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Review article

ORTHOPEDIC SURGERY IN THE AGING POPULATION: CHALLENGES AND FUTURE DIRECTIONS

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ABSTRACT: The rapid aging of the global population has led to a substantial rise in the demand for orthopedic surgery among elderly patients, particularly for hip, knee, and shoulder arthroplasty. However, age-related physiological decline, comorbidities, and frailty increase the risk of complications and present unique clinical challenges. This review aims to summarize current evidence regarding indications, risks, and evolving strategies in orthopedic surgery for patients aged ≥65 years; We conducted a focused narrative review of the literature published between 2015 and 2025 using PubMed, Scopus, and Google Scholar. Search terms included "orthopedic surgery," "geriatric patients," "frailty," "osteoporosis," "arthroplasty," "comprehensive geriatric assessment," and "enhanced recovery after surgery (ERAS)". Priority was given to original studies, systematic reviews, meta-analyses, and international guidelines relevant to orthogeriatric care; Evidence synthesis indicates that while elderly patients face higher rates of perioperative complications, successful orthopedic surgery can substantially improve functional recovery and quality of life. Key risk factors include osteoporosis, malnutrition, and frailty, which correlate with delayed healing and increased morbidity. Strategies such as prehabilitation, Comprehensive geriatric assessment, and ERAS protocols have demonstrated effectiveness in reducing hospital stays, lowering complication rates, and enhancing postoperative outcomes; Orthopedic surgery in the aging population offers both opportunities and challenges. Optimal outcomes require a multidisciplinary approach, preoperative optimization, and the integration of evidence-based perioperative strategies. Wider adoption of orthogeriatric care models may improve both safety and sustainability of orthopedic interventions in elderly patients.

Keywords: Orthopedic surgery; Elderly patients; Aging population; Comprehensive geriatric assessment; Enhanced recovery after surgery – ERAS

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1. INTRODUCTION

The rapid aging of the population has significantly driven the increasing demand for orthopedic surgery, particularly hip and knee arthroplasty, among the elderly. This trend simultaneously poses distinctive challenges due to coexisting conditions such as osteoporosis, malnutrition, sarcopenia, and frailty, factors known to elevate postoperative complication risk. Multiple studies have demonstrated that patients aged 80 years and older undergoing total knee arthroplasty exhibit significantly higher rates of surgical and medical complications, as well as 90-day mortality, compared to younger cohorts [1]. However, quality of life and functional recovery postoperatively, especially after total hip arthroplasty, can be comparable to younger patients, indicating the potential benefits of surgery when appropriately managed [2].

Review reports further highlight that older patients experience longer hospital stays and increased risks of cardiovascular events, deep vein thrombosis, and respiratory complications. However, outcomes vary depending on their underlying health status [1],[3]. The concept of "frailty", characterized by muscle loss, bone density decline, and nutritional deficits, is a critical preoperative risk indicator in geriatric orthopedic patients. Yet, its clinical application remains limited in many settings [4],[5].

Notably, prehabilitation interventions such as strength training, nutritional optimization, and preoperative conditioning have demonstrated efficacy in reducing hospital stay durations and improving short-term functional outcomes in elderly patients undergoing orthopedic surgery [6],[7]. Additionally, the implementation of Comprehensive Geriatric Assessment (CGA) pre- and postoperatively has helped identify high-risk patients, enabling multidisciplinary care coordination to reduce postoperative complications and mortality [8].

In this context, the present review aims to consolidate updated evidence from 2015 to the present regarding the growing demand for orthopedic surgery among the elderly, factors affecting surgical and quality-of-life outcomes, and interventional strategies such as prehabilitation and CGA to optimize long-term results in this patient population. The objective is to provide an evidence-based, holistic perspective to support the development of integrated orthogeriatric care models, ultimately enhancing treatment effectiveness and life quality in older adults.

2. MATERIALS AND METHODS

This article is framed as a current concept review, focusing on the synthesis and analysis of up-to-date evidence on orthopedic surgery in the context of an aging population. We conducted a targeted literature search in PubMed, Scopus, and Google Scholar for the period 2015–2025, using the core terms: "orthopedic surgery," "geriatric patients," "frailty," "osteoporosis," "arthroplasty," "comprehensive geriatric assessment," and "enhanced recovery after surgery (ERAS)". Priority was given to original studies, reviews, meta-analyses, and position statements/guidelines issued by international societies.

Selected sources were organized around three thematic domains: (1) characteristics and risk factors in elderly patients undergoing orthopedic surgery; (2) outcomes and complications of common procedures such as total hip arthroplasty, total knee arthroplasty, and fixation of osteoporotic fractures; and (3) advances in perioperative care strategies, including prehabilitation, CGA, and ERAS.

We employed a descriptive, analytic approach (narrative synthesis) to integrate the evidence, highlighting areas of concordance and divergence as well as remaining knowledge gaps.

3. DISCUSSION

Population aging has driven a marked increase in demand for orthopedic surgery, particularly arthroplasty and the management of osteoporotic fractures. Alongside functional gains is a substantial complication burden attributable to multimorbidity, diminished physiological reserve, osteoporosis, malnutrition, sarcopenia, and, notably, frailty. Recent evidence indicates that integrated orthogeriatric care models reduce mortality, delirium, and length of stay in patients with femoral neck fractures, underscoring the need to reorganize care pathways toward multidisciplinary co-management and perioperative optimization [9]. The discussion below focuses on three axes: (1) characteristics and risk factors in elderly patients undergoing orthopedic surgery; (2) outcomes and complications of common procedures such as total hip arthroplasty (THA), total knee arthroplasty (TKA), and fixation of osteoporotic fractures; and (3) advances in perioperative care strategies, including prehabilitation, CGA, and ERAS.

3.1. Characteristics and risk factors in elderly patients undergoing orthopedic surgery

3.1.1. Frailty and risk stratification tools

Multiple meta-analyses demonstrate that frailty is an independent predictor of postoperative complications in orthopedic surgery, including infection and early mortality [10],[11]; The 5-factor Modified Frailty Index (mFI-5) and the expanded mFI have been validated in large arthroplasty datasets, predicting major complications, readmission, and 30-day mortality. Implementing concise instruments such as the mFI-5 facilitates early identification of high-risk patients for targeted interventions (nutritional optimization, glycemic control, smoking cessation, correction of anemia, etc.) [12]. Contemporary data show that mFI-5 remains useful across diverse clinical settings (hemiarthroplasty/THA for femoral neck fractures, primary THA), including resource-limited environments, supporting the generalizability of this tool [13].

3.1.2. Sarcopenia and malnutrition

Sarcopenia is closely associated with inferior outcomes after TKA/THA: higher surgical complication rates, prolonged length of stay, greater costs, and lower patient satisfaction; sarcopenia and "sarcopenic obesity" also delay range-of-motion recovery after TKA. Accordingly, preoperative screening and combined nutrition–exercise interventions are pivotal[14],[15]. Recent meta-analytic evidence additionally shows a substantial prevalence of sarcopenia among patients undergoing total joint arthroplasty (TJA) and associations with urinary tract infection, transfusion, pneumonia, and prosthetic loosening, highlighting the importance of musculoskeletal assessment before surgery [16].

3.1.3. Osteoporosis, bone quality, and union

Osteoporosis increases mechanical complications after spine surgery (e.g., proximal junctional kyphosis, proximal junctional failure, screw loosening, reoperation) and is generally linked to poorer outcomes across orthopedic procedures; perioperative bone-health optimization is therefore fundamental [17]. Osteoporosis guidelines emphasize the persistent "treatment gap" and the benefits of antiresorptives and PTH analogs for preventing subsequent fractures, measures that should be integrated into postoperative care pathways [18].

3.1.4. Preoperative anemia and blood loss

Preoperative anemia is common (~22% in TJA) and is associated with higher transfusion rates, longer hospitalization, readmission, and complications; systematic optimization of hemoglobin prior to surgery is essential [19]. Conversely, intravenous or topical tranexamic acid (TXA) consistently reduces blood loss and transfusion requirements in THA/TKA, including in older adults [20],[21].

3.2. Outcomes and complications of common procedures such as total hip arthroplasty, total knee arthroplasty, and fixation of osteoporotic fractures

3.2.1. Arthroplasty in patients ≥80 years

Functional benefits can approximate those in younger cohorts when appropriate patient selection and meticulous perioperative care are ensured. A large cohort study of THA in patients ≥80 years reported complication rates and patient-reported outcomes (PROs) comparable to those of patients <80 years within optimized care systems [22]. For TKA, multiple studies demonstrate substantial postoperative functional gains even in patients ≥80 years, albeit with greater resource utilization (longer length of stay and higher discharge rates to rehabilitation facilities) [23]. A systematic review on the "optimal age" for TKA suggests the most favorable PROMs in the 70–80 age bracket; however, older patients still achieve clinically meaningful improvements, supporting the principle that chronological age alone should not be a barrier to indication [24].

3.2.2. Geriatric-specific complications

Older adults are at increased risk of postoperative delirium (POD), cardiovascular events, deep-vein thrombosis, and infection. Regarding POD, contemporary evidence indicates that orthogeriatric co-management reduces the incidence of delirium/subsyndromal delirium. In contrast, anesthetic technique (regional vs general) does not meaningfully reduce POD in a large multicenter randomized trial [25],[26]. A review also associates POD with prolonged hospitalization and higher 30-day mortality, underscoring the need for multimodal prevention (minimizing sedatives, multimodal analgesia, early mobilization, avoidance of anemia/hypoxemia) [27].

3.2.3. Time to surgery for femoral neck/hip fracture

Most large meta-analyses support surgery within 24–48 hours to reduce perioperative complications and mortality. Recent evidence shows clear benefit when surgery is completed within 48 hours; comparisons of "<24 hours" versus "24–48 hours" may not differ in mortality, but earlier surgery shortens length of stay and reduces early adverse events. The practical message is to prioritize medical optimization and proceed to surgery within 48 hours when safe [28],[29].

3.2.4. Standardizing care pathways: ERAS in arthroplasty

The ERAS recommendations for THA/TKA established a framework for multimodal optimization (multimodal analgesia, fluid management, early mobilization, standardized discharge criteria). Subsequent studies corroborate reductions in length of stay and complications with ERAS implementation in TKA/THA [30],[31].

3.3. Advances in perioperative care strategies, including prehabilitation, CGA, and ERAS

3.3.1. Orthogeriatric co-management / CGA

A randomized trial published in The Lancet demonstrated that CGA for patients with femoral neck fractures improves mobility and several functional outcomes compared with standard orthopedic care; recent systematic reviews/meta-analyses further confirm that orthogeriatric models reduce in-hospital mortality, 1-year mortality, delirium, and length of stay. These findings reinforce the leading role of geriatrics within the care pathway for older trauma patients [9],[32].

3.3.2. Prehabilitation before TKA/THA

Evidence from meta-analyses of RCTs and interventional studies indicates that prehabilitation (strength–balance training, patient education, nutritional optimization) increases muscle strength, improves some early postoperative functional endpoints, and may shorten length of stay in selected populations; home-based programs are highly feasible for older adults. Although effects are not uniformly consistent across all metrics (e.g., length of stay), this approach is safe, low-cost, and aligns well with ERAS principles [33],[34].

3.3.3. ERAS: evidence-based perioperative optimization

Beyond reducing length of stay, recent reviews of ERAS in TKA/THA report trends toward fewer complications and accelerated early recovery, particularly when bundles incorporate goal-directed fluid management, multimodal analgesia, opioid-sparing strategies, and early mobilization. Standardizing ERAS bundles is pivotal for scalable implementation in resource-constrained settings [35],[36].

3.3.4. Secondary fracture prevention: Fracture Liaison Service (FLS)

The post-fracture osteoporosis "treatment gap" remains substantial, perpetuating cycles of refracture and excess mortality. FLS programs—systematically identifying, assessing, treating, and following patients after a fragility fracture—have demonstrated reductions in secondary fracture risk (RR ≈ 0.68 at ≥2 years) and improved care metrics (greater DXA uptake, higher antiresorptive use); several studies also report lower mortality compared with hospitals lacking FLS. Implementing FLS after orthopedic interventions (particularly hip-fracture surgery) is a cornerstone strategy to shift from "fixing the break" to "treating bone disease" [37],[38].

3.3.5. Points of debate and knowledge gaps

First, ultra-early surgery (<24 hours) versus "24–48 hours" shows mixed evidence regarding long-term mortality; a pragmatic priority is to ensure surgery within 48 hours following medical optimization, rather than pursuing <24 hours "at all costs" [39]. Second, delirium prevention: multimodal measures and geriatric co-management are beneficial, but anesthetic technique (regional vs general) appears not to meaningfully alter POD risk, directing attention instead to optimized analgesia, sedation minimization, correction of anemia/hypoxemia, and early mobilization [27]. Third, while prehabilitation improves strength and some early outcomes, consistent effects on length of stay/costs require additional multicenter RCTs—particularly in low- and middle-income countries where home-based rehabilitation infrastructure may be limited [33]. Fourth, for FLS, despite supportive syntheses showing reduced refracture and improved treatment adherence, methodological quality varies; scaling FLS should proceed alongside quality assurance and pragmatic trials to tailor the model to individual health-system contexts [40].

3.4. Limitations

This current concept review has several limitations. First, the search was restricted to studies published between 2015 and 2025, which may have resulted in the omission of relevant earlier literature. Second, by design, a current concept review is descriptive and narrative rather than quantitative; we did not conduct meta-analytic pooling or a systematic appraisal of evidence quality, so the findings should be interpreted as directional guidance rather than definitive conclusions. Finally, heterogeneity in healthcare systems across countries may limit the generalizability of these observations to clinical practice in Vietnam.

4. CONCLUSION

Orthopedic surgery in the context of an aging population represents both an opportunity and a challenge. While elderly patients are at higher risk of perioperative complications due to frailty, sarcopenia, osteoporosis, and multiple comorbidities, growing evidence demonstrates that procedures such as total hip and knee arthroplasty can still yield substantial functional recovery and quality-of-life benefits when patients are appropriately selected and perioperative care is optimized. Strategies including Comprehensive Geriatric Assessment, structured prehabilitation, and Enhanced Recovery After Surgery protocols are pivotal to improving outcomes and minimizing risks. In addition, secondary fracture prevention through Fracture Liaison Services is essential to reduce refracture rates and long-term mortality. Moving forward, multidisciplinary orthogeriatric care models should be more widely implemented to ensure safe, effective, and sustainable surgical management for the elderly population.

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