff collectively shortened the preoperative waiting time.

Duaso *et al*. [24] suggested that a multidisciplinary approach can reduce the incidence of readmission within 1 month in elderly patients with hip fractures. A study showed that the highest incidence of complications in elderly patients with hip fractures occurs within 30 days after surgery [25]. It has been reported that the MDT model enhanced with the ERAS management can shorten the preoperative waiting and hospital stay [26], reduce fracture-related complications [27], and improve postoperative mobility and rehabilitation quality [28] in elderly patients with hip fractures, while realizing medical cost savings and facilitating rational use of medical resources [29]. It has been reported that early postoperative mobilization (within the first postoperative day) in older patients with hip fractures is associated with complication rates, enhanced early functional recovery, improved patient-reported outcomes, reduced length of stay, and other favorable prognostic indicators [30]. Early mobilization and functional exercises help prevent muscle atrophy, enhance patients' self-care abilities, and improve overall quality of life [31]. According to the UK's National Institute for Health and Care Excellence (NICE) guidelines in 2023, patients are recommended to perform rehabilitation activities starting the day after surgery to promote mobility and independence [32]. Conceptually, the MDT and ERAS models exert a synergistic effect in hip fracture care: the MDT model provides multidisciplinary support for ERAS, while ERAS offers standardized rehabilitation pathways to guide MDT implementation. In the present study, the incidence of complications in the intervention group at 3 months after discharge was significantly lower than that in the control group, indicating that MDT combined with ERAS is more effective in preventing postoperative complications. At 1 and 3 months after discharge, patients in the intervention group demonstrated higher scores in quality of life, functional recovery, satisfaction, and self-care ability compared with those in the control group, suggesting that the combined MDT-ERAS has potential advantages in promoting recovery of hip function and independent living ability in elderly patients.

Since the turn of the century, nursing services based on Internet+ have garnered considerable attention from nursing scholars, primarily in the United States. The American Nurses Association (ANA) and the European Commission (EC) have successively proposed strategies for the development of remote nursing and mobile health. Argent *et al.* [33] applied an Internet+ approach integrated with wearable devices to support patients' postoperative functional exercises, and the results demonstrated improved rehabilitation exercise experiences for patients. Our hospital leverages the urban medical group as the framework and Internet+ as the supporting platform to establish a family rehabilitation training model for elderly patients with hip fractures. This knowledge translation model integrates pre-diagnosis,

diagnosis, and post-diagnosis care based on the Internet+ approach. After discharge, elderly patients participate in home-based rehabilitation training guided by this knowledge translation model supported by Internet+.

In the family rehabilitation training program based on the knowledge translation model, experts from the database provide patients and their family members with relevant knowledge prior to hospital discharge. This approach enhances their understanding and awareness of elderly fractures, increases their sense of urgency, and encourages active participation and cooperation in rehabilitation training. According to each patient's specific condition, a personalized training plan is developed. For its implementation, the MDT is required to conduct a comprehensive assessment of the patient's health status and formulate a follow-up plan to monitor training effectiveness and ensure patient safety. Aligned with the development of medical technology supported by Internet+ and tailored to the needs of the elderly, this model not only facilitates connectivity between the community and families but also address challenges arising from the shortage of community nurse staff. Therefore, it has the potential to support the implementation of systematic healthcare services for older patients in primary care settings and promote healthy aging. When utilizing Internet+ technology, patient data confidentiality is ensured by implementing electronic medical record access based on principle of data classification, hierarchical labeling, minimum authority access, and implementation of audit trails for all operations.

Conclusions

In summary, using the urban medical group as the framework, an emergency treatment system has been established to improve the group's overall emergency care capacity. The support of Internet+ is showing greater potential advantages in further promoting family doctor–contracted services, clarifying the roles and responsibilities of member units at all levels, integrating medical resources within the regional medical alliance, building a coordinated and efficient service system, and providing well-integrated sequential medical and health services for elderly patients with hip fractures. Additionally, this model may also provide a valuable reference for the management of other diseases and the advancement of regional collaborative care. Guided by the ERAS concept, the anterior-middle-posterior approach for elderly patients with hip fractures shows potential advantages in shortening the preoperative waiting time, reducing complication rates, enhancing quality of life, promoting recovery of hip function, and increasing patient satisfaction. However, further evidence is needed to confirm the long-term effects of this approach and its effectiveness in primary care settings. Future research should emphasize personalized interventions, integration of technology, and health economic evaluations to support standardization and precision in clinical practice. Although this study adopted a prospective quasi-experimental design, several limitations remain: it included only patients from a single hospital, lacked a multicenter design, and had a relatively small sample size. Thus, larger-sample studies are needed to further validate these findings. Secondly, follow-up in this study—particularly for monitoring the occurrence of complications—was limited to the perioperative period, providing limited guidance for the long-term prognosis of patients. Lastly, because the intervention group received comprehensive care starting in the prehospital phase, while the control group received interventions only postoperatively, comparisons of intervention effects between the two groups may be subject to some bias.

Availability of Data and Materials

The data used and analyzed during the current study are available from the corresponding authors on reasonable request.

Author Contributions

XMZ, LL, XML and YLJ designed the study, collected and analyzed data, and wrote the manuscript; MJX, BZ, CFY and JJC contributed to the study's conception and data collection. All authors contributed to the critical revision of the manuscript for important intellectual content. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

The study was approved by the Ethics Committee of Dongying People's Hospital (2024-070) and was performed in accordance with the principles of the Declaration of Helsinki. Informed consent was obtained from every study participant.

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Conflict of Interest

The authors declare no conflict of interest.

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