Loss of Independence after Index Hospitalization Following Proximal Femur Fracture

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Abstract: Purpose: Proximal femur fractures (PFFs) in elderly patients lead to decreased productivity. Skilled nursing facilities (SNFs) and inpatient rehabilitation facilities (IRFs) are non-home destinations for post-discharge disposition. This study aims to evaluate the loss of independence (LOI) following PFFs and examine the economic impact it entails. Method: The literature from various databases was collected and analyzed retrospectively. The inclusion criteria included patients age > 18 years and articles published after 1990. All studies were screened, a PRISMA chart was used to demonstrate the search process, and 24 studies were finally used for review. Results: LOI following PFFs significantly increases with age. Fractures in geriatrics avail a significant amount of post-care resources and had longer lengths of stay. Furthermore, six pre-operative risk factors were identified for non-home disposition, including age > 75, female, non-Caucasian race, Medicare status, prior depression, and Charlson Comorbidity Index. Patients discharged directly to home have lower total costs compared to those discharged to rehabilitation units. Loss of independence increases with advancing age. Conclusions: PFFs can lead to a serious loss of independence among elderly patients. Female gender, advancing age, white population, co-existing morbidities, lack of proper care, post-operative infections, limitation in mobility following surgery, and impaired cognitive function following surgery are the factors that contribute to the decline in the rate of appropriate recovery following surgery. Therefore, these factors could necessitate permanent residence in a nursing facility (IRFs and SNFs), with a direct impact on economic, social, psychological aspects and the healthcare system.

Keywords: loss of independence; proximal femur fracture; geriatric patients; frailty measures; disposition; economic impacts; psychological impacts

1. Introduction

Proximal femur fractures (PFFs) are common injuries among elderly patients [1]. The etiology of PFFs in orthopedic patients varies between age groups, with geriatric patients tending to suffer from increased risk of falls, frailty, more co-morbidities, and osteoporosis [2]. More than one million fractures of the proximal femur occur worldwide every year, with more than 90% of cases occurring in patients over the age of 50 years [3,4]. Furthermore, it has been predicted that the total worldwide number of femur fractures...
will exceed 3.94 million in 2025 and 6.26 million in 2050 due to increased longevity and the aging Baby Boomer population [2,3].

The outcomes of PFFs impact patients in various ways, ranging from the loss of productivity, depressive symptoms, and contribution to higher mortality rates [4]. In recent studies, it has been shown that one out of every six geriatric patients needs to permanently move to a nursing facility following a PFF due to a serious loss of independence (LOI), defined as the loss of function and ability to live independently, and the need for external care [2,5].

The management of proximal femur fractures entails a large socioeconomic burden as major costs can result from impaired functional recovery, which leads to the need for prolonged and expensive care in inpatient rehabilitation facilities (IRFs) and skilled nursing facilities (SNFs) [6]. Chandra et al. found that long-term hospital care, IRFs, and SNFs were the fastest-growing major spending category from 1994 to 2009 [7]. The direct cost for healthcare from a resulting loss of independence in the first six months post-injury has been shown to be as high as USD 23,000 per isolated limb fracture in the United States [8].

The hip fractures figure is projected to rise to 6.26 million by 2050, with 3.25 million of these in Asia, which is an alarming issue for modern medicine [9].

The objective of this study is to evaluate loss of independence following proximal femur fractures in orthopedic patients and to examine the economic impact it entails.

2. Materials and Methods

For this retrospective study, a systematic search of various databases including PubMed, Science Direct, Cochrane and Google Scholar was conducted to obtain the literature on loss of independence and proximal femur fractures from 1990 to August 2023. Reference lists of chosen publications were also searched to collect a wide pool of data. MeSH terms used included “loss of independence”, “proximal femur fracture”, “geriatric patients”, “frailty measures”, “disposition”, “economic impacts” and “psychological impacts”. This study was exempt from institutional board review approval.

The inclusion criteria included patients aged ≥18 years, gender, economic impact, those living at home with a family member or caretaker or living alone or at rehabilitation center at the time of injury, nutritional status, co-morbidities, length of hospital stay, loss of independence, mental health (pre-operatively as well as post-operatively), and mode of deposition, with any kind of proximal femur fracture. In addition, both qualitative and quantitative studies were included.

The exclusion criteria include patients who died during hospitalization, those who did not give consent for the selected study, those transferred to other hospitals due to complications, those with incomplete medical records, types of fracture sustained, histologically confirmed pathological, benign and malignant fractures, studies that did not include age of the patients, economic impact, prior surgical interventions, medication used prior to fracture, and disposition information after surgery.

In this study, our population of interest was geriatric patients. We did not include any intervention in this study as it is a review article. In comparison groups, we compared patients with a disposition to home vs. patients with a disposition to rehabilitation centers (inpatient rehabilitation centers, skilled nursing facility, etc.). The primary outcomes were the economic/financial impacts of the disposition, while the secondary outcomes were the social and psychological impacts of dispositions other than home.

In addition, two authors screened the abstracts independently while being guided by the exclusion and inclusion criteria. The third and fourth authors retrieved the full text if found eligible and resolved the conflicts in order to decrease bias. After a discussion, all the authors reached to a consensus. All articles selected for inclusion in our study comprised data about the geriatric population (Age > 60) with proximal femur fractures and also provided information about the economic, social and psychological impacts of the disposition following index hospitalization and its impact on the patient care and the healthcare system.
In order to select relevant studies, the screening of abstracts was conducted, which returned 43 publications, with 26 publications identified through a search from the primary articles reference lists. After accounting for the exclusion and inclusions criteria, 24 studies in total were included in this study. Approximately 35 min was spent on the review of each article. After extraction, we also conducted a quality assessment on the included studies (Table S1). The risk of bias plots were created using Robvis 0.3.0 [10]. Lastly, a 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) flow diagram was utilized to demonstrate the search process [11] (Figure 1).

**Figure 1.** PRISMA FLOWCHART of the included studies.

### 3. Results

#### 3.1. Study Characteristics

The average age of the patients was 69.16 years, with most studies focusing on geriatric patients (>65 years and old). Article publication dates ranged from 1990 to August 2023. The sample size of the studies identified ranged from 9 to 250,000 per study. Due to focusing more on the surgical complications of fractures, research regarding the loss of independence following proximal femur fracture and the resulting economic impacts has been very limited.

#### 3.2. Prevalence

Berian et al. conducted a study that included 5077 patients. They concluded that loss of independence significantly increased with age. It occurred in 49.9% of the patients aged 65 to 74 years, 67.3% aged 75 to 84 years, and 83.9% in patients aged 85 years and older. Care needs were observed in 46.0% patients, with almost 30% requiring additional skilled services and 18.2% requiring complete discharge to a destination other than home [5].
Patients experiencing LOI were found to be older and sicker; patients 85 years and older experienced a 4.4-fold increased risk for LOI compared with patients aged 65 to 74 years [5]. Furthermore, a study conducted by Van Der Vliet QMJ et al. included 1074 long bone fracture patients over the age of 65. Almost 878 patients were discharged to 207 various rehabilitation facilities (acute rehabilitation or subacute rehabilitation/skilled nursing facility) and were observed for length of stay (LOS) during their interval at rehabilitation facilities [12]. They concluded that geriatric patients following fractures avail a significant amount of post-care resources and longer LOSs. Different factors such as pre-injury ambulatory aid and pre-existing immobility also influenced their LOS.

The assessment of everyday activities can be conducted by the Katz Index of Activities of Daily Living (ADL), a short questionnaire that is utilized to determine an older adult’s level of dependency and whether they need additional care [13]. The measures of functional status include the evaluation of transferring, dressing, making meals, and toileting, as recommended by the American College of Surgeons National Surgical Quality Improvement Program. This assessment also identifies elderly adults who are more at risk of functional decline and may benefit from supplemental aid [13]. Kugelman et al. found that over a quarter of the participants who had a lateral compression type 1 (LC1) pelvic fracture continue to use an aid in the long term for ambulation [14]. Similarly, they also found that older age and other factors were found to be associated with the need for extra assistance.

Keswani A. et al. analyzed 106,360 total joint arthroplasty patients (TJA). They aimed to compare the risks of post-discharge adverse events in TJA patients in regard to discharge destination. They found that the most common discharge destinations to be home (70%), skilled nursing facilities (19%), and inpatient rehabilitation facilities (11%). Based on the adverse events, they identified that IRFs and SNFs were associated with higher risk as compared to home discharge [15]. Furthermore, a study conducted by Rondon et al. investigated 43 variables, of which 6 were found to be crucial pre-operative risk factors for discharge disposition other than home. Among these six variables, an age 75 or greater was found to be a significant predictor for patients going to IRFs. Other variables included female gender, non-Caucasian race, Medicare status, history of depression, and the Charlson Comorbidity Index; these were also important determinants for non-home disposition. In addition, any complication during hospitalization led to a higher chance of the patient being discharged to IRFs and SNFs [16]. Franz Muller et al. studied a population in their tenth decade of life, reflecting that the occurrence of proximal femoral fractures results in high post-operative mortality just within the first 6 months (nearly 50%) [17]. Another study in population over 100 years old by J. Moore et al. suggests that the inpatient cost of treating hip fractures in centenarians was 18% above that of hip fractures of any age, with an expected mortality of 71% within 1 year of surgery [18].

3.3. Patient Demographics and Risk Factors

Risk factors for poor recovery that can lead to the need for additional assistant include frailty, advancing age, female gender, functional disability, and cognitive impairment. Poor pre-operative activity has been a crucial risk factor of impaired post-operative function. Further, delay in timely, proper and appropriate surgical intervention for PFF management, i.e., taking >24 h, lack of proper coordination with multi-disciplinary team and lack of proper physiotherapy post-operatively have a direct impact in returning to independence, early mobility and pre fracture living status. Poor mental well-being pre surgery as well as post-surgery may also contribute to poor functional activity [13]. Elderly patients who sustain orthopedic trauma are at increased risks of sustaining a fracture due to increased vulnerability resulting from age-related decline in reserve and function across many physiological systems such as ability to cope everyday stressors. This is due to many aspects such as poor bone quality and low-energy mechanisms [14]. Studies examining discharge to non-home destinations have recognized that frailty significantly increases the risk by 1.5 to a 20-fold [5,13].
Female predominance was more in most of the papers. According to Tim Chesser et al. hip fracture will occur in 1 in 3 women and 1 in 7 men over the age of 50 [9]. In support of this, Nicola Veronese et al. study showed that worldwide hip fractures occurred in 18% of women and 6% in men [19]. With advancing age one third of women in 80’s will have hip fracture, with white women predominance living at higher altitude [18]. Van Der Vliet et al. study showed that higher Charlson Comorbidity Index (CCI) \( (p = 0.048) \), male sex \( (p < 0.001) \) and pre-injury use of an ambulatory device \( (p = 0.006) \) were associated with longer hospital stay which increases the post-operative complications as well as mortality rate [12]. A. Morice study showed that Mini Nutritional Assessment (MNA) (range: 2–12) score was 7.46 ± 2.23 with no association to 3 months mortality whether patient is living at home or not \( (p < 0.08) \) [20].

3.4. Deposition after Discharge

The mode of deposition also played a significant role in overall outcome and progress in an individual post-operatively. Studied have reflected that home-based rehabilitation have a significantly better outcome and rapid gain in pre fracture state as compared to institutionalized rehabilitation. Home based rehabilitation have multiple benefit over institutionalized rehabilitation i.e., gain in mobility, functional ability, decrease in length of hospital stay, decrease in cost and lower rate of complications. Lavernia CJ et al. study reflects that the total costs were significantly lower in patients discharged directly to home was lower vs. those sent to the institutional rehabilitation center (USD 2405 V/S USD 13435 with \( p < 0.001 \)) [21]. Rehabilitation in the 85+ age group was found to be less effective as compared to the age group <84 [22].

3.5. Economic Impact

In a study conducted on orthopedic patients needing total knee arthroplasty (TKA), Rondon et al. found that orthopedic surgeries have become a global massive financial burden. They established that as much as 36% of TKA related expenses occur in the post-operative period, of which 70% represent expenses related to post-acute care facilities. Recently many other studies have consistently shown that IRF stays are still very costly [15]. Lavernia et al. compared patients with primary arthroplasty surgeries and post-discharge economic impact between comprehensive rehabilitation units (CRU) with subsequent home care (HC) and those who returned home with limited care needed. According to their study, total cost was significantly lower in patients discharged directly to home compared to those who were sent to CRU and subsequently received HC (USD 2405 vs. USD 13,435, \( p < 0.001 \)). They reported that this results in an annual cost of USD 3.2 billion for post-surgical rehabilitation after arthroplasty [21]. Although this data represents the population undergoing TKA, the economic impact can be applied to those with a PFF in need of extended rehabilitation and home care. Furthermore, the percentage of patients in need of this extended care is higher in those with a PFF, amplifying the economic impact. In a study by J. Moore et al., the average inpatient cost of treating hip fractures in centenarians was 18% above that of hip fractures of any age, i.e., EUR 14,898 in Ireland [18]. Kyle T et al. explains the impact of early intervention for hip fractures on total cost. The average cost of the early intervention was USD 49,900 and the average cost of late intervention was USD 65,300 \( (p = 0.0086) \) [23]. Furthermore, a study conducted by Ian D Cameron et al. on PFFs showed that the total cost was approximately AUD 10,600 for accelerated rehabilitation and AUD 12,800 for conventional care \( (p = 0.186) \). With the reduction in the length of hospital stay, the post-surgical component was markedly reduced for the accelerated rehabilitation group (AUD 6420 v/s AUD 8870 \( (p = 0.138) \) [24]. Further, the study of Nicola Veronesi et al. highlights the increase in the trend of hip fracture incidence globally and the cost required for long-term care (LTCs) facilities. They estimated that between 6% and 60% of people suffer from hip fracture, with costs ranging from USD 19,000 to USD 66,000 [19]. Kyosuke Fukuda et al.’s study showed that Japan’s long-term care insurance system allows elderly people to receive appropriate support in their daily living according
to their level of independence and physical and mental functions, which is not present in developed countries in the world [25]. Comparing studies from developed to developing countries, the study of Kyle T. Judd et al. based in the USA showed that the average cost of early intervention per patient was USD 49,900, and the average cost of late intervention per patient was USD 65,300 (p = 0.0086) [26]. R. Aigner et al.’s study based in India showed that the mean total acute care costs per patient was EUR 8853 ± EUR 5676 [27]. These two studies reveal that the average cost of treatment in the USA is 6- to 8-fold higher compared to Indian treatment costs. Furthermore, reoperation in the acute care of PFF patients was associated with a 31% higher rate than the corresponding cost of the primary operation, and according to Tiihonen, reoperation was primarily occurring within the first year after the initial procedure [28]. So, high treatment costs for PFF management will be an economic burden to developed countries in the near future.

3.6. Social and Psychological Impact

Morice et al.’s study in centenarians showed a 36% prevalence of dementia in patients undergoing surgery for PFF [20]. Another study by Tim Chesser et al. on hip fractures provides us with evidence that 30% of patients have dementia prior to surgery and another 20% have impaired cognitive function following a hip fracture episode [9]. Further, a study by Franz Muller et al. on populations in their tenth decade of life showed that dementia was present in 60% of patients prior to surgery who ended up in nursing homes for rehabilitation [17]. Most of the patients with dementia and cognitive impairments pre- or post-PFF surgery significantly guide the health professional in the appropriate selection of the mode of deposition after discharge from hospital [29]. Thus, having dementia and some sorts of cognitive impairment will eventually increase the cost of the total treatment process.

3.7. Loss of Workdays

Andrea Giusti et al.’s study reflects that during the follow-up, both groups showed a significant decline in functional ability (Barthel Index). The home-based rehabilitation (HBR) group had higher Barthel Index scores than the institutional-based rehabilitation (IBR) group at follow-up (p value = 0.007). The Barthel Index score decreased by 10.8% for the HBR group from the pre-fracture level (85.5 ± 23.4) to 12 months (76.2 ± 32.1) and decreased by 25.6% for the IBR group from the pre-fracture level (82.4 ± 22.6) to 12 months (58.92 ± 33.3) [26]. Another study by Kyosuke Fukuda et al. highlights the relationship between staying with co-residents or family members and walking ability 1 week after PFF surgery—the Barthel Index at discharge of the home group vs. hospital-referred group was 75.6 ± 22.7 vs. 58.0 ± 24.6 (p value < 0.01, odds ratios are walking ability one week after surgery 1.9, p < 0.05, staying with co-residents 4.6, p < 0.01) [25]. Suguru Ohsawa et al. suggested that all the patients in the assertive rehabilitation group recovered their ability to walk (FIM score) to some extent, while those in the conventional group did not (Ambulation (FIM): Assertive method (18.29 ± 7.9) v/s Conventional method (9.49 ± 4.3, p-value = 0.00135). At the 6-month follow-up, the FIM score was significantly higher in the patients treated with assertive rehabilitation (p value = 0.0135), which reflects the gain of independence by the patients following surgery [30]. Jean Taillandier et al.’s study reflects that loss of weight bearing and advancing age were the key factors for longer hospital stays and the reason for institutionalization. After 1 year, only 36.6% of the patients had the same level of self-sufficiency as before the fracture [31]. Moreover, Till Berk et al. suggest that a higher BS (Braden Score) increased the odds of developing decubitus by 6.2 times (95% CI 1.5 to 25.7, p < 0.001), which will limit daily activities significantly [32]. Additionally, Tim Chesser et al. emphasize weight bearing without restriction in the immediate post-operative period and the initiation of physiotherapy on the day after surgery, unless contraindicated, for better functional gain and mobility following PFF surgery [9] (Table 1).
Table 1. Summary of studies included for proximal femur fractures and significant outcomes.

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<th>#</th>
<th>Article Author Name</th>
<th>Year of Publication</th>
<th># Patients</th>
<th>Age (SD)</th>
<th>Race</th>
<th>Gender</th>
<th>Disposition to Rehabilitation Facility</th>
<th>Length of Stay in the Facility or Hospital</th>
<th>Economic Impact</th>
<th>Mental Status</th>
<th>Results</th>
<th>Conclusions</th>
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| 1 | Van Der Vliet QMJ, Weaver MJ, Heil K, McTague MF, Heng M. | 2021 | 1074 patients | >65 | N/A | N/A | 168 patients (15.6%) | Median hospital stay = 5 days and Median ICU stay days = 4 days. LOS for rehabilitations = 19 days. (<20 days LOS was found in 398 patients and ≥20 days LOS was found in 392 patients). | N/A | N/A | • Ten percent (n = 108) were re-admitted < 90 days of their discharge.  
• One year after the injury, 924 patients were still alive.  
• Higher Charlson Comorbidity Index (CCI) (p = 0.048), male sex (p < 0.001), pre-injury use of an ambulatory device (p = 0.006) and undergoing surgical treatment (p < 0.001) were associated with longer hospital LOS.  
• Older age (p < 0.001), pre-injury ambulatory aid (p < 0.001), and pre-existing immobility (p < 0.001) were independent risk factors for LOS > 20 days in a rehabilitation facility. | Elderly fracture patients utilize a significant amount of post-acute care resources, and age, CCI, surgery, fracture location, pre-injury ambulatory status, and injury living status were found to be associated with the use of these resources. |

2 | Kugelman DN, Fisher N, Konda SR, Egol KA. | 2019 | 161 | The average age was 63 years (range: 18–94 years) | N/A | 38 (76%) females, 12 (24%) males. | N/A | Average LOS in hospital = 6.32 ± 5.7 days. | N/A | N/A | • Fifty patients were available for long-term outcomes (mean: 36 months), as measured by SMFA subgroup scores were demonstrated to be three times higher in patients currently using an assistive device for walking (p = 0.012).  
• Increased age (p = 0.050) was associated with the continued use of assistive walking devices.  
• Of the patients who did not use an ambulatory device prior to lateral compression type 1 (LC1) pelvic ring injury, five (11.6%) sustained a fall. Forty-three (86%) patients did not use an assistive ambulatory device prior to sustaining the LC1 fracture. Seven (14%) patients utilized assistive devices both before and after the LC1 injury. | More than a quarter of the patients sustaining an LC1 pelvic fracture continue to use an aid for ambulation at long-term follow-up.  
• Older age, complications, and falls within 30 days of this injury are associated with the utilization of an assistive ambulatory device. |
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| 3  | Berian JR, Mohanty S, Ko CY, Rosenthal RA, Robinson TN. | 2016               | 9972       | A mean (SD) age of 75 (7) years. | 3876 (76.3%) were white, 563 (11.1%) were black and 639 (12.6%) were other races. | 2736 (53.9%) female | Increased care need was observed in 2339 (46%) patients. A total of >1414 (27.8%) required additional skilled or supportive services at home. | >Out of the care requiring 2339 (46%) patients, 925 (18.2%) required discharge to a non-home destination. | Patients with LOI stayed longer in hospital (mean LOS was 7.3 day) as compared to those without LOI (mean LOS was 3.3 days). | N/A | N/A         | • A total of 517 patients required readmission (10.2%).  
• In a risk-adjusted model, loss of independence was strongly associated with readmission.  
• Death after discharge occurred in 69 patients (1.4%).  
• After risk adjustment, LOI was the strongest factor associated with death after discharge (odds ratio, 6.7; 95% CI, 2.4–19.3).  
• Loss of independence (LOI) was associated with post-operative readmissions and death after discharge.  
• Loss of independence can feasibly be collected across multiple hospitals in a national registry.  
• Clinical initiatives to minimize LOI will be important for improving surgical care for older adults. |
| 4  | Brinson Z, Tang VL, Finlayson E. | 2016               | N/A        | ≥60 years | N/A | N/A | N/A | N/A | N/A | N/A | 2-25 days | N/A | N/A         | • A randomized control trial showed that the implementation of an inpatient intervention with a focus on the maintenance of the patient’s functional status produced significant improvements in activities of daily living ($p < 0.001$) and physical performance ($p < 0.001$) at discharge compared to usual care.  
• Another study showed that the implementation of a modified Hospital Elder Life Program (HELP) intervention that included ambulation or active range-of-motion exercise three times daily resulted in significantly less functional decline at discharge ($p < 0.001$) in older adults who had had abdominal surgery compared to usual care.  
• Post-operative functional status is an important patient-centered outcome.  
• Living independently is one of the most important aspects in deciding to undergo surgery.  
• Risk factors for poor functional recovery include baseline frailty, functional disability and cognitive impairment. |
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<th>Disposition to Rehabilitation Facility</th>
<th>Discharge to non-home destination was 31,220 (30%) with: skilled nursing facility 19,847 (SNF) (19%), and inpatient rehabilitation facility 11,373 (IRF, 11%).</th>
<th>Length of stay (LOS) tended to be longer in no-home patients (non-home: 3.8 days, home: 3.1 days, p &lt; 0.001). LOS at SNF was 3.6 days and IRF was 3.8 days.</th>
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<td>5</td>
<td>Keswani A, Tasi MC, Fields A, Lovy AJ, Moucha CS, Bozic KJ.</td>
<td>2016</td>
<td>106,360 patients</td>
<td>Average age was 64.3 at home, and 71.0 at non-home. (71.6 at SNF, 69.7 at IRF). Race at home was: Caucasian (72%), Hispanic (2.6%), African Americans (5.4%), Asian (1.7%) and others (18%). Race at non-home destination was: Caucasians (75%), Hispanics (9%), African Americans (8.7%), Asians (2.3%) and Others (9%)</td>
<td>&gt;Home destination, 44% = Male, 56% = females. &gt;Non home setting, 30% = Male, 70% = Female. &gt;In non-home (29% male at SNF and 71% female at SNF, 32% male at IRF and 68% females at IRF)</td>
<td>Disposition to home 74,637 (70%).</td>
<td>N/A</td>
<td>N/A</td>
<td>• Bivariate analysis revealed that rates of post-discharge adverse events were higher in SNF and IRF patients (all p ≤ 0.001). • In multivariate analysis controlling for patient characteristics, comorbidities, and incidence of complication predischarge, SNF and IRF patients were more likely to have post-discharge severe adverse events. • SNF or IRF discharge increases the risk of post-discharge adverse events compared to home. • Modifiable risk factors for non-home discharge and post-discharge adverse events should be addressed pre-operatively to improve patient outcomes across discharge settings.</td>
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<td>Rondon AJ, Tan TL, Greenky MR, Goswami K, Shohat N, Phillips JL, Purtill JJ.</td>
<td>2018</td>
<td>2281 patients (IRF = 218 and Home = 2063)</td>
<td>Average age: 73.8 In rehabilitation and 65.7 at home. Race (non-Caucasian): IRF = 74 (34.9) and Home = 409 (20.2)</td>
<td>Gender (male) IRF = 45 (20.6%) and Home = 880 (42.7%)</td>
<td>90.4% (2063/2281) of the cohort</td>
<td>Discharged to post-acute care facilities: 9.6% (218/2281).</td>
<td>LOS: IRF = 3.4 days and Home = 2.0 days</td>
<td>N/A</td>
<td>N/A</td>
<td>• Among 43 variables studied, 6 were found to be significant pre-operative risk factors for discharge disposition other than home. • An age 75 or greater, female, non-Caucasian race, Medicare status, history of depression, and the Charlson Comorbidity Index were predictors for patients going to IRFs. • Any in-hospital complications led to a higher likelihood of being discharged to IRFs and SNFs. • Both models had excellent predictive assessments with area under curve values of 0.79 and 0.80 for pre-operative visit and hospital course. • Pre-operative and in-hospital factors that predispose patients to non-routine discharges allow surgeons to better predict patient post-operative disposition.</td>
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<td>7</td>
<td>Lavernia CJ, D’Apuzzo MR, Hernandez VH, Lee DJ, Rossi MD.</td>
<td>2006</td>
<td>136 patients</td>
<td>• Average age = 72.5.</td>
<td>Race: White (80.4), Black (6.3%) and others (13.3%).</td>
<td>• Female = 69.9%.</td>
<td>• 81.1%.</td>
<td>Discharge to non-home destination was 31,220 (30%).</td>
<td>Skilled nursing facility 19,847 (SNF) (19%).</td>
<td>Inpatient rehabilitation facility 11,373 (IRF; 11%).</td>
<td>N/A</td>
<td>N/A</td>
<td>Total cost was significantly lower in patients discharged directly to home compared to those who were sent to CRU and subsequently received HC (USD 2405 vs. USD 13,435 with p &lt; 0.001).</td>
<td>Patients who underwent primary arthroplasty were observed for total cost differences between comprehensive rehabilitation unit (CRU) and homecare (HC). According to this study, total costs were significantly lower in patients discharged directly to home vs. those who were sent to the CRU and subsequently received HC (USD 2405 vs. USD 13,435 with p &lt; 0.001). An estimated USD 3.2 billion is spent annually on post-surgical rehabilitation after arthroplasty.</td>
</tr>
<tr>
<td>8</td>
<td>R. Tühonen1, R. Alaranta1, T. Helkamaa2, I. Nurmi-Lüthje3, J.-P. Kaukonen1, R. Tühonen, R. Alaranta1, T. Helkamaa, I. Nurmi-Lüthje, J.-P. Kaukonen, P. Luthje</td>
<td>2018</td>
<td>70 of 480 patients</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>The mean direct costs of primary fracture care were lower than the mean costs of reoperations (EUR 7500 vs. EUR 9800)</td>
<td>N/A</td>
<td>N/A</td>
<td>Reoperations after an operative treatment of hip fracture patients may be associated with higher costs and inferior survival. The costs of reoperations were calculated using the diagnosis-related groups (DRG)-based prices. In all, 70/480 patients (14.3%) needed reoperations. Of all reoperations, 34.2% were performed during the first month and 72.9% were within 1 year after the primary operation. Alcohol abuse was associated with a heightened risk of reoperation.</td>
<td>Reoperations increased the overall immediate costs of index fractures by nearly 20%. One-third of all reoperations were performed during the first month and almost 75% within 1 year after the primary operation.</td>
<td>Cost per patient of reoperation in acute care was 31% higher than the corresponding cost of a primary operation.</td>
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<tr>
<td>9</td>
<td>Andrea Giusti, Antonella Barone, Mauro Oliveri, Monica Pizzonia, Monica Razzano, Ernesto Palummeni, Giulio Pioli,</td>
<td>2006</td>
<td>194</td>
<td>&gt;70, averaged 83.6 6 years old</td>
<td>N/A</td>
<td>14.5% male</td>
<td>99 (49.7%)</td>
<td></td>
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<td>• In the multiple logistic regression model, the only significant variable affecting the choice of IBR at discharge was the absence of relatives at home (odds ratio [OR], 6.7; 95% confidence interval [CI], 3.33–13.46; p &lt; 0.001), whereas a pre-fracture functional impairment in more than three IADLs (at 12 mo: OR 3.99; 95% CI, 1.57–10.18; p &lt; 0.004), the absence of relatives at home (at 12 mo: OR 8.81; 95% CI, 2.47–31.46; p &lt; 0.001), and delay to surgery longer than 3 days (at 12 mo: OR 5.51; 95% CI, 1.28–23.81; p &lt; 0.022) resulted in significant risk factors for long-term institutionalization.</td>
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<td>10</td>
<td>Devora Lieberman, David Lieberman</td>
<td>2002</td>
<td>424</td>
<td>&gt;75, Mean age ± SD (y) 85+ group 88.8 ± 3.1, 75–84 years group 79.3 ± 2.9</td>
<td>Israel</td>
<td>Female gender</td>
<td>85+ Group 96 (76), 75–84 Group 233 (79)</td>
<td>Discharged to home: 85+ Group 105 (83), 75–84 group 270 (91), p value = 0.02</td>
<td>Days waiting until surgery 85 + group 4.0 ± 2.5, 75–84 group 4.4 ± 3.2, &gt;Days in orthopedic surgery ward after surgery 85 + group 8.0 ± 4.3, 75–84 group 7.1 ± 3.5 &gt;Days hospitalized for rehabilitation 85 + group 22.0 ± 8.2, 75–84 group: 22.0 ± 9.0</td>
<td>Discharge FIM (mean ± SD) 85+ Group 74.8 ± 22.1, 75–84 Group 90.5 ± 18.8, p value = 0.000001</td>
<td></td>
<td>• Mean Katz Index score ± SD: HBR 4.7 ± 1.8, IBR 4.3 ± 1.9, p value = 0.041. • Delirium (%) during hospitalization seen in HBR 29 and IBR 45, p value = 0.022. • The number of patients with complete recovery was higher in the HBR group during the follow-up, even if the differences between the groups were highly significant only at 12 months (52.7% in HBR vs. 32.9% in IBR, p 0.008). • The only factors associated with discharge to the rehabilitation facility were the living situation and the occurrence of delirium during hospital stay.</td>
<td>• Rehabilitation after surgery for PFF is less successful in an &gt;85 group than in a group of 75-to-84-year-olds. • No differences in terms of duration or the rate of most complications or mortality during the process.</td>
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| 11 | Kyosuke Fukuda, Takashi Amari, Kohei Yoshino, Hikaru Izumiya, Kenichiro Yamaguchi | 2022 | 228 (Home group (n = 110), Hospital transfer group (n = 118)) | Home group 86.2 ± 6.1, Hospital transfer group 88.0 ± 6.7, \( p \) value < 0.05 | Japanese | (female: %) Home group 86 (78.1%), Hospital transfer group 86 (72.8%) | N/A | N/A | N/A | N/A | Walking ability before injury (independence: %) 99 (90.0%) 95 (80.5%), \( p \) value < 0.05, Pre-operative waiting days: 2.1 ± 1.9 2.1 ± 1.9. | • Japan’s long-term care insurance system that allows elderly people to receive appropriate support in their daily lives according to their level of independence and physical and mental functions. • In acute care, a support system called the “community comprehensive care system”, supported by the long-term care insurance system, facilitates community support projects and networks to ensure that elderly people transition smoothly from acute care back into society. • Walking ability one week after surgery (FAC3 ≤ %): Home group—40.0 ± 16.6, Hospital referred group—39.7 ± 17.7. • Walking ability after 1 week of surgery and the staying with co-residents or family members significantly increases the rate of home discharge after PFF surgery.
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<tr>
<td>12</td>
<td>Suguru Ohsawa, Aiko Miura, Mie Yagyu, Anzu Oizumi, Eiji Yamada</td>
<td>2006</td>
<td>20 (Assertive method = 13, conventional method = 7)</td>
<td></td>
<td>Age (years)</td>
<td></td>
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<td></td>
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<td></td>
<td>• All the patients in the assertive rehabilitation group recovered their ability to walk (FIM score) to some extent, while those in the conventional group did not. Ambulation (FIM), Assertive method = 18.29 ± 7.9, Conventional method = 9.48 ± 4.3, p-value = 0.00135. • At 6-month follow-up, the FIM score was significantly higher in the patients treated with assertive rehabilitation (p-value = 0.0135), which reflects the gain of independence following surgery by the patients. • However, the mental state (MMSE) in the assertive group was significantly better than that in the conventional one at the start of rehabilitation (p-value = 0.0029).</td>
</tr>
<tr>
<td>13</td>
<td>J. Moore, O. Carmody, B. Carey, J. A. Harty, D. Reidy</td>
<td>2017</td>
<td>9</td>
<td>&gt;100 (101 years and 7 months)</td>
<td></td>
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<td></td>
<td>• This study shows that there is no association with age and longer length of hospital stays in hip fracture patients. • Average inpatient cost of EUR 14,898—this cost is exclusive of component cost, rehabilitation (e.g., physiotherapy, occupational therapy), convalescent care, and outpatient follow-up. • The most recent figures show that the inpatient cost of treating the average hip fracture in Ireland is EUR 12,600, while the inpatient cost of treating hip fractures in centenarians was 18% above that of hip fractures of any age.</td>
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<td>14</td>
<td>R. Aigner, T. Meier Fedeler, D. Eschbach, J. Hack, C. Bliemel, S. Ruchholtz, B. Bücking</td>
<td>2016</td>
<td>402</td>
<td>Age in years 81 ± 8</td>
<td>N/A</td>
<td>Female 293 (73%)</td>
<td>N/A</td>
<td>N/A</td>
<td>• The mean total acute care costs per patient = EUR 8853 ± 5676 with ward costs (EUR 5828 ± 4294) and costs for surgical treatment (EUR 1972 ± 956) representing the major cost factors. • Pre-fracture Charlson index: 2.4 ± 2.3, That ward costs accounted for the biggest proportion of total hospitalization costs (EUR 5828 ± 4294 65.8%).</td>
<td>Cognitive impairment (Mini Mental State Examination &lt; 20) did not have a significant effect on total costs (MMSE ≤ 20 EUR 8353 ± 4616, ≥ 4: EUR 10,383 ± 7909, p value = 0.047, Cognitively impaired patients were discharged sooner because these patients often did not have the potential for rehabilitation, resulting in shorter lengths of hospital stay.</td>
<td>• Length of stay in hospital (in days) 14 ± 6 days. • The length of hospital stay was shorter for patients with an MMSE ≤ 20 (12 vs. 15 days; p &lt; 0.001).</td>
<td>• Only 3% of total costs were spent on physiotherapy EUR 262 ± 224 (3.0%). If physiotherapy can be performed properly, then the total cost could be minimized significantly. • Cost of treatment in males is about EUR 800 higher than for females (p value = 0.128) due to pre-existing premorbid conditions and longer hospital stay. • Charlson comorbidity index: &lt; 4: EUR 8353 ± 4616, ≥ 4: EUR 10,383 ± 7909, p value = 0.047, Cognitively impaired patients were discharged sooner because these patients often did not have the potential for rehabilitation, resulting in shorter lengths of hospital stay.</td>
<td>• Cost for pre-existing cognitive impairment: MMSE ≤ 20 EUR 8248 ± 3662 and MMSE &gt; 20 EUR 9176 ± 8459; p value = 0.616.</td>
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<tr>
<td>15</td>
<td>Jean Taillandier, Fabrice Langue, Martine Alemanni, Elodie Taillandier-Heriche</td>
<td>2003</td>
<td>60</td>
<td>83 ± 7.1 years</td>
<td>N/A</td>
<td>54 (90%) females, 6 (10%) males</td>
<td>N/A</td>
<td>N/A</td>
<td>Mean length of hospital stay was 45 ± 28 d (range, 10–130 d).</td>
<td>N/A</td>
<td>N/A</td>
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- Insufficiency fractures of the pelvis occur in older patients, either spontaneously or after a trivial trauma such as a fall from the standing position.
- A total of 52 patients reported a minor fall on the day of admission or within the last few days, while 8 of the fractures were considered spontaneous.
- A history of osteoporotic fracture was present in 24 (40%) patients (vertebral fracture, n = 16; femoral neck fracture, n = 10).
- A simple fall caused the fracture in 86.6% of patients.
- A total of 56 (93%) patients lived at home before the fracture (11 with their spouse or children and 12 with visits from home aides), and the other 4 lived in nursing homes.
- A total of 41 (68.3%) were fully self-sufficient before the fracture, 11 used a cane to walk outside their home, and 8 were not self-sufficient.
- Complete elimination of weight bearing was required in 52 patients, the mean duration being 12.7 d (range, 3–55 d), whereas 8 patients were able to continue walking, with analgesic treatment.
- Length of stay was significantly longer in the patients who were not self-sufficient before the fracture.
- Lower degree of self-sufficiency is the reason for institutionalization.
- Pelvic insufficiency fractures are fairly common in older patients and can raise diagnostic challenges.
- Pelvic fractures adversely affected self-sufficiency in this study.
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- A total of 44 patients returned to their previous place of residence, but 15 were discharged to institutions (11 to nursing homes and four to extended-stay hospitals).
- Only 22 patients had the same level of self-sufficiency as before the fracture and 10 experienced a decrease in self-sufficiency. Seven patients (14.3%) died within the year after the fracture.
- Only age was significantly associated with loss of self-sufficiency; patients who experienced a marked decrease in self-sufficiency were significantly older than those who recovered their previous level of self-sufficiency (88.2 years vs. 78.5 years; \( p = 0.0001 \)).
- After 1 year, only 36.6% of our patients had the same level of self-sufficiency as before the fracture.
- A total of 25% of patients were discharged to institutions.
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<tr>
<td>16</td>
<td>Kyle T. Judd, Eric Christianson</td>
<td>2015</td>
<td>657, (111 = early interventions, 546 = late interventions)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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- Average age for the early intervention group = 79 years.
- Average age for the late intervention group = 81 years.

- The average LOS for the early intervention group was 4.11 days.
- Average LOS 5.68 days for the late intervention group ($p = 0.0005$).
- The average cost of the early intervention = USD 49,900 and
- The average cost of late intervention = USD 65,300 ($p = 0.0086$).

- Due to high costs and an increasing burden of care, there has been interest in newer methods to increase efficiency of care.
- One such method is expedited fracture care, with earlierative intervention. The purpose of this study was to determine if intervention within 6 h of admission decreased costs with no change in the rate of major complications.
- Patients were divided into two groups: those undergoing operative intervention $< 6$ h after admission (early) and those undergoing operative intervention $> 6$ h after admission.
- The average length of stay for the early intervention group was 4.11 days, and it was 5.68 days for the late intervention group ($p = 0.0005$).
- The average cost of the early intervention was USD 49,900, with the average cost of late intervention being USD 65,300 ($p = 0.0086$).

- Expedited fracture care with earlier operative intervention helps to decrease the cost significantly.
- The purpose of this study was to determine if intervention within 6 h of admission decreased costs with no change in the rate of major complications.
- Programs emphasizing early intervention for hip fractures have the potential for large healthcare savings, with an average saving of USD 15,400.
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<td>17</td>
<td>Ian D Cameron, David M. Lyle, Susan Quine</td>
<td>1994</td>
<td>252</td>
<td>84 years</td>
<td>N/A</td>
<td>39% lived in nursing homes prior to sustaining their fracture.</td>
<td>(83% = female, 17% = male)</td>
<td>39% lived in nursing homes prior to sustaining their fracture.</td>
<td>19.5 days for the accelerated rehabilitation group and 28.1 days for the conventional care group.</td>
<td>Total cost was approximately AUD 10,600 for accelerated rehabilitation and AUD 12,800 for conventional care (p value = 0.186). Because of the reduction in length of stay, the post-surgical component is markedly reduced for the accelerated rehabilitation group (AUD 6420 v/s AUD 8870 (p value = 0.138).).</td>
<td>N/A</td>
<td>N/A</td>
<td>• The focus of the analysis in this paper is that of a third-party funding agency (in Australia, the Commonwealth and State Government finance most of the cost of PFFs). • Community services were utilized more frequently by the accelerated rehabilitation group, while the conventional care patients utilized more institutional care. • Physical independence of patients at 4 months after fracture, as measured by the Bathel Index. Accelerated rehabilitation v/s conventional care (50% v/s 41%), which reflects the benefit of accelerated rehabilitation. • The major factor contributing to cost of treatment for PFF in this study was the length of hospital stay.</td>
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<tr>
<td>18</td>
<td>Franz Muller, Michael Galler, Michael Zellner, Christian Baum, Bernd Fuchtmeier</td>
<td>2015</td>
<td>117 (121 fractures)</td>
<td>Patient in 10th decade of life (90–99 years)</td>
<td>Mean age = 92.3 years.</td>
<td>N/A</td>
<td>Female</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>The incidence of dementia was 60% before surgery.</td>
<td>• Patient with dementia were referred to nursing home for care.</td>
<td>• In revision surgery, 20.5% have dementia who survived (n = 34)</td>
</tr>
<tr>
<td>19</td>
<td>Till Berk, Marion Thalmann, Kai Oliver Jensen, Peter Schwarzerberg, Gerrolt Nico Jukema, Hans Christoph Pape, Sascha Halvachizadeh</td>
<td>2023</td>
<td>71</td>
<td>≥70</td>
<td>Mean = 83.54 ± 7.78</td>
<td>N/A</td>
<td>Male: 24(33.8%), Female: 47(66.2%)</td>
<td>N/A</td>
<td>LOS = 14.85 days</td>
<td>N/A</td>
<td>N/A</td>
<td>• Proximal femur fractures (PFFs) are among the most common injuries in the geriatric population; they require hospitalization and surgical treatment.</td>
<td>• Mechanism of injury = Low energy impact in 67 (94.4%).</td>
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| 19 | Till Berk, Marion Thalmann, Kai Oliver Jensen, Peter Schwarzenberg, Gerrolt Nio Jukema, Hans-Christoph Pape, Sascha Halvachizadeh | 2023 | 71 | N/A | N/A | N/A | N/A | LOS = 14.85 days | N/A | N/A | • The group with complications (Group C) had a significantly higher FFI (Fried Fragility Index) compared with the group without complications (Group NC) (1.7 ± 0.5 vs. 1.2 ± 0.4, p = 0.002).  
• A higher FFI score increased the risk of developing complications (OR 9.8, 95% confidence interval [CI] 2.00 to 47.7, p < 0.005).  
• A higher CDD (confusion, delirium and dementia) score increased the risk of developing delirium (OR 9.3, 95% CI 2.9 to 29.4, p < 0.001).  
• A higher BS (Braden Score) increased the odds of developing decubitus by 6.2 times (95% CI 1.5 to 25.7, p < 0.001).  
• Post-operative complications influence the course and outcome following surgery and are associated with increased socioeconomic burden.  
• The results of this study have shown that the ePA-AC could represent such a multidimensional assessment tool, especially because it seems that the search for an ideal score for the assessment of elderly patients has not yet been achieved.   | • The FFI has the highest predictive value for an increased risk of developing complications in general.  
• CDD is a promising tool for identifying geriatric trauma patients at risk of delirium.  
• Utilization of the appropriate assessment tool for geriatric trauma patients might support individualized treatment strategies. |
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<td>20</td>
<td>Nicola Veronese, Stefania Maggi</td>
<td>2018</td>
<td>N/A</td>
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- World-wide, hip fractures occurred in 18% of women and 6% of men.
- Higher incidence in white women than in men.
- Economic Impact: N/A
- Mental Status: N/A
- Results: N/A
- Conclusions: N/A

- Hip fracture is an important and debilitating condition in older people, particularly affecting women.
- It is globally estimated that hip fractures will affect around 18% of women and 6% of men (1992 DATA).
- The direct costs associated with this condition are enormous since it requires a long period of hospitalization and subsequent rehabilitation.
- Cause of hip fracture: decreasing bone mineral density (BMD) and those increasing the rate of fall.
- Gender is one of the factors that is influence hip fracture. Higher incidence in white women than in men.
- One-third of women in their eighties will have a hip fracture.
- Severity: above 80 years—one-third of males die within 1 year after hip fracture as compared to females.
- RACE: Whites living at higher latitudes exhibit a higher incidence of hip fractures ranging from 420/100,000 new hip fractures each year in Norway to 195/100,000 in the USA.
- Their more recent data (2012) showed that the highest incidence of hip fracture was observed in Denmark (439/100,000), with the lowest in Ecuador (55/100,000).
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<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>• World-wide, hip fractures occurred in 18% of women and 6% of men. • Higher incidence in white women than in men.</td>
<td>• It is noteworthy that every year about 300,000 subjects are hospitalized for hip fractures in the United States alone. • The estimated cost of treatment in the US was approximately USD 17 billion in 2002. • Worldwide, in women, the lowest annual incidence rate was seen in Nigeria (2/100,000), while the highest was in Northern Europe countries, such as Denmark (574/100,000). • Asians demonstrate an intermediate risk of hip fracture, between white and black individuals [31–33], with about 30% of the world’s hip fractures occurring in China, making this a public health concern. • People requiring a long-term care (LTC) facility is estimated between 6 and 60% of people suffering from hip fracture, with costs ranging from USD 19,000 to USD 66,000. • Costs were significantly greater for rehabilitation hospital patients than for nursing home patients.</td>
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<td>21</td>
<td>A. Morice, N. Reina, G. Gracia, P. Bonneville, J-M. Laffosse, K. Wytrykowski, E. Cavaignac, N. Bonneville</td>
<td>2016</td>
<td>39</td>
<td>&gt;100 years</td>
<td>mean age of 101.3 years (range, 100–108 years)</td>
<td>France</td>
<td>33 women and 6 men</td>
<td>A total of 15 patients living at home at the time of injury; 5 entered nursing homes for dependent senior citizens and 7 were admitted to geriatric rehabilitation units. Seven patients who were in nursing homes for dependent senior citizens at the time of injury returned to the same institution. Of the 14 retirement home patients, 8 returned to their previous institution, 5 entered nursing homes for dependent senior citizens, and 1 was admitted to a geriatric hospital.</td>
<td>Mean hospital stay = 9.5 days [2-26]</td>
<td>N/A</td>
<td>Most patients (61.5%) were institutionalized and many (36%) had dementia</td>
<td>PFFs carry a high risk of death among centenarians. Mortality is high in centenarians after a PFF. Multidisciplinary approach is necessary for better outcome.</td>
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<td>22</td>
<td>Nicole Simunovic, PJ Devereaux, Mohit Bhandari</td>
<td>2011</td>
<td>&gt;50 years the guideline is applicable</td>
<td>&gt;50 years the guideline is applicable</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>• In Canada, the cost of hip fractures is USD 650 million annually and is expected to rise to USD 2.4 billion based on a projected number of 88,124 hip fracture patients by 2041. • The estimated lifetime cost for all hip fractures in the United States in 1997 likely exceeded USD 20 billion. • In the United Kingdom, direct hospital costs alone were estimated to be USD 125 million in 2003.</td>
<td>• Hip fractures are associated with a high rate of in hospital mortality of 7–14% and a profound temporary and sometimes permanent impairment of quality of life. • Surgery within &lt;24 h has associations with better functional outcomes and lower rates of perioperative complications and mortality. • Surgical delay increases the rate of pressure ulcers and avascular necrosis. • Early surgery helps in improved ability of patients to return to independence, mobility and pre-fracture living status. • Early surgical correction directly proportional to shorter hospital stay. • The current evidence for optimal surgical timing is entirely observational and often conflicting for the outcomes of mortality, most post-operative complications, length of hospital stay and return to living status.</td>
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<td>23</td>
<td>Nidhi Tiwari, Shubhangi Patil, Rupali Popalbhat</td>
<td>2022</td>
<td>21 years male</td>
<td>21</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>• A patient’s ability to carry out activities of daily living effectively and efficiently post-surgery is hampered by a variety of obstacles. • Physiotherapy procedures commenced with the purpose of alleviating pain and establishing a normal range of motion. • A significant portion of trauma-related hospitalizations are due to proximal femoral fractures. • To reinstate hip and knee movements to normal, or at the very least to a functional ROM to improve and regain the strength of hip movements, and to restore ROM for hip and knee joints, the patient underwent physiotherapy. • After proper rehabilitation, the patient’s ROM, i.e., both active and passive, was increased at the time of discharge. • After 8 weeks, the ADL (Activity of Daily living assessment was performed with assistive devices. • Muscle strength increased, i.e., pre-treatment v/s post treatment ((1 v/s + 3))-manual muscle testing (MMT).</td>
<td>Patient’s ROM and muscle strength in the lower limb and face muscles were enhanced with physiotherapy.</td>
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<td>24</td>
<td>Johannes Gleich, Carl Neuerburg, Carsten Schoeneberg, Matthias Knobe, Wolfgang Böcker, Katherine Rascher, Evi Fleischhacker</td>
<td>2023</td>
<td>19712 (data taken from Registry for Geriatric Trauma founded by German Trauma Society. All hospitals certified as Alters TraumaZentrum DGU)</td>
<td>≥70 years</td>
<td></td>
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<td>• Treatment in hospitals with higher level of care and subsequent increased time to surgery. • Increased odds for worse walking ability 7 days after surgery were found in level I trauma centers. • Mobilization on the first day after surgery was performed significantly more often in level II/III trauma centers.</td>
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4. Discussion

The management of elderly patients who sustain orthopedic fractures is an increasingly relevant topic in current practice. Due to the elderly population growing rapidly in recent years, a larger number of patients are more susceptible to fractures and loss of independence [5,13]. This narrative review aimed to evaluate loss of independence following proximal femur fractures in orthopedic patients as well as examine its economic impact. Proximal femur fractures are known to be a highly prevalent injury in the geriatric population, hence necessitating the understanding of ensuing loss of independence and its financial impact. There is also a major physical impact on the patient, including loss of physical activity and feelings of anxiety and depression. Loss of independence encompasses the inability to perform tasks necessary for survival, personal care such as ADLs, and additional aid with physical activity either at home or in an inpatient rehabilitation facility or skilled nursing facility [13].

This study demonstrates that a PFF has hefty costs associated with surgery, with a large portion needing expensive post-operative care in rehabilitation facilities and nursing facilities due to a loss of functional independence [16]. Patients have even reported selling possessions to pay for expenses incurred during surgery and care needed at rehabilitation facilities, with others having to reach out to friends and family as a source of financial aid [32]. Patients losing independence also resulted in a lack of ability to work or sustain a job, exponentially increasing their financial burden. Proximal femur fractures also place a patient at a higher risk of sustaining another fracture later, also increasing the chances of other infections in the early stages of recovery. Beside this, in later days, it worsens the pre-existing morbid condition, leading to an increase in the rate of morbidity and mortality, mostly within 3–6 months of surgical interventions, which has a direct impact on creating additional costs for the individual [33]. Also, hospital-acquired conditions following orthopedic procedures also contribute to the length of stay and the post-operative disposition to the rehabilitation centers [34].

There is a significant difference in the overall cost of management of PFFs in developed countries as compared to developing ones. Few studies have shown that the average cost of treatment in the overall management of PFFs in developed countries is 6–8-fold higher compared to developing ones. This reflects that the proportional increase in the cost of management of PFFs in developed countries will be a burden in the near future [25,35]. The cost is higher due to the longer hospital stay, which accounts for nearly one-third of the total cost of treatment [35]. Further, rapid intervention for fracture management significantly decreases the burden of higher expenses in treatment. Furthermore, the site of fracture, severity of the fracture and the Charlson Comorbidity Index play a pivotal role in increasing the cost during fracture management. Additionally, cognitive impairment also plays a significant role in increasing the acute care costs [25,35]. Also, according to a few studies, the level of trauma center plays a significant role in the timing of interventions, which impacts the disposition and recovery period for these fractured populations [36,37].

These findings may be best interpreted by considering loss of independence and the need for discharge to a faculty other than home. Previously, it was very common for patients to be discharged to IRFs following surgery due to the safety and assistance they would receive from the staff [13,16]. This notion has recently changed, as surgeons routinely opt against sending their patients to IRFs after surgery due to the increased costs. This creates a fine line of balancing patient needs and safety with increased cost, necessitating a proper analysis of who truly needs this extra care. Additionally, this brings increased attention to “why” some patients experience a loss of independence, including what can be done to prevent this and increase self-motivation among patients. There is a significant gain of functional ability in those populations whose disposition is directly to their home or with their loved ones as compared to those whose disposition is in nursing home setups or institutional rehabilitation centers [15,24,33]. Studies have shown that loss of independence following the surgical management of PFFs is greater in advancing-age populations [5,14,35]. Thus, the importance and need for regular, proper, adequate and
timely physiotherapy for rapid gain in the pre-fracture independence state is an increasing trend [33,38]. Future studies should examine these variables and attempt to create risk assessment and stratification tools that may better optimize patients prior to surgery.

This study did have its limitations. We acknowledge that our inclusion and exclusion criteria prevented the assessment of the financial and physical burdens of proximal femur fractures and the loss of independence in other countries. In this narrative review, various heterogeneous studies were included and hence the bias of each study was also incorporated. Like other narrative reviews, this study also lacked the explicit criteria for the article selection and hence there was no evaluation of selected articles for validity. Moreover, the studies included in his review were retrospective in nature, so we do not have a consistent measure of frailty.

5. Conclusions

Proximal femur fractures are highly prevalent, with incidence steadily increasing as the Baby Boomer population ages. Female gender, advancing age, white population, co-existing morbidities, lack of proper care, post-operative infections, limitation in mobility following surgery, and impaired cognitive function following surgery are the factors that contributes to the decline in the rate of appropriate recovery following surgery. These fractures can lead to a serious loss of independence among elderly patients and, therefore, could necessitate permanent residence in a nursing facility (IRFs and SNFs). In addition, PFFs have a considerable economic impact on the patient and healthcare system. These findings are crucial and should prompt further investigation into risk factors for loss of independence, as well as discussions with orthopedic patients prior to surgery.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/surgeries5030047/s1, Table S1: Risk of bias assessment using Newcastle-Ottawa Score.

Author Contributions: Study conception and design: H.A.M., A.P., A.S. and K.J.S.; acquisition, analysis, and interpretation of the data: All Authors; drafting of the manuscript: All Authors; critical revision of the manuscript for important intellectual content: H.A.M., A.P., A.S., H.K. and K.J.S.; statistical analysis: H.A.M.; study supervision: A.S., K.J.S. and A.P. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare that there are no conflicts of interest to disclose and there are no financial or non-financial interests related to the work submitted.

Abbreviations

Proximal Femur Fractures (PFF), Skilled Nursing Facilities (SNFs), Inpatient Rehabilitation Facilities (IRFs), Loss of Independence (LOI), Comprehensive Rehabilitation Units (CRU), Long Term Care (LTC) facility, Home Care (HC), Home Based Rehabilitation (HBR), Institutional Based Rehabilitation (IBR), Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA), Length of stay (LOS), Activities of Daily Living (ADL), Lateral compression type 1 (LC1) Pelvic Fracture, Total Joint Arthroplasty (TJA), Total Knee Arthroplasty (TKA), Charlson Comorbidity Index (CCI), Mini Nutritional Assessment (MNA), Braden Score (BS).
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