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Effect of a Discharge Preparation Service on Postoperative Recovery in Older Adults with Hip Fracture: A Quasi-Experimental Study

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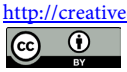

Abstract

Background: Older adults with hip fractures face complex hospital-to-home transitions. Discharge Preparation Services (DPS) may improve continuity and outcomes, but evidence in orthopedic wards remains limited. **Objective:** To evaluate the effect of a structured DPS on functional recovery, readiness for hospital discharge (RHD), inpatient complications, length of stay (LOS), and 30-day unplanned readmission. **Methods:** Quasi-experimental study in a tertiary hospital. Ninety-two patients were enrolled; 83 completed analysis (intervention n = 40; control n = 43). Both groups received routine perioperative care; the intervention additionally received DPS comprising early dual-person assessment (patient + caregiver), individualized written discharge plan and rehab pathway, multimodal education (bedside + booklet + WeChat), and post-discharge telephone/WeChat follow-up with community referral as needed. Outcomes—Harris Hip Score (HHS), Barthel Index, patient/caregiver RHD, inpatient complications, LOS, and 30-day readmission—were assessed at discharge, 1 month, and 3 months. Group comparisons used t/Mann-Whitney, χ^2/Fisher, and two-way repeated-measures ANOVA ($\alpha = 0.05$). **Results:** Groups were comparable at baseline. The intervention achieved higher HHS at discharge (total/function/ROM, $P < 0.05$) and at 1 and 3 months across total, pain, function, and ROM (all $P < 0.001$). Barthel Index scores were greater at discharge, 1 month, and 3 months (respectively $P < 0.05$, $P < 0.001$, $P < 0.05$). Repeated-measures ANOVA showed significant time and group effects, with significant time × group interactions for HHS domains (all $P < 0.001$ except pain $P = 0.008$) and a modest interaction for Barthel ($P = 0.034$). Patient and caregiver RHD totals and all dimensions were higher with DPS (all $P < 0.001$). DPS reduced composite inpatient complications (10.00% vs 30.23%, P =

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0.022), shortened LOS (9.98 ± 2.68 vs 12.72 ± 5.03 days, P = 0.003), and lowered 30-day readmission (5.00% vs 20.93%, P = 0.032). **Conclusions:** A structured DPS meaningfully improves functional recovery and discharge readiness while reducing complications, LOS, and early readmissions in older adults with hip fracture. DPS is feasible for orthopedic wards and should be integrated with community rehabilitation through a referral-and-feedback loop.

Keywords

Older Hip Fracture, Discharge Preparation Service, Readiness for Hospital Discharge, Functional Recovery, Readmission

1. Introduction

Hip fracture in older adults is a sentinel event that often triggers functional decline, loss of independence, and high early rehospitalization, in part because the hospital-to-home transition is fragmented and caregivers are underprepared [1]. Discharge Preparation Services (DPS) [2] operationalize continuity by integrating early dual-person assessment (patient and caregiver), individualized written plans, structured education, and light-touch follow-up to address both capacity (skills, knowledge, confidence) and context (home environment, available support) [3] [4]. Readiness for hospital discharge (RHD) is a modifiable intermediate outcome that should translate into safer recovery, better adherence to rehabilitation, and earlier problem recognition. Yet evidence for DPS after hip fracture within orthopedic wards remains limited, and few studies measure both patient and caregiver readiness alongside objective recovery metrics and short-term utilization [5]. To address this gap, we implemented a structured DPS and evaluated its effect on functional recovery (Harris Hip Score, Barthel Index) [6], RHD for patients and caregivers, inpatient complications, length of stay, and 30-day unplanned readmission compared with routine care, hypothesizing the superiority of DPS across these outcomes.

2. Subjects and Methods

2.1. Study Population

This quasi-experimental study enrolled older adults who underwent surgical treatment for hip fracture in a tertiary hospital. A total of 92 patients were recruited; 83 completed the study and analysis (intervention n = 40; control n = 43).

Inclusion criteria

- Age ≥65 years.
- First-episode, unilateral hip fracture treated surgically (internal fixation or arthroplasty).
- Hemodynamically stable after surgery and able to participate in rehabilitation and follow-up.
- Provided informed consent (patient or legally authorized representative).

Exclusion criteria

• Pathological fracture, multiple trauma, or perioperative life-threatening complications.

• Severe cognitive impairment or psychiatric illness precluding participation or reliable follow-up.

• End-stage disease with expected survival < 3 months.

• Pre-fracture bedbound state or inability to communicate or receive post-discharge follow-up.

2.2. Methods (Intervention and Control)

Routine perioperative care and standard discharge instructions (both groups). All patients received the ward's usual hip-fracture pathway: multimodal analgesia; VTE prophylaxis per orthopedic protocol; early mobilization with physical therapy as tolerated; standard wound care and fall-prevention precautions; medication reconciliation and written instructions (dose, timing, adverse-effect warnings); guidance on hip precautions, home safety, and nutrition; scheduling of outpatient surgical review; and a printed discharge summary including contact information for urgent queries. This "usual care" package constituted the baseline against which the DPS additions were evaluated.

Design justification. A quasi-experimental design was chosen because individual randomization was operationally infeasible in a single orthopedic ward with rolling admissions and shared staff, which raised a high risk of cross-group contamination. The pragmatic allocation preserved natural care flows while allowing for a controlled evaluation of DPS effects in real-world conditions.

Control group. Routine care only (as above).

Intervention group (Discharge Preparation Service, DPS). In addition to routine care, patients and primary caregivers received a structured DPS comprising: 1) early dual-person assessment (patient + caregiver) of clinical status, functional level, home environment, and available support; 2) an individualized written discharge plan plus a concise rehabilitation pathway; 3) multimodal education (bedside counseling, booklet, and WeChat push content); and 4) post-discharge telephone/WeChat check-ins for four weeks, with issue "tickets" closed upon resolution.

Community referral. "Referral as needed" included written referrals to a) community rehabilitation clinics or home-based PT/OT, b) community health service centers/visiting nurses for wound care and medication management, and c) social work for caregiver respite or equipment procurement (e.g., walker, raised toilet seat). Triggers for referral were predefined: limited home support, need for supervised gait/ADL training beyond caregiver capacity, wound-care needs, medication self-management concerns, or high fall risk on discharge assessment. The referral note specified goals and priority; receiving services determined visit frequency according to local capacity and patient tolerance. (Referral frequency was recorded descriptively but was not a primary outcome.)

2.3. Outcomes and Data Collection

Assessments were performed at discharge, 1 month, and 3 months postoperatively (baseline comparisons also documented). Primary functional outcomes were the Harris Hip Score (total and domains: pain, function, range of motion, deformity; 0 - 100) and the Barthel Index (0 - 100). Readiness outcomes included the Readiness for Hospital Discharge (RHD) for patients and for caregivers (total and three dimensions: personal status, coping ability, expected support). Safety and utilization outcomes comprised inpatient complications (composite and components), length of stay (LOS), and 30-day unplanned readmission. Data were obtained from charts, standardized forms, and scheduled phone/WeChat follow-ups.

2.4. Statistical Analysis

Continuous variables were checked for normality and analyzed with independent-samples t tests when normally distributed; otherwise, Mann-Whitney tests are reported as z. Categorical variables were compared using χ^2 or Fisher's exact tests. For repeated measurements (Harris and Barthel across time points), two-way repeated-measures ANOVA assessed time, group, and time × group interaction effects. Two-sided $\alpha = 0.05$ defined statistical significance.

3. Results

Participants. Of the 92 enrolled, 83 completed (intervention 40; control 43). Baseline sociodemographic and clinical characteristics were comparable between groups (no significant differences).

Functional recovery. Across discharge, 1 month, and 3 months, the intervention group demonstrated superior recovery on the Harris Hip Score (HHS) total and key domains versus control (all $P < 0.05$ at discharge for total/function/ROM; all $P < 0.001$ at 1 and 3 months). Detailed between-group means at each timepoint are presented (Table 1), and the repeated-measures ANOVA (time, group, and time × group interaction effects) is summarized (Table 2).

Activities of daily living. The Barthel Index improved in both groups over time, with higher scores in the intervention group at discharge, 1 month, and 3 months (respectively $P < 0.05$, $P < 0.001$, $P < 0.05$). Summary statistics and between-group tests are shown (Table 3); the repeated-measures ANOVA for Barthel appears in (Table 4).

Readiness for hospital discharge. At discharge, both patient and caregiver RHD totals and all three dimensions were significantly higher in the intervention group than in controls (all $P < 0.001$). Patient and caregiver RHD results are detailed (Table 5, Table 6); the within-intervention comparison of patients versus caregivers is provided (Table 7).

Safety and utilization. The composite inpatient complication rate was lower with DPS (10.00% vs 30.23%, $P = 0.022$), as summarized (Table 8). The intervention group had a shorter length of stay (9.98 ± 2.68 vs 12.72 ± 5.03 days, $P = 0.003$) and fewer 30-day unplanned readmissions (5.00% vs 20.93%, $P = 0.032$), as shown (Table 9).

Table 1. Harris Hip Score by timepoint (mean ± SD) and between-group comparison.

Domain	Discharge_Intervention	Discharge_Control	Discharge_Test	Discharge_P	Month1_Intervention	Month1_Control	Month1_Test	Month1_P	Month3_Intervention	Month3_Control	Month3_Test	Month3_P
Total	43.29 ± 5.29	40.00 ± 6.16	z = 2.62	*	56.88 ± 5.40	49.84 ± 6.82	z = 5.19	**	70.28 ± 5.49	62.54 ± 4.70	z = 6.92	**
Pain	31.25 ± 4.04	30.70 ± 5.07	z = 0.545	ns	39.10 ± 3.14	35.81 ± 4.99	z = 3.56	**	43.50 ± 1.34	41.21 ± 1.86	z = 6.40	**
Function	5.38 ± 1.89	3.44 ± 1.26	z = 4.456	**	10.43 ± 3.83	7.07 ± 3.71	z = 4.053	**	18.88 ± 4.70	13.88 ± 4.27	z = 5.070	**
ROM	2.97 ± 0.57	2.48 ± 0.59	z = 3.78	**	3.43 ± 0.41	3.02 ± 0.46	z = 4.28	**	3.93 ± 0.47	3.42 ± 0.39	z = 5.33	**
Deformity	3.70 ± 0.46	3.37 ± 0.79	-	<0.05	4.00 ± 0.00	4.00 ± 0.00	-	-	4.00 ± 0.00	4.00 ± 0.00	-	-

Table 2. Repeated-measures ANOVA for Harris Hip Score.

Domain	Time effect F	Time effect P	Group effect F	Group effect P	Time × Group F	Time × Group P
Total	1456.593	**	31.754	**	13.419	**
Pain	725.606	**	8.301	0.005	4.414	0.008
Function	564.194	**	29.799	**	13.417	**
ROM	1248.908	**	20.344	**	12.577	**

Table 3. Barthel Index by timepoint (mean ± SD) and between-group comparison.

Timepoint	Intervention	Control	Test	P
Discharge	45.00 ± 7.60	40.12 ± 5.93	t = 3.28	*
1 month	55.25 ± 5.88	50.12 ± 5.93	t = 3.96	**
3 months	65.00 ± 7.60	61.28 ± 7.33	t = 2.27	*

Table 4. Repeated-measures ANOVA for the Barthel Index.

Outcome	Time effect F	Time effect P	Group effect F	Group effect P	Time × Group F	Time × Group P
Barthel Index	352.322	**	18.117	**	2.94	0.034

Table 5. Patient Readiness for Hospital Discharge (mean ± SD) at discharge.

Dimension	Intervention	Control	Test	P
Personal status	24.88 ± 1.44	22.02 ± 2.62	t/z = −5.562	**
Coping ability	31.90 ± 4.98	23.19 ± 5.09	t/z = 7.877	**
Expected support	33.90 ± 2.90	31.53 ± 2.72	t/z = 3.829	**
Total	90.65 ± 6.52	76.74 ± 7.44	t/z = 9.027	**

Table 6. Caregiver Readiness for Hospital Discharge (mean ± SD) at discharge.

Dimension	Intervention	Control	Test	P
Personal status	23.05 ± 2.68	22.58 ± 2.46	t/z = 0.831	0.409
Coping ability	29.20 ± 5.69	22.81 ± 4.56	t/z = −5.063	**
Expected support	36.45 ± 1.57	32.23 ± 2.64	t/z = 8.909	**
Total	88.70 ± 8.33	77.63 ± 6.57	t/z = 6.942	**

Table 7. Intervention-group comparison: patient vs caregiver RHD (mean ± SD).

Dimension	Patient	Caregiver	Test	P
Personal status	24.88 ± 1.44	23.05 ± 2.68	t/z = −3.631	**
Coping ability	31.90 ± 4.98	29.20 ± 5.69	t/z = 2.258	0.027
Expected support	33.90 ± 2.90	36.45 ± 1.57	t/z = −4.883	**

Table 8. Inpatient complications, n (%).

Event	Intervention n (%)	Control n (%)	Test	P
DVT (lower limbs)	2 (5.00)	4 (9.30)	Fisher	0.677
UTI	1 (2.50)	3 (6.98)	Fisher	0.336
Wound infection	0 (0.00)	2 (4.65)	Fisher	0.833
Pressure injury	1 (2.50)	4 (9.30)	Fisher	0.401
Composite	4 (10.00)	13 (30.23)	$\chi^2 = 5.209$	0.022

Table 9. Length of stay and 30-day unplanned readmission.

Outcome	Intervention	Control	Test	P
LOS, days (mean ± SD)	9.98 ± 2.68	12.72 ± 5.03	t = −3.071	0.003
30-day unplanned readmission	2/40 (5.00)	9/43 (20.93)	$\chi^2 = 4.574$	0.032

4. Discussion

This study shows that a structured Discharge Preparation Service meaningfully augments the standard perioperative pathway for older adults with hip fracture. Early dual-person assessment, individualized planning, targeted education, and light-touch remote follow-up created a continuous hospital-to-home bridge [7]. This mechanism plausibly improved self-management, caregiver alignment, and early identification of problems—reflected in higher readiness, faster functional gains, fewer inpatient complications, shorter stays, and lower 30-day readmissions [8]. Beyond patient education, the dual-person design likely acted through caregiver readiness as a mediator of outcomes: higher caregiver RHD improves alignment on rehabilitation goals, dosing/analgesia adherence, timely escalation of red-flags (fever, wound issues, uncontrolled pain), and safer ambulation support at home. These caregiver-dependent behaviors plausibly link the observed gains in HHS/Barthel to lower complications, shorter stays, and fewer early readmissions. The observed reduction in LOS (−2.74 days) and absolute decrease in 30-day readmission (−15.9%) suggest DPS is likely cost-saving from a hospital perspective by freeing bed-days and avoiding penalty-prone readmissions; a formal cost-effectiveness analysis is warranted to quantify budget impact and return on investment.

Two implementation lessons emerge. First, readiness is an actionable, measurable intermediate endpoint: flag low subdomains early and tailor education/referrals accordingly [9]. Second, simple digital follow-ups (phone/WeChat) maintained adherence without adding clinic congestion, enabling timely micro-adjustments in home rehabilitation.

Limitations include the single-center design, modest sample size, and a 3-month follow-up window that cannot capture long-term outcomes. Future multicenter studies with longer follow-up and stratification are warranted.

5. Conclusion

A structured Discharge Preparation Service for older adults with hip fracture improved postoperative function and ADL, enhanced discharge readiness for patients and caregivers, reduced inpatient complications, shortened length of stay, and lowered 30-day unplanned readmissions. DPS is feasible to operationalize on orthopedic wards and should be integrated with community rehabilitation through a clear referral-and-feedback loop.

Notes

Abbreviations: DPS, Discharge Preparation Service; ROM, range of motion; RHD, Readiness for Hospital Discharge; LOS, length of stay; ns, not significant (>0.05). "*" $P < 0.05$; "**" $P < 0.001$; "—" not applicable. Group sizes: intervention n = 40; control n = 43.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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