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The Impact of Timing of Surgery on Patients with Hip Fractures

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Abstract

Purpose: A hip fracture is a severe injury with complications that can be life-threatening. Studies show that the risk of hip fracture increases with age. As a result, hip fracture is common among the elderly. This paper aims to assess the impact of the timing of surgery in patients with hip fractures. Exploring the duration that patients with hip fracture have to wait before getting surgery will help promote rehabilitation services as well as provides a reference to how clinical postoperative complications can be prevented.

Methods: To assess the impact of the timing of surgery in patients with hip fractures, we conducted a systematic review on PubMed and Web of Science using the keywords: hip fracture, delayed operation, early operation, waiting time, rehabilitation.

Results: The literature review showed that patients who undergo surgery within 24 hours experience stroke, delirium, non-septic infection and moderate to severe pain. When the surgery is conducted after 24 hours, patients get pneumonia, pulmonary embolism, and myocardial infarction. Additionally, studies show that delirium increase, mobility becomes worse and hospitalization time increases when surgery is conducted after 24 hours. In addition to the signs and symptoms experienced during the surgery after 24 hours, patients get urinary tract infection, sepsis, septic shock, and cardiac arrest when the surgery is delayed by 48 hours.

Conclusion: This study shows that patients with hip fractures must undergo surgery within 24 hours. Otherwise, they risk developing various complications. If the operation is inevitably delayed, more attention and preventive measures should be paid to the peculiar complications caused by the delay.

Keywords: Hip fracture; Delayed operation; Early operation; Waiting time; Rehabilitation.

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Introduction

Studies show that hip fracture is a global problem and is common among the elderly. A study stated that the incidence rate of hip fracture is as high as 171/100000 [1]. The study also stated that the risk of hip fracture increases with increasing lifespan. As a result, the elderly patients tend to have worse prognoses and longer recovery time than the younger ones [2]. The estimated 12-month mortality among elderly patients with hip fractures is about 27% to 30% [3]. In addition to the high mortality rate, taking care of patients with hip fractures is an expensive endeavor. It places a substantial burden on social healthcare resources [4,5]. Therefore, several scholars are concerned with improving the prognosis of patients with hip fractures.

After studying many factors, researchers have since turned their attention to the timing of surgery and concluded that early surgery has no effect on the outcomes of hip fracture patients [6]. For instance, Gökhan Karademir said that there is no significant difference in mortality between patients who undergo surgery within five days and those who undergo surgery after five days [7]. Nonetheless, other researchers like Paul Welford concluded that performing surgery on patients within 24 hours can reduce the mortality rate [8]. A study conducted by Zachary Tran showed that delayed operation (time to surgery ≥ 48 h) increases the likelihood of mortality [9]. Notably, even among researchers who support early surgery, the relationship between time to surgery and the exact prognosis is controversial.

Materials & methods

To review the literature on waiting time before surgery for patients with hip fractures, a comprehensive search was performed in PubMed and Web of Science between the 19 December, 2011 and the 19 December, 2021. The search strategy included the following terms: (Hip fracture) OR (Trochanteric Fractures) OR (Fractures, Trochanteric) OR (Fractures, Hip) OR (Intertrochanteric Fractures) OR (Subtrochanteric Fractures) OR (Fractures, Intertrochanteric) OR (Fractures, Subtrochanteric) AND (Early Operation) OR (Delayed Surgery) OR (Delayed Operation) OR (Early Surgery) AND (Rehabilitation) OR (Habilitation).

A total of 834 articles were found, and 241 duplicate articles were excluded from the study. Additional 558 unrelated articles were excluded from the study after reading the title and abstract. Furthermore, seven articles were excluded from the study for several reasons. First, we excluded articles that mentioned the concept of a delayed or early operation but did not study it. Second, we excluded articles that lacked the time boundary between early and delayed operation and those with multivariable interaction. After all the exclusions, 15 articles were included in this study.

Results

In a retrospective cohort study published by Daniel Pincus [10], in 2017, 42230 patients who underwent hip fracture surgery from 2009 to 2014 were included. The patients were assigned into two groups. One group comprised patients whose waiting time before surgery was less than 24 hours and the other group comprised patients whose waiting time before surgery was more than 24 hours. After matching the baseline characteristics of the patients in the two groups, the average age was 80.1. In the analyses of outcomes, mortality (30 days, $P=0.006$; 90 days, $P<0.001$; 12

months, $P<0.001$), pneumonia ($P=0.002$), pulmonary embolism ($P<0.001$), myocardial infarction ($P<0.001$) showed significant differences and deep venous thrombosis ($P=0.86$) showed no significant differences. In another article, Daniel Pincus, MD, states that when the waiting time for surgery is more than 24 hours, it significantly increases the length of stay ($P=0.006$) and the medical expenses ($P<0.001$).

In a randomized controlled trial published by Flavia K Borges in 2020, 2970 patients who underwent hip fracture surgery from 2014 to 2019 were included [11]. The patients were assigned into two groups. One group comprised patients whose waiting time before surgery was about 6 hours and the other group comprised patients whose waiting time before surgery was about 24 hours. All patients in this study were above 45 years. In the analyses of outcomes, stroke ($P=0.047$), delirium ($P=0.009$), urinary tract infection, moderate to severe pain on day 4-7 showed significant differences and mortality (90 days, $P=0.40$), myocardial infarction ($P=0.77$), pressure ulcer ($P=0.46$), infection ($P=0.08$) showed no significant differences. In conclusion, advancing the operation to about 6 hours will be better than 24 hours.

In a retrospective cohort study published by Alejandro L in 2018, 1234 patients who underwent hip fracture surgery from 2011 to 2016 were included [12]. The patients were assigned into three groups. Group one comprised patients whose waiting time before surgery was less than two days. Group two comprise patients whose waiting time before surgery was more than two days with medical reasons and group three comprised patients whose waiting time was also more than two days but with organizational reasons. The average age of the three groups was 83.5, 83.3 and 82.4, respectively. In the analyses of group 1 and group 3, mortality (6 months, $P=0.027$; 12 months, $P=0.002$), pneumonia ($P=0.042$), urinary infection ($P=0.017$), pulmonary exacerbation ($P=0.001$) showed significant differences and 30-day mortality, deep venous thrombosis, renal insufficiency, wound infection, dementia, cardiac arrhythmia, myocardial infarction, thromboembolism, stroke, gastrointestinal bleeding showed no significant differences. However, in the analyses of group 1 and group 2, mortality and complications didn't have significant differences. In conclusion, the prognosis of surgical patients who are delayed for organizational reasons will be worse.

In a retrospective cohort study published by Boris Sobolev Ph.D. in 2018, 139119 patients who underwent hip fracture surgery from 2004 to 2012 were included [13]. All the patients in this study were above 65 years. The patients were assigned into four groups. The patients who underwent surgery on admission day were assigned group 1; patients operated on the second day were assigned group 2; patients operated on the third day were assigned group 3; and patients operated after the third day were assigned group 4. In the analyses of outcomes, compared with patients operated on admission day, 30-day mortality of those operated on the third or after the third day showed significant differences. But those operated on the second day showed no significant differences. In conclusion, surgery within 48 hours can decrease the 30-day mortality.

In a prospective cohort study published by Chris A. Anthony in 2017, 8254 patients who underwent hip fracture surgery from 2005 to 2010 were included [14]. The study placed the subjects

into two cohorts. One cohort is operation ≤ 2 days undergoing all surgery and operation > 2 days undergoing all surgery. The other cohort is operation ≤ 2 days except for total hip arthroplasty and operation > 2 days except for total hip arthroplasty. All the patients in this study are above 60 years. In the analyses of cohorts, two cohorts reached a similar conclusion. Pneumonia (in cohort 1, $P=0.009$; in cohort 2, $P=0.010$), myocardial infarction (in cohort 1, $P=0.015$; in cohort 2, $P=0.025$), stroke (in cohort 1, $P=0.018$; in cohort 2, $P=0.031$), cardiac arrest (in cohort 1, $P=0.043$; in cohort 2, $P=0.039$), sepsis (in cohort 1, $P=0.010$; in cohort 2, $P=0.008$), septic shock (in cohort 1, $P=0.010$; in cohort 2, $P=0.007$) showed significant differences and mortality (30 days), pulmonary embolism, deep venous thrombosis, infection, renal insufficiency, deep wound infection, organ space infection, superficial infection, wound dehiscence, unplanned intubation, urinary tract infection, acute renal failure, coma > 24 hours, bleeding transfusions, peripheral nerve injury showed no significant differences. In conclusion, surgery within 24 hours improves the prognosis.

In a retrospective cohort study published by Giulio Piol in 2019, 939 patients who underwent hip fracture surgery from 2012 to 2015 were included [15]. All patients in this study were above 75 years. Patients were assigned into three groups. Group one comprised patients who underwent surgery within one day. The second group comprised patients who underwent surgery within two days and the third group comprised patients who underwent surgery after more than three days. In the disturbance of consciousness group before the operation, delayed operation showed no significant differences. In the mild disturbance of consciousness group before operation, delayed operation (≤ 2 days, $P=0.009$; > 2 days, $P=0.002$) showed significant differences. In conclusion, surgery within 2 days can improve the prognosis.

A prospective cohort study by Defei Meng in 2021, included 480 patients who underwent hip fracture surgery from 2016 to 2017 [16]. The average age of the patients in this study was 65 years. The researcher divided the patients into three groups. Patients operated within 2 days were assigned group one, patients operated within 7 days were assigned group two and patients operated after seven days were assigned group. There was no significant difference in the 12-month mortality and mobility between groups one and two. However, the analysis of group one and group three showed a significant difference in the 12-month mortality ($P=0.020$) and mobility ($P=0.027$). This study concluded that performing surgery within 7 days can improve the prognosis of hip fracture.

A retrospective cohort study published by Takahisa Ogawa in 2019, included 175 patients who underwent hip fracture surgery from 2013 to 2015 [17]. The researcher assigned patients into two groups. One group comprised patients whose waiting time before surgery was less than 24 hours and the other group comprised patients whose waiting time is more than 24 hours. The average age of the two groups was 86.7 and 85.4, respectively. The study showed that patients whose waiting time before surgery was less than 24 hours had better mobility than those whose waiting time was more than 24 hours. The study concluded that shorter waiting time before surgery for patients with hip fracture promotes mobility rehabilitation and reduces mortality.

In 2021, Obada Hasan conducted a case-cohort study that included 911 patients who had undergone hip fracture surgery between 2010 and 2018 [18]. The average age of the patients in this study was 50 years. The patients were assigned into four groups based on the waiting time before surgery and whether they were transferred to ICU after the operation. In the analyses of outcomes, postoperative ICU ($P=0.37$) showed no significant differences. In conclusion, surgery within 48 hours has no relationship with postoperative ICU.

A study conducted by Nathalie Declarador in 2018 included 450 patients who had undergone hip fracture surgery between 2011 and 2012 [19]. The patients were assigned into two groups. Group one comprised patients whose waiting time before surgery was less than 48 hours and group two comprised patients whose waiting time was more than 48 hours. The average age for the two groups was 79.3 and 80.6, respectively. In the analyses of outcomes, 12-month mortality ($P=0.03$), primary complications (urinary tract infection and pneumonia, $P<0.01$), length of stay ($P<0.01$), mobility ($P=0.030$) showed significant differences but in-hospital mortality ($P=0.16$) showed no significant differences. In conclusion, surgery within 48 hours can improve the prognosis.

A retrospective cohort study by Luigi de Palma in 2014 comprised 1169 patients who had undergone hip fracture surgery between 1995 and 2008 [20]. All the patients in this study were above 65 years. The researcher placed the patients into two groups. The first group comprised patients whose waiting time was less than 48 hours and the second group comprised patients whose waiting time was more than 48 hours. In the analyses of outcomes, 30-day mortality ($P<0.001$) showed significant differences. In conclusion, surgery within 48 hours improves the prognosis.

In 2017, Natasha Morrissey conducted a study that comprised 1880 patients who had undergone hip fracture surgery between 2011 and 2015 [21]. The average age of patients in this study was 83.9. The study showed that there is no significant difference in the 30-day mortality and length of stay when patients are divided into groups depending on the 12 or 18 hour waiting time before surgery. However, the study showed that there is a significant difference in the 30-day mortality when patients are divided into groups based on longer waiting times of more than 24 hours or 36 hours. The study concluded that performing surgery within 24 hours positively impacts the mortality rate of patients with hip fracture after the operation.

In 2016, Andre M Samuel conducted a study that involved 1361 patients who had undergone hip fracture surgery between 2011 and 2012 [22]. Unlike most of the studies, Andre selected patients that were less than 50 years. The patients were assigned into two groups. The first group comprised patients whose waiting time was less than 24 hours and the second group comprised patients whose waiting time was more than 24 hours. In the analyses of outcomes, adverse events (serious adverse events: thromboembolic event, acute respiratory distress syndrome, unplanned return to the operating room, cardiac arrest (requiring CPR), severe sepsis, cerebrovascular accident, death, myocardial infarction; minor adverse events: pneumonia, urinary tract infection, drug/ethanol withdrawal, unplanned intubation, acute kidney injury, surgical site infection, decubitus ulcer, compartment syndrome, unplanned return to ICU line-associated bloodstream infection,

osteomyelitis) showed significant differences. In conclusion, surgery within 24 hours can improve the prognosis.

In 2019, Gurger conducted a retrospective study that comprised 324 patients who had undergone hip fracture surgery between 2015 and 2016 [23]. The patients were assigned into three groups. Two groups comprised of patients whose waiting time was less than 72 hours and the third group comprised of patients whose waiting time was more than 72 hours. The average age of the three groups was 79.3. In the analyses of outcomes, 1-year mortality showed significant differences. In conclusion, surgery within 72 hours decreases the mortality rate.

Discussion

This study included 15 studies: nine retrospective studies, one randomized controlled trial, one case-control study, and 4 four prospective studies. The paper used these collected articles to assess the impact of waiting time before surgery for patients with hip fracture. The goal of the paper was to improve prognosis of hip fracture. The specific characteristics are as shown in Table 1. In all the papers included in this study, the researchers divided the patients into two or more groups depending on their waiting time before surgery. After assigning the patients into groups, the researchers then performed a prognosis analysis to determine whether there is a significant difference between the groups with different waiting time before surgery. Except for Obada Hasan's research, all the other articles concluded that the waiting time before surgery impacts the prognosis of hip fracture. The studies stated that patients with delayed surgery have higher mortality, more complications, higher costs and longer hospital stay than patients with shorter waiting time before surgery. Moreover, the studies stated that patients whose waiting time before surgery is longer are less likely to recover to preoperative mobility. Unlike all the other studies, Obada Hasan's research concluded that several factors aside from the timing of the surgery influence the occurrence of critical postoperative illness in patients with hip fractures. Based on the literature reviewed, this paper concludes that the waiting time before surgery does not determine whether

a patient will be taken to ICU after the surgery, but it influences the patient's mortality rate and the occurrence of complications. Nonetheless, studies have shown that early surgery is beneficial to patients with hip fractures. This study found that performing hip fracture surgery within 24 hours had no effect on most prognostic indicators. However, it still influenced the occurrence of delirium, stroke, infection without sepsis, urinary tract infection, 4-7-day moderate-to-severe pain. Additionally, the study found that 30-day mortality, 90-day mortality, 12-month mortality, pneumonia, myocardial infarction, pulmonary embolism, length of hospital stay, delirium and mobility are affected when the operation is postponed to more than 24 hours. Nonetheless, the events that occur when the surgery is delayed for more than 48 hours to those that occur when the surgery is delayed by 24 hours.

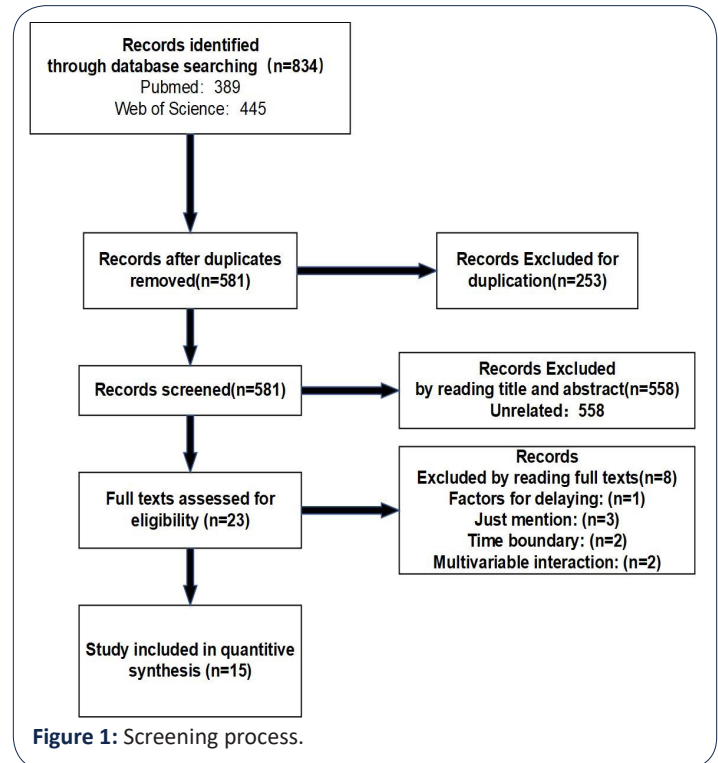


Figure 1: Screening process.

Table 1: Characteristic of individual study.

Author, Year	Study Period	Study Method	Group	Sample Size	Age, Mean or Range	Outcome Measures
Daniel Pincus, MD et al., 2017	2009-2014	RCS	operation ≤ 24h operation > 24h	14174 28056	80.1 80.1	30-Day Mortality, 90-Day Mortality, 12-Month Mortality, Deep Venous Thrombosis, Pneumonia, Pulmonary Embolism, Myocardial Infarction
Daniel Pincus, MD et al., 2018	2009-2014	RCS	operation ≤ 24h operation > 24h	14174 28056	80.1 80.1	Length of Stay, Medical Costs
Flavia K Borges et al., 2020	2014-2020	RCT	operation = 6h operation = 24h	1487 1483	79 79	Mortality, Myocardial Infarction, Pressure Ulcer and so on, Infection without Sepsis, Stroke, Delirium, Urinary Tract Infection, 4-7 Day Moderate-to-Severe Pain
Alejandro Lizaur-Utrilla et al., 2018	2011-2016	PCS	operation ≤ 2days operation > 2days for medical reasons operation > 2days for organizational reasons	609 286 339	83.5 83.3 82.4	30-Day mortality, 6-Month Mortality, 12-Month Mortality, Deep Venous Thrombosis, Pneumonia, Renal Insufficiency, Urinary Infection, Pulmonary Exacerbation, Wound Infection, Dementia, Cardiac Arrhythmia, Myocardial Infarction, Thromboembolism, Stroke, Gastrointestinal Bleeding
Boris Sobolev PhD et al., 2018	2004-2012	RCS	operation on admission day operation on inpatient day 2 operation on inpatient day 3 operation after inpatient day 3	32120 60505 29236 17258	≥ 65	30-Day Mortality
Chris A Anthony et al., 2017	2005-2010	PCS	operation ≤ 2days operation > 2days operation > 2days except THA operation > 2days except THA	2901 1314 2797 1242	≥ 60	30-Day Mortality, Deep Venous Thrombosis, Pneumonia, Pulmonary Embolism, Myocardial Infarction, Infection, Renal Insufficiency, Stroke, Superficial Infection, Deep Wound Infection, Organ Space Infection, Wound Dehiscence, Unplanned Intubation, Acute Renal Failure, Urinary Tract Infection, Coma > 24 hours, Peripheral Nerve Injury, Bleeding Transfusions, Cardiac Arrest, Sepsis, Sepsis Shock
Gaio Pliot et al., 2019	2012-2015	RCS	operation ≤ 1days operation ≤ 2days operation ≥ 3days	357 415 167	≥ 75	Delirium
Defei Meng et al., 2019	2016-2017	PCS	operation ≤ 2days operation ≤ 7days operation > 7days	480	≥ 65	12-Month Mortality, Mobility
Takahisa Ogawa et al., 2019	2013-2015	RCS	operation ≤ 24h operation > 24h operation < 48h with postoperative ICU operation > 48h with postoperative ICU operation < 48h without postoperative ICU operation > 48h without postoperative ICU	130 45 16 32 351 512	86.7 85.4	Mobility
Obada Hasan et al., 2021	2010-2018	CCS	operation < 48h operation > 48h	32	≥ 50	Postoperative ICU
Nathalie Declarador et al., 2018	2011-2012	PCS	operation ≤ 48h operation > 48h	144 302	79.3 80.6	12-Month Mortality, Postoperative Complication (urinary tract infection, pneumonia), Mobility, Length of Stay
Luigi de Palma et al., 2014	1995-2008	RCS	operation ≤ 48h operation > 48h	207 962	≥ 65	30-Day Mortality
Natasha Morrissey et al., 2017	2011-2015	RCS	operation < 12h operation = 12h operation < 18h operation = 18h operation < 24h operation = 24h operation < 36h operation = 36h	227 1653 629 1251 1271 609 1615 265	83.9	30-Day Mortality, Length of Stay
Andre M. Samuel, BBA et al., 2016	2011-2012	RCS	operation ≤ 24h operation > 24h	923 438	≤ 50	Serious Adverse Events, Minor Adverse Events, Any Adverse Events
M Gurger, 2019	2015-2016	RS	24h < operation ≤ 72h operation > 72h	109	79.3	1-Year Mortality

Finally, the study found that the most critical surgery time for hip fracture patients should be within 24 hours. The patients undergoing surgery during this period should be closely monitored for the development of delirium, stroke, non-septic infection and moderate to severe pain in 4-7 days after surgery. Moreover, patients who postpone the operation by 24 hours for various reasons, more attention should be monitored for the development of pneumonia, pulmonary embolism, myocardial infarction. Furthermore, patients who delay the operation by 48 hours should be monitored not only for pneumonia, pulmonary embolism and myocardial infarction but also for sepsis and arrhythmia.

The advantage of this article is that it treats the problem from a new perspective and accurately predicts the complications which promotes recovery. This study also has some limitations. First, the articles in this study were retrieved from only two databases; PubMed and Web of Science. As a result, there are still some studies about the waiting time for hip fracture surgery that have not been included. For this reason, therefore, the information included in this paper might be incomplete. The other limitation for this study is that it included articles that are not more than 10 years. This limitation affects the inclusion of articles which also limits the information and conclusion derived from the studies.

Conclusions

The time within which patients with hip fracture undergo surgery is critical. According to studies conducted by various scholars, patients with hip fractures must undergo surgery within 24 hours to prevent the occurrence of postoperative complications such as pneumonia and myocardial infections. Delaying the surgery of patients with hip fractures increases the risk of developing postoperative complication and increases the patient's mortality rate. Nonetheless, the occurrence of postoperative complications is influenced by the waiting time. For instance, patients who take less than 48 hours to undergo surgery experience less severe postoperative complications than those that delay the surgery by more than 48 hours.

Declarations

Conflict of interest: The authors declare that there are no conflicts of interest.

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