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IMPACT OF TIME TO SURGICAL FIXATION ON COMPLICATIONS AND MORTALITY IN ELDERLY PATIENTS WITH HIP FRACTURES: A SYSTEMATIC REVIEW

IMPACTO DO TEMPO PARA FIXAÇÃO CIRÚRGICA NAS COMPLICAÇÕES E MORTALIDADE EM PACIENTES IDOSOS COM FRATURAS DE QUADRIL: UMA REVISÃO SISTEMÁTICA

IMPACTO DEL TIEMPO PARA FIJACIÓN QUIRÚRGICA EN COMPLICACIONES Y MORTALIDAD EN PACIENTES ANCIANOS CON FRACTURAS DE CADERA: UNA REVISIÓN SISTEMÁTICA

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Isaías Miguel de Almeida[1], **Luiz Fernando Albuquerque**[2], **Bruna Tomasi**[3], **Augusto Simionato Bianchi**[4], **Eduardo Fanelli de Figueiredo**[5]

ABSTRACT

Introduction: Hip fractures are among the most serious orthopedic injuries affecting older adults and are associated with high rates of postoperative complications, functional decline, institutionalization, and mortality. Surgical timing has emerged as a potentially modifiable factor, although uncertainty remains regarding the optimal interval between hospital admission and operative fixation. Objective: This systematic review aimed to evaluate the impact of time to surgical fixation on short- and long-term mortality in elderly patients with hip fractures. Secondary objectives included assessing postoperative complications, functional recovery, hospital length of stay, causes of surgical delay, and the influence of orthogeriatric co-management. Methods: A systematic search was conducted in PubMed/MEDLINE, Scopus, Web of Science, Cochrane Library, LILACS, ClinicalTrials.gov, and the World Health Organization International Clinical Trials Registry Platform. Studies published within the previous five years were prioritized, with expansion to ten years when necessary. Randomized trials, prospective and retrospective cohorts, registry-based studies, and systematic reviews evaluating surgical timing in elderly patients with hip fractures were considered eligible. Results and Discussion: Twenty studies were included in the qualitative synthesis. Most investigations demonstrated that surgery performed within 24 to 48 hours of hospital admission was associated with lower short-term mortality, fewer pulmonary and infectious complications, reduced incidence of pressure injuries and delirium, shorter hospitalization, and earlier functional recovery. Delays caused by organizational limitations were consistently associated with worse outcomes, whereas postponement required for

[1] Universidade Nove de Julho Câmpus Vergueiro. E-mail: imiguelalmeida2013@gmail.com
[2] FAMERP (Faculdade de Medicina de São José do Rio Preto). E-mail: albluf@hotmail.com
[3] Feevale. E-mail: brunatomasi6@gmail.com
[4] Centro Universitário Barão de Mauá. E-mail: augusto.simionato@hotmail.com
[5] Faculdade de Ciências Médicas da Santa Casa de São Paulo. E-mail: dudufanelli@hotmail.com

stabilization of acute medical conditions appeared clinically justified. Considerable heterogeneity was observed regarding definitions of early surgery, patient frailty, perioperative protocols, and adjustment for confounding factors. The overall certainty of evidence was considered moderate for mortality and low to moderate for postoperative complications and functional outcomes. Conclusion: Early surgical fixation, preferably within 24 to 48 hours, should be prioritized in medically stable elderly patients with hip fractures. Timely surgery should be integrated into multidisciplinary orthogeriatric pathways that combine rapid clinical optimization, standardized perioperative care, early mobilization, delirium prevention, nutritional support, and structured rehabilitation. Individualized postponement remains appropriate when necessary for correction of clinically significant and reversible medical instability.

Keywords: Hip Fractures. Aged. Time-to-Treatment. Mortality.

RESUMO

Introdução: As fraturas de quadril estão entre as lesões ortopédicas mais graves que afetam idosos e estão associadas a altas taxas de complicações pós-operatórias, declínio funcional, institucionalização e mortalidade. O tempo cirúrgico emerge como um fator potencialmente modificável, embora permaneça incerteza quanto ao intervalo ideal entre admissão hospitalar e fixação operatória. Objetivo: Esta revisão sistemática teve como objetivo avaliar o impacto do tempo para fixação cirúrgica na mortalidade de curto e longo prazo em pacientes idosos com fraturas de quadril. Os objetivos secundários incluíram avaliar complicações pós-operatórias, recuperação funcional, tempo de internação hospitalar, causas de atraso cirúrgico e a influência do co-gerenciamento ortogeriátrico. Métodos: Uma busca sistemática foi realizada em PubMed/MEDLINE, Scopus, Web of Science, Cochrane Library, LILACS, ClinicalTrials.gov e Plataforma de Registro de Ensaios Clínicos Internacionais da Organização Mundial da Saúde. Estudos publicados nos últimos cinco anos foram priorizados, com expansão para dez anos quando necessário. Ensaios randomizados, coortes prospectivas e retrospectivas, estudos baseados em registros e revisões sistemáticas avaliando tempo cirúrgico em pacientes idosos com fraturas de quadril foram considerados elegíveis. Resultados e Discussão: Vinte estudos foram incluídos na síntese qualitativa. A maioria das investigações demonstrou que a cirurgia realizada dentro de 24 a 48 horas da admissão hospitalar estava associada a menor mortalidade de curto prazo, menos complicações pulmonares e infecciosas, incidência reduzida de lesões por pressão e delírio, hospitalização mais curta e recuperação funcional mais precoce. Atrasos causados por limitações organizacionais foram consistentemente associados a piores resultados, enquanto o adiamento necessário para estabilização de condições médicas agudas pareceu clinicamente justificado. Considerável heterogeneidade foi observada em relação a definições de cirurgia precoce, fragilidade do paciente, protocolos perioperatórios e ajuste para fatores de confundimento. A certeza geral da evidência foi considerada moderada para mortalidade e baixa a moderada para complicações pós-operatórias e resultados funcionais. Conclusão: A fixação cirúrgica precoce, preferencialmente dentro de 24 a 48 horas, deve ser priorizada em pacientes idosos medicamente estáveis com fraturas de quadril. A cirurgia oportuna deve ser integrada em caminhos ortogeriátricos multidisciplinares que combinem otimização clínica rápida, cuidado perioperatório padronizado, mobilização precoce, prevenção de delírio, suporte nutricional e reabilitação estruturada. O adiamento individualizado permanece apropriado quando necessário para correção de instabilidade médica clinicamente significativa e reversível.

Palavras-chave: Fraturas de Quadril. Idosos. Tempo para Tratamento. Mortalidade.

RESUMEN

Introducción: Las fracturas de cadera se encuentran entre las lesiones ortopédicas más graves que afectan a los adultos mayores y se asocian con altas tasas de complicaciones posoperatorias, declive funcional, institucionalización y mortalidad. El tiempo quirúrgico ha surgido como un factor potencialmente modificable, aunque persiste la incertidumbre con respecto al intervalo óptimo entre el ingreso hospitalario y la fijación operatoria. Objetivo: Esta revisión sistemática tuvo como objetivo evaluar el impacto del tiempo para la fijación quirúrgica en la mortalidad a corto y largo plazo en pacientes ancianos con fracturas de cadera. Los objetivos secundarios incluyeron evaluar complicaciones posoperatorias, recuperación funcional, duración de la estadía hospitalaria, causas de retraso quirúrgico e influencia de la co-gestión ortogerátrica. Métodos: Se realizó una búsqueda sistemática en PubMed/MEDLINE, Scopus, Web of Science, Cochrane Library, LILACS, ClinicalTrials.gov y la Plataforma del Registro de Ensayos Clínicos Internacionales de la Organización Mundial de la Salud. Se priorizaron los estudios publicados en los últimos cinco años, con expansión a diez años cuando fue necesario. Se consideraron elegibles los ensayos aleatorizados, cohortes prospectivas y retrospectivas, estudios basados en registros y revisiones sistemáticas que evaluaran el tiempo quirúrgico en pacientes ancianos con fracturas de cadera. Resultados y Discusión: Veinte estudios fueron incluidos en la síntesis cualitativa. La mayoría de las investigaciones demostraron que la cirugía realizada dentro de 24 a 48 horas del ingreso hospitalario se asoció con menor mortalidad a corto plazo, menos complicaciones pulmonares e infecciosas, menor incidencia de lesiones por presión y delirio, hospitalización más corta y recuperación funcional más temprana. Los retrasos causados por limitaciones organizacionales se asociaron consistentemente con peores resultados, mientras que el aplazamiento necesario para la estabilización de condiciones médicas agudas pareció clínicamente justificado. Se observó considerable heterogeneidad con respecto a las definiciones de cirugía temprana, fragilidad del paciente, protocolos perioperatorios y ajuste para factores de confusión. La certeza general de la evidencia se consideró moderada para la mortalidad y baja a moderada para las complicaciones posoperatorias y los resultados funcionales. Conclusión: La fijación quirúrgica temprana, preferiblemente dentro de 24 a 48 horas, debe ser priorizada en pacientes ancianos médicamente estables con fracturas de cadera. La cirugía oportuna debe integrarse en vías ortogerátricas multidisciplinarias que combinen optimización clínica rápida, cuidado perioperatorio estandarizado, movilización temprana, prevención del delirio, apoyo nutricional y rehabilitación estructurada. El aplazamiento individualizado sigue siendo apropiado cuando es necesario para la corrección de la inestabilidad médica clínicamente significativa y reversible.

Palabras clave: Fracturas de Cadera. Anciano. Tiempo para el Tratamiento. Mortalidad.

1 INTRODUCTION

Hip fractures represent one of the most frequent orthopedic emergencies among older adults and are associated with substantial morbidity, mortality, functional decline, and healthcare expenditures worldwide.[1] The continuous increase in life expectancy has contributed to a growing incidence of fragility fractures, making hip fracture management an important public health priority in both developed and developing countries.[1] Despite advances in perioperative care, mortality during the first year after injury remains high, particularly among frail individuals with multiple comorbidities.[1]

The physiological consequences of prolonged immobilization before surgery include increased inflammatory response, venous thromboembolism, pulmonary complications, muscle wasting, and progressive functional deterioration.[2] Elderly patients frequently present with cardiovascular disease, diabetes mellitus, chronic kidney disease, cognitive impairment, and malnutrition, all of which may further increase the risk of adverse outcomes while awaiting surgical treatment.[2] Consequently, reducing unnecessary delays before operative fixation has become an important objective in contemporary geriatric trauma care.[2]

Several international societies currently recommend performing surgery within the first 24 to 48 hours whenever patients are medically optimized, although these recommendations are supported by evidence of varying certainty.[3] In clinical practice, however, surgical timing is often influenced by hospital logistics, operating room availability, specialist consultation, anticoagulant management, and optimization of unstable medical conditions.[3] These competing priorities have generated ongoing debate regarding whether early surgery itself improves prognosis or simply reflects better baseline patient status and institutional organization.[3]

The relationship between delayed surgery and mortality has been evaluated in numerous observational studies, systematic reviews, and meta-analyses, yet important methodological limitations remain.[4] Many investigations differ regarding the definition of surgical delay, using thresholds ranging from 24 to 72 hours or considering operative timing as a continuous variable.[4] Furthermore, heterogeneity in patient selection, fracture classification, perioperative protocols, and statistical adjustment complicates direct comparisons among published studies.[4]

Beyond mortality, the timing of surgery may influence several clinically meaningful outcomes, including postoperative pneumonia, urinary tract infection, pressure injuries, delirium, venous thromboembolism, prolonged hospitalization, intensive care admission, and recovery of functional independence.[5] These complications contribute substantially to healthcare costs and frequently determine whether patients are able to return to their previous

living arrangements after hospital discharge.[5] Understanding the magnitude of these associations is essential for establishing evidence-based institutional protocols and optimizing perioperative resource allocation.[5]

The implementation of orthogeriatric co-management programs has introduced a multidisciplinary approach that seeks to accelerate medical optimization while minimizing unnecessary operative delays.[6] Collaboration among orthopedic surgeons, geriatricians, anesthesiologists, rehabilitation specialists, nurses, physiotherapists, and nutrition teams has demonstrated potential benefits in improving perioperative outcomes and shortening hospital length of stay.[6] Nevertheless, uncertainty persists regarding the extent to which multidisciplinary care modifies the independent effect of surgical timing on mortality and postoperative complications.[6]

Recent publications have incorporated large national registries, multicenter cohorts, and updated meta-analyses that provide additional evidence regarding the optimal timing for hip fracture fixation in elderly patients.[7] These contemporary studies have improved adjustment for confounding variables and have expanded the evaluation of important patient-centered outcomes beyond short-term mortality alone.[7] An updated systematic review is therefore warranted to critically synthesize the current evidence, evaluate methodological quality, and determine whether earlier surgical fixation consistently improves survival and reduces postoperative complications in elderly patients with hip fractures.[7]

2 OBJECTIVES

The primary objective of this systematic review was to evaluate the impact of time to surgical fixation on mortality among elderly patients undergoing operative treatment for hip fractures. Secondary objectives were to assess the association between surgical delay and postoperative complications, including pneumonia, urinary tract infection, venous thromboembolism, pressure injuries, delirium, surgical site infection, cardiovascular events, and prolonged hospitalization. Additional objectives included comparing different definitions of “early” and “delayed” surgery adopted in the literature, analyzing the influence of patient comorbidities and preoperative optimization on outcomes, evaluating the role of orthogeriatric co-management in reducing surgical delays, examining the methodological quality of the available evidence, determining the certainty of evidence using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) framework, identifying current knowledge gaps, and discussing the implications of contemporary evidence for clinical practice, healthcare policy, and future research.

3 METHODOLOGY

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 Statement and was designed to synthesize the most recent evidence regarding the association between time to surgical fixation and clinical outcomes in elderly patients with hip fractures. The review protocol was structured before study selection, defining eligibility criteria, outcomes of interest, data extraction procedures, quality assessment methods, and evidence synthesis. The systematic review design was selected because it provides the highest level of evidence for summarizing available literature, identifying methodological limitations, and supporting evidence-based clinical decision-making.

A comprehensive literature search was performed in PubMed/MEDLINE, Scopus, Web of Science, Cochrane Library, LILACS, ClinicalTrials.gov, and the World Health Organization International Clinical Trials Registry Platform (ICTRP). Controlled vocabulary (Medical Subject Headings [MeSH] and Emtree terms) and free-text keywords were combined using Boolean operators. The principal search strategy included combinations of the terms “hip fracture,” “femoral neck fracture,” “intertrochanteric fracture,” “elderly,” “older adults,” “geriatric,” “time to surgery,” “surgical delay,” “early surgery,” “mortality,” “complications,” and “functional outcomes.” Reference lists of all eligible studies and relevant systematic reviews were manually screened to identify additional publications not retrieved during the electronic search.

Studies published within the previous five years were preferentially included. When fewer than ten eligible studies addressing a specific outcome were identified, the search window was expanded to include publications from the previous ten years. Randomized controlled trials, prospective and retrospective cohort studies, case-control studies, registry-based investigations, and systematic reviews with meta-analysis were considered eligible. Studies involving human participants were prioritized, whereas animal and in vitro studies were recorded separately when they provided mechanistic evidence relevant to perioperative pathophysiology. No language restrictions were applied. Studies with small sample sizes were not excluded but were identified as having limited statistical power during quality assessment. Case reports, editorials, narrative reviews, conference abstracts without complete data, duplicate publications, and studies lacking adequate outcome reporting were excluded.

4 RESULTS

The systematic search identified 2,184 records across all electronic databases. After removal of 624 duplicate records, 1,560 studies underwent title and abstract screening. A total of 1,472 articles were excluded because they did not meet the predefined eligibility criteria. Eighty-eight full-text articles were assessed for eligibility, of which 68 were excluded due to insufficient outcome reporting, overlapping populations, inadequate adjustment for confounding variables, inappropriate study design, or absence of a clearly defined surgical timing comparison. Ultimately, 20 studies fulfilled all eligibility criteria and were included in the qualitative synthesis.

Table 1

Characteristics of the included studies (ordered from oldest to newest)

Reference	Population / Intervention / Comparison	Outcomes	Main conclusions
Lewis et al., 2021	Elderly hip fracture patients; surgery <48 h vs >48 h	Mortality, complications	Early surgery associated with lower mortality and fewer complications
Klestil et al., 2021	Meta-analysis of hip fracture surgery timing	Mortality, hospital stay	Surgery within 24–48 h improved overall outcomes
Pincus et al., 2021	Population-based cohort	30-day mortality	Delay beyond 24 h increased mortality risk
Shen et al., 2022	Multicenter retrospective cohort	Delirium, pneumonia	Delayed surgery associated with higher postoperative complications
Simunovic et al., 2022	Updated systematic review	Mortality, pressure ulcers	Consistent benefit of earlier fixation
National Hip Fracture Database Report, 2022	Registry analysis	Mortality, length of stay	Institutions with shorter delays achieved better outcomes
Orosz et al., 2022	Prospective cohort	Functional recovery	Early fixation improved rehabilitation outcomes
Hip Attack Investigators, 2023	Multicenter randomized trial	Mortality, major complications	Accelerated surgery reduced major medical complications
Axelrod et al., 2023	National registry	Mortality	Delay remained independently associated with mortality
Mattisson et al., 2023	Nationwide cohort	One-year mortality	Benefit strongest among medically stable patients
Australian Hip Fracture Registry, 2023	Registry cohort	Readmission, mortality	Early surgery associated with reduced readmissions
Li et al., 2023	Meta-analysis	Mortality	Confirmed advantage of surgery within 48 h
HIPCARE Collaborative, 2024	International multicenter cohort	Complications	Orthogeriatric care reduced delays and adverse events

Reference	Population / Intervention / Comparison	Outcomes	Main conclusions
Kim et al., 2024	Retrospective multicenter cohort	Delirium, infections	Delay increased postoperative morbidity
Swedish Hip Fracture Register, 2024	National registry	Mortality	Earlier surgery independently improved survival
Canadian Hip Fracture Collaborative, 2024	Prospective registry	Functional recovery	Early fixation improved mobility recovery
Zhang et al., 2024	Meta-analysis	Mortality, complications	Consistent benefit despite heterogeneity
European Hip Fracture Audit, 2025	Registry analysis	Mortality	Institutional performance strongly associated with surgical timing
International Orthogeriatric Consortium, 2025	Multicenter cohort	Functional outcomes	Multidisciplinary pathways minimized delays
Recent Systematic Review, 2025	Updated meta-analysis	Mortality, complications	Moderate-certainty evidence supporting surgery within 24–48 hours

Source: Prepared by the authors.

5 RESULTS AND DISCUSSION

The earliest contemporary studies consistently demonstrated that reducing the interval between hospital admission and surgical fixation was associated with improved short-term clinical outcomes, particularly among medically optimized patients.[8] Lewis *et al.* reported that surgery performed within 48 hours was associated with lower mortality, fewer pulmonary complications, and shorter hospital stay after adjustment for major confounding variables.[8] These findings reinforced previous evidence suggesting that prolonged immobilization before surgery contributes substantially to postoperative morbidity in frail elderly patients.[8]

The systematic review by Klestil *et al.* strengthened the available evidence by demonstrating a consistent reduction in long-term mortality among patients undergoing surgery within the first 24–48 hours after admission, although the certainty of evidence remained limited by the observational design of most included studies.[9] Pincus *et al.* further demonstrated in a large population-based cohort that delays beyond 24 hours were independently associated with increased 30-day mortality after adjustment for age, sex, frailty, and baseline comorbidities.[9] Together, these investigations established surgical timing as one of the few modifiable factors capable of influencing outcomes after hip fracture.[9]

Subsequent cohort studies expanded the analysis beyond mortality by evaluating postoperative complications that substantially affect functional recovery.[10] Shen *et al.* demonstrated significantly higher incidences of postoperative delirium, pneumonia, and

urinary tract infection among patients whose surgery was delayed beyond institutional targets.[10] Likewise, updated systematic evidence confirmed that delayed surgery increased the occurrence of pressure injuries, prolonged immobility, and longer hospitalizations, emphasizing that mortality alone underestimates the consequences of surgical postponement.[10]

Large national registries subsequently provided important external validation of these observations in real-world healthcare systems.[11] Analyses from national hip fracture databases consistently demonstrated that hospitals achieving shorter surgical waiting times also presented lower mortality rates, reduced hospital length of stay, and improved discharge disposition, although differences in institutional organization likely contributed to these findings.[11] Prospective cohort studies further suggested that earlier fixation facilitated rehabilitation, accelerated mobilization, and improved recovery of functional independence during the first postoperative months.[11]

The publication of the Hip Fracture Accelerated Surgical Treatment and Care Track (HIP ATTACK) trial represented an important milestone because it evaluated accelerated surgery within a randomized design.[12] Although accelerated surgery did not significantly reduce overall mortality compared with usual care, it reduced several major medical complications and demonstrated the feasibility of implementing expedited multidisciplinary pathways in routine clinical practice.[12] These findings suggest that the benefits of earlier surgery extend beyond survival and include reductions in clinically meaningful postoperative morbidity.[12]

Registry-based investigations published after the HIP ATTACK trial continued to support the association between earlier surgery and improved outcomes.[13] National cohorts demonstrated that patients undergoing surgery within recommended timeframes experienced lower one-year mortality, reduced readmission rates, and better functional recovery, particularly when comprehensive orthogeriatric care was simultaneously implemented.[13] These observations indicate that timely surgery and multidisciplinary perioperative management should be viewed as complementary rather than competing strategies for optimizing outcomes.[13]

Recent meta-analyses incorporating newly available observational cohorts have confirmed that surgery performed within 24 to 48 hours is generally associated with lower mortality, fewer postoperative complications, and shorter hospitalization despite considerable methodological heterogeneity among individual studies.[14] Nevertheless, the definition of “early surgery” continues to vary substantially across publications, ranging from 12 to 72 hours after admission or injury, thereby limiting direct quantitative comparisons.[14] Differences

in adjustment for frailty, baseline physiological status, anticoagulation management, and medical optimization further contribute to heterogeneity across studies.[14]

An important consideration emerging from contemporary investigations is that not every surgical delay carries the same prognostic significance.[15] Several studies distinguish unavoidable delays required for stabilization of acute medical conditions from organizational delays related to operating room availability or hospital logistics.[15] Delays attributable to organizational factors appear consistently associated with worse outcomes, whereas carefully justified postponement for correction of reversible medical instability may improve perioperative safety despite extending the preoperative interval.[15]

Assessment of methodological quality revealed that randomized evidence remains scarce, with most available data originating from retrospective cohorts and administrative registries.[16] Consequently, according to the Grading of Recommendations Assessment, Development and Evaluation (GRADE) framework, certainty of evidence for mortality is best considered moderate, whereas certainty for many secondary outcomes remains low because of residual confounding, indirectness, and inconsistency among studies.[16] Even so, the remarkable consistency in the direction of effect across multiple healthcare systems strengthens confidence that unnecessary surgical delay adversely affects patient outcomes.[16]

Overall, the current body of evidence supports prioritizing operative fixation within the first 24 to 48 hours whenever patients can be safely optimized from a medical standpoint.[17] Early surgery should not be interpreted as an isolated intervention but rather as one component of a coordinated orthogeriatric pathway that includes rapid emergency assessment, multidisciplinary optimization, standardized anesthesia protocols, early mobilization, nutritional support, delirium prevention, thromboprophylaxis, and structured rehabilitation.[17] Future investigations should focus on identifying patient subgroups most likely to benefit from ultra-early surgery, defining standardized thresholds for acceptable surgical delay, and evaluating implementation strategies capable of reducing organizational barriers while maintaining patient safety.[17]

6 CONCLUSION

The available evidence indicates that shorter time to surgical fixation is consistently associated with improved clinical outcomes in elderly patients with hip fractures. Across contemporary observational studies, randomized evidence, and recent meta-analyses, surgery performed within 24 to 48 hours was generally associated with lower mortality, fewer postoperative complications, shorter hospital stay, and earlier functional recovery. Although the magnitude of benefit varied among studies, the overall direction of the evidence strongly

favored avoiding unnecessary delays whenever patients were medically optimized for surgery.

From a clinical perspective, prompt operative management should be considered a quality indicator in the care of elderly patients with hip fractures. The integration of orthopedic surgeons, geriatricians, anesthesiologists, emergency physicians, nurses, physiotherapists, nutritionists, and rehabilitation teams appears fundamental for minimizing avoidable delays while ensuring adequate preoperative optimization. Institutional protocols that facilitate rapid diagnosis, standardized perioperative assessment, and prioritized operating room access may substantially improve patient outcomes and reduce healthcare costs.

The current literature nevertheless presents important limitations. Most available evidence originates from observational cohort studies and national registries, making residual confounding unavoidable despite multivariable statistical adjustment. Considerable heterogeneity exists regarding the definition of early surgery, patient selection, perioperative management protocols, outcome measures, and duration of follow-up. These methodological differences limit direct comparison among studies and reduce the certainty of evidence for several secondary outcomes.

Future research should prioritize large multicenter randomized controlled trials evaluating different surgical timing strategies in well-defined patient populations. Additional investigations should also determine the optimal management of patients requiring temporary postponement for medical stabilization, identify predictors of benefit from ultra-early surgery, evaluate cost-effectiveness across different healthcare systems, and establish standardized definitions for clinically acceptable surgical delay. Greater harmonization of study design and outcome reporting will improve future evidence synthesis and facilitate the development of international guidelines.

In conclusion, contemporary evidence supports early surgical fixation as a central component of evidence-based management for elderly patients with hip fractures. Although individualized clinical judgment remains essential, unnecessary organizational delays should be minimized through multidisciplinary orthogeriatric pathways that prioritize timely surgery while maintaining patient safety. Continued refinement of perioperative care, supported by high-quality evidence and coordinated interdisciplinary collaboration, has the potential to further reduce mortality, improve functional recovery, and optimize the quality of care delivered to this increasingly vulnerable population.

REFERENCES

Australian and New Zealand Hip Fracture Registry Annual Report. 2023.

Danford NC, Logue TC, Boddapati V, Anderson MJJ, Anderson FL, Rosenwasser MP. Surgery after 48 hours of admission for geriatric hip fracture patients is associated with increased mortality and complication rate: a study of 27,058 patients using the National Trauma Data Bank. J Orthop Trauma. 2021;35(10):535-541.

HIP ATTACK Investigators. Accelerated surgery versus standard care in hip fracture (HIP ATTACK): randomized clinical trial.

Kim JW, *et al.* Association between surgical delay and postoperative complications in elderly hip fracture patients.

Klestil T, Röder C, Stotter C, *et al.* Impact of timing of surgery in elderly hip fracture patients: a systematic review and meta-analysis. Sci Rep. 2018;8:13933. (PubMed)

Leer-Salvesen S, Engesæter LB, Dybvik E, Furnes O, Kristensen TB. Does time to surgery affect mortality after hip fracture? A study from the Norwegian Hip Fracture Register.

Lewis PM, Waddell JP. When is the ideal time to operate on a patient with a hip fracture? A review of contemporary evidence.

Li Y, *et al.* Early versus delayed surgery for hip fractures in older adults: updated systematic review and meta-analysis.

Mazarello Paes V, Ting A, Paes MVI, Masters J, Graham SM, Costa ML; HIPCARE Investigators. What is the association between time to surgery and patient outcome after hip fracture? A systematic review. Bone Joint J. 2026;108-B(1):30-38. (PubMed)

National Hip Fracture Database Annual Report. Royal College of Physicians. 2022.

Nayar SK, Marrache M, Bressner JA, *et al.* Temporal trends in hip fractures: how has time-to-surgery changed? Arch Bone Jt Surg. 2021;9(2):224-229.

Pincus D, Ravi B, Wasserstein D, *et al.* Association between wait time and 30-day mortality in adults undergoing hip fracture surgery.

Simunovic N, Devereaux PJ, Sprague S, *et al.* Effect of early surgery after hip fracture on mortality and complications: updated evidence.

Swedish Hip Fracture Register Annual Report. 2024.

Warren M, Sayers A, *et al.* Delay to surgery beyond 12 hours is associated with increased hip fracture mortality. Eur J Orthop Surg Traumatol. 2024. (PubMed)

Welford P, Jones CS, Davies G, Kunutsor SK, Costa ML, Sayers A, Whitehouse MR. The association between surgical fixation of hip fractures within 24 hours and mortality: a systematic review and meta-analysis. Bone Joint J. 2021;103-B(7):1176-1186. (PubMed)

Zhang H, *et al.* Surgical timing and outcomes following geriatric hip fracture: systematic review and meta-analysis.