Saudi Journal of Medicine and Public Health

https://saudijmph.com/index.php/pub

https://doi.org/10.64483/202412674

The Symphony of Recovery: A Narrative Review of the Interdisciplinary Perioperative Pathway for Major Joint Arthroplasty

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Abstract

Background: Total hip and knee arthroplasty (THA/TKA) are highly successful yet resource-intensive procedures, with outcomes deeply influenced by the coordination of care across the entire perioperative continuum. Siloed approaches can lead to delays, complications, and suboptimal patient experiences. **Aim:** This narrative review aims to synthesize evidence on optimizing the interdisciplinary workflow for major joint replacement, from pre-habilitation through to post-operative imaging, by examining the specific and integrated roles of physiotherapy, nursing, operating room technicians, anesthesia technology, and medical imaging. **Methods:** A comprehensive literature search was conducted in PubMed, CINAHL, Scopus, and Cochrane Library databases (2010-2024). **Results:** The review identifies optimal practices at each phase: structured pre-hab improves strength and outcomes; nurse-led education and standardized order sets enhance preparedness; OR technician efficiency and instrument standardization reduce surgical time; regional anesthesia with technology-managed catheters optimizes pain control and mobility; and protocol-driven imaging ensures accurate placement without delays. Success hinges on shared protocols, continuous communication, and data feedback loops between all disciplines. **Conclusion:** The arthroplasty pathway is an interdependent sequence where each discipline's performance directly impacts the next. Optimizing workflow requires a systems-based, interdisciplinary approach embedded within an Enhanced Recovery After Surgery (ERAS) framework. Institutional commitment to integrated care pathways, supported by ongoing team training and audit, is essential for achieving superior clinical and operational outcomes.

Keywords: Perioperative Pathway; Joint Arthroplasty; Interdisciplinary Care; Enhanced Recovery After Surgery; Workflow Optimization.

Introduction

Total hip and knee arthroplasty (THA/TKA) ranks among the most successful and cost-effective interventions in modern medicine, reliably alleviating pain and restoring function for end-stage osteoarthritis (Price et al., 2018). With aging populations and rising obesity rates, the volume of these procedures continues to climb globally, placing unprecedented demands on healthcare systems (Kurtz et al., 2007). This surge has catalyzed a paradigm shift from viewing arthroplasty as a standalone surgical event to conceptualizing it as a longitudinal, multidisciplinary pathway where coordination directly dictates efficiency, cost, and—most critically—patient outcomes (Ahn et al., 2019). Isolated excellence in the operating theatre is insufficient if pre-operative optimization is lacking or post-operative rehabilitation is fragmented. Consequently, structured perioperative pathways, most notably within Enhanced Recovery After Surgery (ERAS) protocols, have emerged as the standard of care, demonstrating significant reductions in length of stay (LOS), complications, and readmission rates (Wainwright et al., 2020).

This narrative review contends that the full potential of these pathways is only realized through the deliberate integration of five core allied health and

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Receive Date: 22 December 2024, Revise Date: 30 December 2024, Accept Date: 31 December 2024

technological
disciplines: Physiotherapy, Nursing, Operating Room (OR) Technicians, Anesthesia Technology, and Medical Imaging. Each possesses unique expertise that governs a critical phase of the patient journey. The physiotherapist's pre-habilitation lays the physiological foundation; the nurse coordinates education and navigates care transitions; the OR technician's mastery of complex instrumentation enables surgical precision; the anesthesia technologist's management of advanced regional pain blocks facilitates early mobilization; and the imaging technologist's work confirms technical success and monitors recovery. This review synthesizes contemporary evidence to map the optimized workflow from "pre-hab to post-op imaging," arguing that seamless interdisciplinary handoffs and shared mental models are the true engines of enhanced recovery. Examining each role in sequence and their points of intersection, it provides a blueprint for healthcare institutions seeking to refine their arthroplasty pathways for superior clinical and operational performance.

Foundation for Success - The Critical Role of Pre-Habilitation and Nursing Assessment

The pathway begins weeks before the patient enters the hospital, in the pre-habilitation phase. This period is dedicated to optimizing the patient's physiological and psychological readiness for surgery, a concept strongly supported within ERAS principles (Krysa et al., 2022). Physiotherapy leads this charge, shifting from a purely post-operative focus to a proactive model. Structured pre-hab programs typically involve strength training (focusing on quadriceps, gluteal, and core stability), gait training, and education on post-operative mobility aids and exercises (Gränicher et al., 2020). Evidence consistently shows that even short-term pre-hab improves pre-operative function, reduces post-operative pain, accelerates functional recovery, and may shorten LOS, particularly for patients with significant baseline deconditioning (Anderson et al., 2022). The physiotherapist also conducts a baseline functional assessment, creating a benchmark against which post-operative progress is measured.

Concurrently, nursing engages in comprehensive pre-operative assessment and education, often through dedicated "joint school" or pre-admission clinics. This nursing role is multifaceted: conducting medical co-morbidity reviews (e.g., optimizing diabetes, managing anticoagulation), performing nutritional screening, and initiating patient education (See et al., 2018). Education covers the surgical process, pain management expectations, infection prevention protocols (MRSA decolonization), and detailed instructions for the day of surgery. Crucially, nurses set realistic expectations, which is a powerful determinant of post-operative satisfaction (Waljee et al., 2014). This pre-operative nursing contact also establishes a therapeutic relationship that supports the patient through the ensuing hospital stay. The physiotherapist and nurse must communicate to ensure the patient receives a consistent, reinforced message about the importance of early mobilization and active participation in their recovery, creating a unified front from the outset (Hafkamp et al., 2020).

The Orchestrated Efficiency of the Operating Room

On the day of surgery, the patient enters the domain of highly specialized technical teams. Operating Room Technicians (also known as Surgical Technologists or Scrub Nurses) are the custodians of surgical efficiency and precision in arthroplasty. Their role extends far beyond passing instruments; it involves meticulous preparation and management of highly specialized, often vendor-specific, arthroplasty sets. This includes ensuring the availability, sterility, and correct assembly of precision instruments for bone cutting, trialing, and implant insertion (Feng et al., 2018). A proficient OR technician anticipates the surgical sequence, significantly reducing non-operative time—a key factor in minimizing infection risk and improving theatre turnover (Zachwieja et al., 2020). They also collaborate with the surgical team on patient positioning, applying specialized positioning aids (e.g., lateral positioners for THA, leg holders for TKA) that must secure the patient for a lengthy procedure while protecting against nerve injuries and pressure sores (Rutherford et al., 2018).

Simultaneously, the Anesthesia Technology team prepares for a paradigm centered on multimodal, opioid-sparing analgesia to facilitate ERAS. The cornerstone is regional anesthesia, typically a spinal-epidural or peripheral nerve block (e.g., femoral, adductor canal, lumbar plexus). The anesthesia technologist or anesthetist is responsible for setting up and managing sophisticated technology: ultrasound machines for precise needle guidance, nerve stimulators, and continuous peripheral nerve block catheters connected to portable infusion pumps (Ilfeld & Grant, 2016). The technologist ensures these devices are functioning correctly, educates the patient on pump use, and is often part of the acute pain service managing post-operative settings. This technology-enabled analgesia provides superior pain control with fewer systemic side effects like nausea and sedation, which is the single most important factor enabling early physiotherapy (Wang et al., 2017). The OR technician and anesthesia team must coordinate closely regarding patient positioning to ensure safe block administration and proper padding of anesthetized limbs.

Immediate Post-Operative Care - Mobilizing the Nexus of Nursing and Physiotherapy

The immediate post-operative period, spanning the Post-Anesthesia Care Unit (PACU) and the first 24-72 hours on the ward, is where recovery momentum is either gained or lost. Nursing care here

is intensive and protocol-driven. Priorities include monitoring for surgical complications (neurovascular status, bleeding), managing multimodal analgesia (often involving the anesthesia-managed nerve catheter pump, scheduled NSAIDs, and acetaminophen), preventing post-operative nausea and vomiting (PONV), and initiating venous thromboembolism (VTE) prophylaxis (Zhang & Xiao, 2020). Nurse-driven analgesia protocols, with clear parameters for administering rescue medications, are essential for consistent pain control (Frödin et al., 2022).

Crucially, the nurse creates the logistical and clinical conditions for early mobilization, which is the most potent intervention for preventing complications like pneumonia, ileus, and deconditioning. This is where seamless integration with physiotherapy is paramount. Under ERAS protocols, physiotherapy assessment and first mobilization often occur on the day of surgery or the first post-operative morning (Berger et al., 2023). The nurse ensures the patient is medicated for pain, has orthostatic vital signs monitored, and is assisted with transfers. The physiotherapist then conducts the session, focusing on safe bed mobility, transfers, gait training with appropriate aids, and reinforcing home exercise programs (Buller et al., 2021). This collaboration requires constant communication; the nurse informs the physiotherapist of the patient's pain scores and endurance, while the physiotherapist updates the nurse on mobility progress and any concerns. This dyad is the engine of early recovery, directly influencing a patient's confidence and functional progression (Wu et al., 2021).

Confirmation and Surveillance - The Role of Medical Imaging

Medical Imaging serves as the objective quality assurance mechanism throughout the pathway, providing critical data at three distinct points (Table 1). Pre-operatively, standardized weight-bearing radiographs (AP and lateral views of the knee/hip) are essential for surgical planning. The Radiologic Technologist must obtain images with precise positioning and labeling to allow the surgeon to accurately template implant size and positioning using digital or physical overlays (Vigdorchik et al., 2021). Intraoperatively, fluoroscopy is frequently employed, especially in complex primary or revision cases, and for confirming component positioning and leg length equality in THA. The imaging technologist in the hybrid OR must work in a sterile fashion, maneuvering the C-arm efficiently to minimize radiation exposure and surgical disruption while capturing the crucial images requested by the surgeon (Van Papendorp et al., 2023).

Post-operatively, routine imaging confirms final implant position, assesses for periprosthetic fractures, and establishes a new baseline for future comparison. Technologists must adapt techniques to patients with limited mobility and pain, often using portable X-ray units at the bedside. The clarity and accuracy of these images are vital for the surgical team's early post-op assessment and for the physiotherapist to understand any specific mobility restrictions (e.g., hip precautions based on component orientation) (Heckmann et al., 2023). Furthermore, in cases of suspected complications like instability or infection, advanced imaging (CT, MRI with metal artifact reduction sequences, or nuclear medicine scans) plays a diagnostic role, requiring close collaboration between surgeons, radiologists, and technologists to tailor protocols for optimal diagnostic yield (Plodkowski et al., 2013). Figure 1 illustrates the optimized perioperative pathway for total hip and total knee arthroplasty within an Enhanced Recovery After Surgery (ERAS) framework.

Table 1: The Interdisciplinary Perioperative Pathway for Joint Arthroplasty

Phase	Key Disciplines	Primary Objectives & Actions	Critical Interdisciplinary Handoffs
Pre-Habilitation & Education (Weeks Pre-Op)	**Physiotherapy, Nursing**	Optimize physical function; educate on process & expectations; screen/optimize medical status.	PT communicates baseline function to team. Nursing shares medical & educational data with inpatient team.
Intraoperative (Day of Surgery)	**OR Technician, Anesthesia Technology, Medical Imaging**	Precise, efficient surgery; establish optimal opioid-sparing analgesia; confirm implant placement.	Anesthesia reports block details to PACU nurse. OR Tech communicates implant details/peculiarities to ward.
Acute Recovery (PACU & Post-Op Days 1-3)	**Nursing, Physiotherapy**	Manage pain & complications; initiate early mobilization; prepare for discharge.	Nurse reports pain status & readiness to PT. PT communicates mobility progress & goals to nursing team.
Post-Operative Confirmation & Surveillance (Post-Op & Beyond)	**Medical Imaging, Surgical Team**	Confirm technical success; establish baseline; diagnose complications.	Imaging provides objective data to surgeon to guide therapy restrictions (PT) and inform future care.

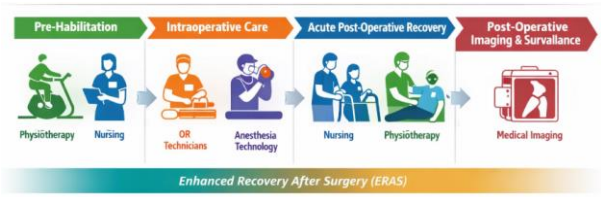

Figure 1: The Interdisciplinary Perioperative Pathway for Major Joint Arthroplasty (THA/TKA)

ERAS Protocols as the Unifying Framework

The coordination of these distinct phases and disciplines is best achieved through formalized Enhanced Recovery After Surgery (ERAS) protocols. These are evidence-based, multidisciplinary bundles of care processes designed to attenuate the surgical stress response and accelerate recovery (Melnyk et al., 2011). For arthroplasty, key ERAS elements directly involve all five disciplines: pre-hab and education, multimodal pain management with regional blocks, standardized surgical protocols and tranexamic acid use, avoidance of routine drains and catheters, and early feeding and mobilization (Soffin & YaDeau, 2016).

The successful implementation of ERAS is a systems-engineering challenge. It requires the development of shared protocols (e.g., standard order sets for analgesia, VTE prophylaxis, and mobilization), interdisciplinary education, and regular audit of compliance and outcomes (Ljungqvist, 2019). Data feedback loops are essential; for instance, tracking time-to-first-mobilization or pain scores can identify bottlenecks, prompting re-education of nursing or anesthesia staff. Technology, such as integrated electronic health records with ERAS pathway modules, can prompt adherence and facilitate communication (Thiele & Friedman, 2020). The pathway's success is ultimately measured by a composite of outcomes: reduced LOS and complications, improved patient-reported outcome measures (PROMs) like the HOOS/KOOS scores, and high patient satisfaction—all of which are demonstrably improved by well-implemented ERAS programs (Changjun et al., 2023).

Challenges, Barriers, and Strategies for Implementation

The transition from a theoretical, evidence-based pathway to a consistently implemented, high-reliability clinical practice is fraught with systemic and human factor challenges (Table 2). Despite the robust evidence supporting Enhanced Recovery After Surgery (ERAS) protocols and interdisciplinary integration, widespread implementation encounters significant resistance (Özçelik, 2024). A primary and pervasive barrier is the persistence of professional silos and entrenched hierarchical structures within healthcare. These traditional divisions can stifle the open, flattened communication essential for protocol adherence and rapid problem-solving, as team members may be reluctant to speak up or challenge established practices (Kehlet & Memtsoudis, 2020). Furthermore, tangible resource constraints directly impede equitable care delivery; limited availability of physiotherapists to conduct comprehensive pre-habilitation or a shortage of anesthesia providers skilled in regional block techniques creates access disparities and pathway fragmentation (Grosu et al., 2014). Perhaps most disruptive to standardization is individual practitioner variability. Even within a single institution, lack of consensus—such as one surgeon insisting on surgical drains while another forbids them—creates confusion in nursing protocols, undermines collective adherence, and weakens the pathway's integrity (Drew et al., 2019).

To navigate these formidable barriers, a multifaceted, strategic approach is required. The foundational strategy is the establishment of an interdisciplinary steering committee comprising representatives from all core disciplines—physiotherapy, nursing, operating room technology, anesthesia technology, medical imaging—as well as surgeons and hospital administration. This committee is tasked with co-designing the pathway, which fosters a sense of shared ownership and ensures each discipline's practical concerns are addressed from the outset, thereby increasing buy-in and reducing top-down resistance (Kehlet & Memtsoudis, 2020). To build the non-technical skills necessary for pathway success, such as communication, situation awareness, and role clarity, simulation and team training are invaluable. Conducting in-situ simulations of high-stakes, pathway-specific scenarios (e.g., managing a hypotensive patient with a dense regional block) allows teams to practice in a psychologically safe environment, forging shared mental models and improving collaborative performance before real-world application (Gros et al., 2021).

Sustaining change requires robust audit and feedback mechanisms paired with clinical champions. Regularly collecting and transparently sharing key performance metrics (e.g., rates of day-of-surgery mobilization, nerve block success, patient-reported pain scores) provides objective data on progress (van Eijck et al., 2023). Appointing respected clinical champions within each discipline to advocate, mentor peers, and troubleshoot issues ensures that the pathway remains a living, supported process rather than a forgotten policy document (Wainwright, 2021). Finally, leveraging technology to enhance patient engagement transforms the patient from a passive recipient to an active partner. Digital platforms that deliver pre-habilitation exercise programs, educational content, and post-operative patient-reported outcome measure (PROM) surveys empower patients, improve adherence, and provide valuable

real-time feedback to the care team, closing the loop on pathway effectiveness (Gonçalves et al., 2023).

Table 2: Key Outcome Metrics for an Optimized Arthroplasty Pathway

Metric Category	Specific Metrics	Primary Influencing Disciplines
Clinical Outcomes	30/90-day complication rates (SSI, VTE, readmission); Patient-Reported Outcome Measures (HOOS/KOOS, PROMIS); Incidence of severe post-op pain.	Nursing, Physiotherapy, Anesthesia, Surgery
Process Efficiency	Length of Stay (LOS); Time to first mobilization; Operating Room turnover time; On-time surgery starts.	OR Tech, Nursing, Physiotherapy, Administration
Patient Experience	Satisfaction scores (e.g., HCAHPS); Achievement of discharge goals; Readiness for discharge.	Nursing, Physiotherapy, All (Communication)
Economic Outcomes	Direct cost per case; Implant & supply cost variance; Rate of discharge to home vs. rehab.	OR Tech (supply chain), Nursing/PT (disposition planning)

Conclusion and Future Directions

The journey of a patient undergoing major joint replacement is a profound testament to the power of interdisciplinary collaboration. This review has charted the optimized workflow, demonstrating that exceptional outcomes are not the product of any single intervention but the symphony of coordinated efforts from pre-habilitation to post-operative surveillance. The physiotherapist builds resilience, the nurse guides and safeguards, the OR technician enables precision, the anesthesia technologist blocks pain to enable movement, and the imaging technologist provides the map and the verification. When these roles are integrated within an ERAS framework, guided by shared protocols and continuous communication, the result is a superior pathway: safer, faster, more satisfying, and more cost-effective.

The future of arthroplasty pathways lies in further personalization and technological integration. Predictive analytics using pre-operative data could tailor pre-hab and discharge planning. Wider adoption of robotic-assisted surgery, requiring new competencies from OR techs and imaging, may enhance precision. Digital health platforms will deepen patient engagement from home. However, these advances will only magnify, not replace, the need for strong interdisciplinary foundations. Investing in the training, integration, and mutual respect of these five core disciplines remains the most critical step for any institution committed to excellence in joint arthroplasty care. The pathway to recovery is a team sport, and its optimization is the ultimate marker of a mature and patient-centered surgical service.

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