

**Review Article**

# Outpatient Surgery in Total Hip and Knee Athroplasty - A Review Article

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**Introduction**

Enhanced recovery after surgery, or rapid recovery after surgery, is a concept that was first described in the context of colorectal surgeries in the late 1990s, which adopted a multifaceted approach to the implementation of fast-track recovery protocols. These protocols accelerate recovery and reduce time in hospital in the hospital creating a smoother and more efficient process for the patient and hospital. [1] These protocols were recognized by orthopaedic surgeons as useful in total joint arthroplasty and have been widely and quickly assimilated. The main goals are to enhance recovery and reduce morbidity, and secondarily to reduce length of stay, convalescence, and costs. [2] Today, numerous institutions have implemented rapid recovery protocols for common elective orthopedic procedures such as hip and knee arthroplasty. A successful rapid recovery program encompasses many aspects. Firstly, a thorough standardized pre-operative assessment of risk factors and fitness for rapid recovery should be conducted well in advance for surgical optimization. Preoperative education should be provided, and the expectation of rapid recovery should be enforced with the patient as well as the healthcare team. Additionally, as per the American Society of Anesthesiologists, healthy patients undergoing elective procedures may continue oral

hydration with clear fluids to 2 hours prior to the procedure [3]. Intraoperatively, considerations for rapid recovery should also be enforced, notably with regards to anesthetic techniques and nausea management. While admitted, postoperatively, proper fluid and pain management protocols should be maintained, as well as coordinated efforts of the nursing and physiotherapy teams [4]. Upon discharge, patients should have adequate pain control and a plan in place to manage pain satisfactory.

Several studies have investigated pre-operative, intra-operative and post-operative factors contributing to the safety and success of outpatient joint replacement procedures. This paper offers the results of a literature review with the goal of presenting the best available evidence from such studies. We conducted the search in Pubmed, Medline and Embase. We focused on the most recent literature with 81% of studies being performed within the past 5 years. We used the standard terms (Medical Subject Headings or MeSH in Medline and Emtree terms in Embase) as well as the words used by authors in their titles, abstracts and keywords. Terms we used includes but was not limited to “total knee replacement, total hip replacement, ambulatory surgical procedures, rapid recovery, outpatient, office, fast track procedures). The search was performed using Boolean operators.

**Patient Selection (See Table 1)**

Study Title	Authors	Date	Study Size	Results
<b>Predictors of Same-Day Discharge in Primary Total Joint Arthroplasty Patients and Risk Factors for Post-Discharge Complications [5]</b>	Sher et al.	2017	7474 primary TJAs among 120,847 TJA patients discharged within 24hh	Younger (<50 years), male sex, American Society of Anesthesiologists class 1 or 2, and less likely to be obese or taking steroids (P < .05 for all). They were also less likely to have co-morbidities. Age > 80, bleeding-causing disorders, smokers = predictor for adverse effects
<b>Rapid Recovery Total Joint Arthroplasty is Safe, Efficient, and Cost-Effective in the Veterans Administration Setting</b>	Yanik et al.	2018		LOS decreased from 3.2 to 1.7 days (P < .0001)
<b>Measuring rapid recovery program outcomes: are all patients candidates for rapid recovery</b>	Callaghan et al	2015		
<b>Is Rapid Recovery Hip and Knee Replacement Possible and Safe in the Octogenarian Patient? [6]</b>	Edwards et al	2017	N = 2482, retrospective review	Octogenarians receiving primary THA and TKA were discharged home >90% of the time with LOSs <2 days and low readmission rates. Revision THA and TKA patients aged 80 years and older were discharged home about 70% of the time with significantly longer LOSs than patients aged more than 80 years.
<b>Factors associated with hospital stay length, discharge destination, and 30-day readmission rate after primary hip or knee arthroplasty: Retrospective Cohort Study [7]</b>	Roger et al	2019	N = 938 THA, n = 725 TKA, retrospective cohort study	Factors predicting discharge to rehabilitation unit were older age, female gender, chronic obstructive pulmonary disease, anxiety-depressive disorder, and a history of stroke. Risk factors for 30-day readmission were male gender, obesity, and discharge to rehabilitation unit.
<b>Primary Total Hip Arthroplasty With Same-Day Discharge: Who Failed and Why [8]</b>	Kim et al	2019	N = 164, 143 discharges same day	Women, patients younger than 40 years, and patients older than 60 years all had an increased risk of failing the program. Body mass index of 26 kg/m <sup>2</sup> or less was associated with a 40% greater risk of failure. Patients with an ASA score of 3 had a 3-fold risk of failure compared with patients with an ASA score of 2 or less.
<b>Predictors of (Un)successful Same-Day Discharge in Selected Patients Following Outpatient Hip and Knee Arthroplasty [4]</b>	Keulen et al	2020	N = 525, 440 successful same day discharge	Charnley class B2 was associated with a higher chance of successful SDD (odds ratio [OR], 0.29; 95% confidence interval [CI], 0.12-0.72), whereas female gender (OR, 1.7; 95% CI, 1.0-2.8), total knee arthroplasty (OR, 1.9; 95% CI, 1.1-3.4), and a higher American Society of Anesthesiologists (ASA) physical function score (ASA II: OR, 1.9; 95% CI, 1.1-3.3; ASA III: OR, 3.9; 95% CI, 1.1-13) were associated with a higher risk of unsuccessful SDD.
<b>Allergies, Preoperative Narcotic Use, and Increased Age Predict Failed Same-Day Discharge After Joint Replacement [5]</b>	Lieberman et al	2021	N = 2615 (1425 TKAs, 1190 THAs), 271 successful SDD	Age over 70 years (P = .007), greater than 2 self-reported allergies (P < .001), and preoperative narcotic use (P = .01) were associated with failure of SDD. Gender, body mass index, American Society of Anesthesiologists class, and prior TJA were not significantly associated (P > .05).

**Table 1:** Patient Selection.

In order to determine which patients may benefit from rapid recovery pathways after total hip and knee arthroplasty, we have reviewed the literature over the past 10 years. There is evolving consensus that certain characteristics are important predictors for successful outpatient surgery, such as: male sex, ASA class 1 or 2, lower BMI, highly motivated patients, patients with support at home and lack of cardiorespiratory comorbidities. [1,2,4,8-15].

Several clinical tools have been developed to help predict patient outcomes in total joint arthroplasty. The Outpatient Arthroplasty Risk Assessment Score (OARA) is one such tool designed to identify patients medically appropriate for same- and next-day discharge after surgery, based on medical comorbidities. [16] It has been compared to the American Society of Anesthesiologists Physical Status Classification System (ASA-PS) and Charlson Comorbidity Index (CCI) scores with respect to length of stay prediction and has been shown to have a more precise predictive ability [17]. Other predictive tools, such as the Risk Assessment and Prediction Tool (RAPT) and Predicting Location after Arthroplasty Nomogram (PLAN) have been developed to predict need for extended care facilities and help in discharge planning after total joint arthroplasty, but these have not been tailored specifically to same day surgery [17].

One study demonstrated the confounding finding that body mass index of 26 kg/m<sup>2</sup> or less was associated with a 40% greater risk of failure of same day discharge. In addition, the current findings suggest that women, particularly those with lower body mass index, may have an even higher incidence of postoperative hypotension and nausea. This finding may be incidental or may be related to the inability of these physically smaller patients to reach osmotic homeostasis immediately after surgery [8]. Patients in this study with an ASA score of 3 had a 3-fold risk of failure compared with patients with an ASA score of 2 or less. [8] Another study showed greater than two self-reported allergies ( $P < .001$ ), and preoperative narcotic use ( $P = .01$ ) to be additional factors closely associated with failure of same day discharge after joint replacement. [5] Other studies identified risk factors which were associated with a longer length of stay. These factors included female gender, BMI > 30, non-white race, ASA score >2, Charlson Comorbidity index of > 0 and preoperative hemoglobin of less than 130 [18,19]. Some studies excluded patients which were dependent on a walker or cane and patients scheduled for complex primary replacements [10,20].

There is support for safely including patients from groups considered higher risk, such as for instance octogenarians or veterans, in same day arthroplasty protocols, although no agreement on this matter currently exists in the literature. [6,7] Interestingly, one study reported a Charnley class B2, meaning the contralateral side has previously undergone arthroplasty, to be predictive of successful same day discharge [4].

**In conclusion:** There are no concord amongst studies regarding the optimal patient for rapid discharge, but certain factors do predict a successful outcome: male sex, ASA score < 3, lower BMI, support at home for at least 24h after surgery, motivated patient and lack of cardiovascular comorbidities.

### Perioperative Management

The rapid recovery protocols must encompass several aspects of perioperative care, and actually begin their implementation long before the patient enters the operating room. Additionally, optimal pre and intra operative multimodal pain management techniques have been shown to have potential benefit in decreasing length of stay in hospital. Multimodal, opiate-sparing analgesic regimens should be initiated the morning of surgery, and intraoperative anesthetic care should be tailored to facilitate nausea control and early ambulation with a goal of meeting dismissal criteria later that day. [21] Most studies used Paracetamol 1G orally the morning of surgery [9,10,12,18,22] in addition to Celecoxib 400mg orally [9,10,22]. Additional medications added include Pregabalin 75mg orally [10,22] and Temazepam [12]. One study showed the contribution of a preemptive COX-2 inhibitor and oxycodone decreased postoperative narcotic requirements and increased participation in rehabilitation. Consequently, length of stay was reduced [23].

With regard to intraoperative anesthesia (see Table 2), one study of over 5000 patients demonstrated shorter lengths of Stay (LOS) and higher likelihood of discharge home with Neuraxial (NA) vs General Anesthesia (GA) in the context of both primary total hip and knee arthroplasty. Patients receiving NA had a significantly shorter LOS (total hip arthroplasty [THA]: GA 1.74 vs NA 1.36 days,  $P < .001$ ; Total Knee Arthroplasty [TKA]: GA 1.77 vs NA 1.64 days,  $P < .001$ ) Patients receiving NA were more likely to be discharged home (THA: GA 83.4% vs NA 92.3%,  $P < .001$ ; TKA: GA 83.3% vs NA 86.3%,  $P = .010$ ). Some smaller studies also have advocated for the use of ropivacaine for total knee surgery and mepivacaine for total hip surgery as agents for neuraxial anesthesia in the rapid recovery context [21,24].

Study Name	Authors	Date	Patient Population	n	Results
<b>Multi-modal, pre-emptive analgesia decreases the length of hospital stay following total joint arthroplasty [24]</b>	Duellman et al	2009			The use of pre-emptive oxycodone and a selective COX-2 inhibitor decreased postoperative narcotic requirements and increased participation in rehabilitation. In addition, patients receiving pre-emptive analgesics had a decreased hospital length of stay and reduced likelihood of discharge to a skilled nursing facility. Length of hospital stay for the pre-emptive group averaged 2.74 vs 3.28 days for patient-controlled analgesia patients.
<b>A Pre-Emptive Multimodal Pathway Featuring Peripheral Nerve Block Improves Perioperative Outcomes After Major Orthopedic Surgery [23]</b>	Hebl et al	2008	Mayo Clinic (TJRA protocol)	N = 100 with matched controls	TJRA patients had significantly shorter hospital lengths of stay (3.8 days v 5.0 days; P < .001), achieved discharge eligibility significantly sooner (1.7 ± 1.9 days earlier; P < .0001), and had improved joint range of motion (90° v 85°; P = .008) when compared with matched controls. TJRA patients had significantly improved postoperative analgesia, including lower VAS pain scores (postoperative day 0 through postoperative day 3; P < .001), and lower opioid requirements (postoperative day 0 to postoperative day 2; P = .04). Adverse outcomes such as postoperative urinary retention (50% v 31%; P < .001), and ileus formation (7% v 1%; P = .01) occurred more frequently among control patients.
<b>The Effect of Neuraxial Anesthesia on Postoperative Outcomes in Total Joint Arthroplasty With Rapid Recovery Protocols [25]</b>	Turcotte et al	2020		N = 5914, retrospective single centre study	Patients receiving NA had a significantly shorter LOS (total hip arthroplasty [THA]: GA 1.74 vs NA 1.36 days, P < .001; total knee arthroplasty [TKA]: GA 1.77 vs NA 1.64 days, P < .001) Patients receiving NA were more likely to discharge home (THA: GA 83.4% vs NA 92.3%, P < .001; TKA: GA 83.3% vs NA 86.3%, P = .010) (THA: NA adjusted OR [aOR] 2.04, P < .001; TKA: NA aOR 1.23, P = .048)
<b>Identifiable Risk Factors to Minimize Postoperative Urinary Retention in Modern Outpatient Rapid Recovery Total Joint Arthroplasty [26]</b>	Ziembra-Davis et al	2019		N = 663, incidence 5.5%	Overall incidence of POUR was 5.5% (3.9% for same day discharges). Avoidance of anticholinergics and cholinesterase inhibitors during anesthesia should be carefully considered in outpatient TJA, particularly in stand-alone ambulatory surgery centers.

<p><b>Comparison of Effectiveness of Ropivacaine Infusion Regimens for Continuous Femoral Nerve Block for Recovery After Total Knee Arthroplasty: A Randomized Double-Blind Trial [9]</b></p>	<p>Zhang et al</p>	<p>2020</p>		<p>N = 60</p>	<p>Patients administered the regimens of 0.15% and 0.2% ropivacaine infusion for cFNB were ready for discharge earlier than the 0.1% group after TKA, at the dose of 10 mg/h for 48 h. The regimen of 0.15% ropivacaine, which is associated with less quadriceps muscle strength weakness than 0.2%, is recommended for postoperative analgesia after TKA.</p>
<p><b>Mepivacaine versus Bupivacaine Spinal Anesthesia for Early Postoperative Ambulation</b></p>	<p>Schwenk et al</p>	<p>2020</p>		<p>N 154 (50 received mepivacaine, 53 received hyperbaric bupivacaine, and 51 received isobaric bupivacaine)</p>	<p>Mepivacaine patients ambulated earlier and were more likely to be discharged the same day than both hyperbaric bupivacaine and isobaric bupivacaine patients. Mepivacaine could be beneficial for outpatient total hip arthroplasty candidates if spinal is the preferred anesthesia type.</p>

**Table 2:** Anesthetic Considerations.

Currently there is no consensus if NA or GA should be used for rapid discharge. Both techniques have been used successfully in rapid discharge and outpatient surgery protocols [9-13,18,22,24,27]. The use of peripheral nerve blocks has also shown some promise in accelerating recovery and improving post-operative pain scores, as well as it being associated with a decreased risk of adverse outcomes such as urinary retention and ileus. [23] There is however no clear evidence to support the combined usage routinely [18,28]. Avoidance of anticholinergics and cholinesterase inhibitors during anesthesia, such as glycopyrrolate with neostigmine, should be carefully considered in outpatient TJA, particularly in stand-alone ambulatory surgery centers, given their association with urinary retention [25].

**Conclusion:** The rapid protocol should encompass several aspects of the perioperative care. This includes adequate pain management (Paracetamol, Celecoxib +- Pregabalin) on the morning of surgery; even though there isn't a clear advantage of using GA or NA, the anesthetist should be cognizant of drug administration during anesthesia to avoid postoperative concerns (Nausea, vomiting, hypotension and urinary retention).

**Surgical Approaches (See Table 3)**

Study Name	Authors	Date	Patient Population	n	Results
<p><b>Slower recovery after two-incision than mini-posterior-incision total hip arthroplasty. Surgical technique</b></p>	<p>Pagnano et al</p>	<p>2009</p>		<p>N = 72, randomized 36 per approach</p>	<p>The patients in the two-incision group recovered more slowly than did those in the mini-posterior-incision group as measured on the basis of the mean time to discontinue a walker or crutches, to discontinue all walking aids, and to return to normal daily activities. Mean OR time 24 min longer for 2 incision. Similar clinical outcome at 1 year</p>

<b>Early discharge and recovery with three minimally invasive total hip arthroplasty approaches: a preliminary study [29]</b>	Meneghini et al	2009		N = 24, randomized	3 minimally invasive surgical approaches (two-incision, mini-posterior, and mini-anterolateral) and enrolled in an aggressive postoperative rehabilitation program. Hospital discharge, early functional milestone recovery, and validated outcome measures (SF-36, WOMAC, Harris hip score, lower extremity activity scale) were collected. No difference identified
<b>Does mini-midvastus approach have an advantageous effect on rapid recovery protocols over medial parapatellar approach in total knee arthroplasty? [30]</b>	Zora et al	2020		N = 54, randomized and single blinded	With the use of contemporary rapid recovery protocols during TKA, MMV approach had no superiority over MPP approach when quadriceps muscle strength, LOS, pain, function, and quality of life were assessed. Longer operative time in the MMV approach compared to MPP approach may be considered as a disadvantage.
<b>Outpatient total hip or knee arthroplasty in ambulatory surgery center versus arthroplasty ward: a randomized controlled trial</b>	Husted et al	2020		N = 50	24/25 of the patients who stayed in the ASC compared with 20/25 of the patients on the arthroplasty ward were discharged on the DOS following fulfillment of discharge criteria (p = 0.08). All THA patients were discharged on the DOS and significantly more TKA patients were discharged from the ASC (15/16) vs. from the ward (9/14) (p = 0.04). Interpretation - Despite fixed discharge criteria, the logistical setting may play a role for achieving discharge on DOS and the ASC may facilitate achieving discharge criteria earlier especially in TKA.
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<p><b>Outpatient total hip or knee arthroplasty in ambulatory surgery center versus arthroplasty ward: a randomized controlled trial</b></p>	<p>Husted et al</p>	<p>2020</p>		<p>N = 50</p>	<p>24/25 of the patients who stayed in the ASC compared with 20/25 of the patients on the arthroplasty ward were discharged on the DOS following fulfillment of discharge criteria (p = 0.08). All THA patients were discharged on the DOS and significantly more TKA patients were discharged from the ASC (15/16) vs. from the ward (9/14) (p = 0.04). Interpretation - Despite fixed discharge criteria, the logistical setting may play a role for achieving discharge on DOS and the ASC may facilitate achieving discharge criteria earlier especially in TKA.</p>
<p><b>Study name</b></p>	<p><b>Type of study</b></p>	<p><b>Number of patients - Inpatients(IP); outpatients(OP)</b></p>	<p><b>Type of anesthesia</b></p>	<p><b>Postoperative medications</b></p>	<p><b>Discharge home percentage</b></p>

Baker et al. (2021) [18]	Retrospective study	915 patients (All THA patients) 543 standard discharge; 372 Rapid discharge	GA + paravertebral / quadratus lumborum nerve block	Tylenol 1g (main drug used) For breakthrough Tramadol 50mg or Oxycodone 5mg upon patient request until discharge	N/A
Husted et al. (2020) [9]	Randomized controlled trial	50 patients (20 THA; 30 TKA) - all outpatient	GA	Tylenol 1g q6h; Celebrex 200mg BID - until POD 6; Breakthrough Sufentanil or Morphine	All THA went home on day of surgery while 24/30 TKA went home
Fransen et al. (2018) [12]	Randomized controlled trial	25 patients (fast track) 25 patients regular joint protocol)	GA	Paracetamol 1g q6h; diclofenac 50mg tid, Oxynorm 5mg as needed. Icepacks 3 three times a day	N/A
Shapira et al. (2021) [15]	Sytematic review	683 THA's - all outpatient THA	N/A	Celebrex in addition to Tramadol, Acetaminophen, Hydrocone, Ketorolac, Lyrica	88.1% of enrolled patients were discharged the same day - most common reasons for delaying discharge was nausea, dizziness, hypotension
Deng et al. (2019) [31]	Sytematic review	9755 Conventional discharge; 6944 ERAS (enhanced recovery after surgery)	N/A	N/A	N/A
Shah et al. (2019) [32]	Sytematic review	2149459 patients underwent TKA (no outpatient groups)	N/A	N/A	N/A
Gromov et al. (2017) [13]	Prospective two center study	302 patients (167 THA; 137 TKA)	Spinal	N/A	28% (THA) 24% TKA - most common reason for staying: lack of safe mobilization; Female sex; >75 years old, BMI >35



Porsius et al. (2018) [14]	Prospective cohort study	94 patients (All THA)	N/A	N/A	N/A
Goyal et al. (2017) [10]	Prospective, randomize, multicenter study	220 patients (112 outpatients; 108 inpatients)	Spinal	Tramadol 50mg q6h, Acetaminophen, Hydrocodone, Ketoralac 15-30mg q6h (15mg <70 years of age - 30mg <70 w/o renal disease), Lyrica 75mg BID, Celebrex 200mg BID(not in sulph allergy patients)	76% discharged as planned – Reasons for delayed discharge: dizziness/hypotension (9); pain(6);patient preference(5);nausea (4) ambulatory dysfunction(2); urinary retention(1)
Darrith et al. (2019) [20]	Matched Cohort Analysis	243 outpatients; 243 inpatients (UKA(36.6%); THA(30%);TKA(18.9%)	N/A	N/A	98.7% -Reasons for delayed discharge: pain control,nausea, patient preference
Lovecchio et al (2016) [27]	Propensity Score Matched Analysis	24929 patients (492 outpatients; 1476 fast track patients(<=2 days)) (THA + TKA) - Majority of cases was TKA	Majority of outpatients was GA; Majority of fast track pt's was spinal	N/A	N/A
kolisek et al. (2009) [28]	Matched cohort analysis	64 patients Outpatients(TKA); 64 patients inpatients	Continues fem nerve block+single shot sciatic nerve block	Toradol 10-15mg IM + Hydrocodone 5-7.5mg + Tylenol 350mg + Odansetron 4mg q4-8 PRN	N/A
Aynardi et al. (2014) [22]	Retrospective case control study	119 OP ; 78 Inpatients - All THA	Spinal anesthetic	Toradol 15-30mg IVI;Lyrica 75 mg BID, Tylenol 650mg Q6h po, Lortab/Dilaudid 2mg tablets upon discharge	96.63% - (4 patients were admitted)postop desaturations (atelectasis); intraop EKG changes; two patients with non displaced calcar fractures intraoperative
Springer et al (2017) [11]	Retrospective case control study	137 OP , 106 inpatients - total joint arthroplasty patients - 166 TKA, 77 THA	GA/ Spinal	NSAIDS, Acetaminophen, short acting narcotics	N/A

**Table 3:** Surgical Approaches.

It is also reasonable to hypothesize that the surgical approach to the joint used by the surgeon, and consequently the degree of soft tissue disruption, may play into how quickly a patient will mobilize. Several studies have explored the relative benefits of certain surgical approaches, but their impact on same day discharge planning has not been extensively studied. One randomized study of 24 patients showed no differences in early discharged rates with 3 minimally invasive surgical approaches (two-incision, mini-posterior, and mini-anterolateral), that had patients enrolled in the same aggressive postoperative rehabilitation program [33]. In the total knee setting, one study of 54 patients with the use of contemporary rapid recovery protocols showed that the mini mid-vastus approach had no superiority over the medial parapatellar approach when quadriceps muscle strength, length of stay, pain, function, and quality of life were assessed [26].

Additionally, the role of non-operative factors such as the recovery setting has been shown to impact the rapidity of a patient's recovery. Husted et al. demonstrated that patients who stayed in the day surgery unit postoperatively were more likely to be discharged home after fulfilling criteria than patients admitted to the arthroplasty ward. [9] Twenty four out of twenty-five

patients who stayed in the Ambulatory Surgery Centre (ASC) compared with 20/25 of the patients on the arthroplasty ward were discharged on the day of surgery following fulfillment of discharge criteria ( $p = 0.08$ ). All THA patients were discharged on the day of surgery and significantly more TKA patients were discharged from the ASC (15/16) vs. from the ward (9/14) ( $p = 0.04$ ). Therefore, the logistical setting may facilitate achieving discharge criteria earlier, especially in TKA. Currently there are no definitive conclusions that can be made regarding the best approach for rapid discharge or outpatient surgery. Multiple studies used the direct anterior approach [10,14,18,22] while others had great success with the posterolateral approach [9,11,13]. This was also similar for knee replacements, where a subvastus approach was used [34] compared to the standard medial parapatellar approach [9,11,13,28]. Most studies did not use drains postoperatively [9,12,18,13,28].

**Conclusion:** There is no clear direction regarding surgical approach in total knee and total hip replacements. There is greater success in outpatient surgery with patients in an ACS due to factors that include better patient selection and environmental expectations. This pathway however can still be successful in a general hospital setting.

**Postoperative Management (See Table 4)**

Study name	Type of study	Number of patients - Inpatients(IP); outpatients(OP)	Type of anesthesia	Postoperative medications	Discharge home percentage
Baker et al. (2021) [18]	Retrospective study	915 patients (All THA patients) 543 standard discharge; 372 Rapid discharge	GA + paravertebral / quadratus lumborum nerve block	Tylenol 1g (main drug used) For breakthrough Tramadol 50mg or Oxycodone 5mg upon patient request until discharge	N/A
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kolisek et al. (2009) [28]	Matched cohort analysis	64 patients Outpatients(TKA); 64 patients inpatients	Continues fem nerve block+single shot sciatic nerve block	Toradol 10-15mg IM + Hydrocodone 5-7.5mg + Tylenol 350mg + Odansetron 4mg q4-8 PRN	N/A

Aynardi et al. (2014) [22]	Retrospective case control study	119 OP ; 78 Inpatients - All THA	Spinal anesthetic	Toradol 15-30mg IVI;Lyrica 75 mg BID, Tylenol 650mg Q6h po, Lortab/Dilaudid 2mg tablets upon discharge	96.63% - (4 patients were admitted) postop desaturations (atelectasis); intraop EKG changes; two patients with non displaced calcar fractures intraoperative
Springer et al (2017) [11]	Retrospective case control study	137 OP , 106 inpatients - total joint arthroplasty patients - 166 TKA, 77 THA	GA/ Spinal	NSAIDS, Acetaminophen, short acting narcotics	N/A

Postoperative management, which includes medical management, pain management and physical therapy, after surgery is crucial to the success of the outpatient program. This starts in the recovery room and extends after the patient has left the hospital and is managing at home. Most studies start with physiotherapy on the day of surgery, with emphasis on early mobilization [18,22,28]. Physiotherapy can even be started in the recovery room if resources are available. Hospitalists and anesthesiologists can be involved to manage patients aggressively to control nausea, vomiting, manage pain, maintain fluid balance and addressing medical concerns if they arise [9,18]. Three key issues that need to be addressed aggressively are dizziness, nausea and vomiting. Both these issues could lead to poor mobilization and prolonged stay in hospital. Therefore, having a dedicated anesthesiologist or hospitalist assigned to the outpatient ward might be very useful in addressing these concerns in an urgent manner [9,18]. The most common medication administered to patients for nausea and vomiting is Ondansetron, and fluid boluses should be liberally administered to control hypotension and subsequent dizziness. Some studies demonstrated the benefit of having outpatient surgery patients in the same room, even outpatients from different specialties. By placing outpatient surgery patients in-between inpatients, they might become discouraged leaving the hospital on the same day. Logistically that might be difficult for a hospital to have a separate ward available, only for day surgery patients. They also mentioned that outpatients should be placed in recovery beds. Not only can the bed be placed in reverse trendelenburg position (which will help to overcome orthostatic hypotension), but it is less comfortable than ward beds which will in turn encourage patients to get up and about earlier [9,13]. The percentage of patients being discharged as planned on the operative day varied greatly between studies from 24.1% - 100%. The most common reasons cited for staying longer than anticipated is nausea

and vomiting, dizziness, hypotension, pain and patient preference. Other reasons also mentioned included female sex, age >75, BMI >35 and lack of safe mobilization [10,12,13,15,20].

The discharge criteria used for outpatient surgery to qualify in leaving the hospital on the same day as surgery includes: the ability to ambulate 80-100 feet [10,12,18,28]; nausea and vomiting well controlled [9,10,12,18]; VAS pain score < 3 at rest and < 5 with mobilization [12,13,18]; hemodynamically safe [13,18] no signs of dizziness [9,12]; able to climb up or down stairs independently [10,18,22]; toilet independently [10,12]; able to get in and out of the bed safely [10,22] and have support at home [13]. Postoperative pain medications are crucial to control pain adequately at home and allow patients to stay mobile and perform their postoperative exercises. Goyal et al. [10] demonstrated that outpatients and inpatients had similar pain scores except for postoperative day 1 where the outpatient group had statistically significant higher pain scores compared to the inpatient group. This was also observed in another study where the most readmissions occurred because of inadequate pain control [38]. Therefore, a combination of medications to control the pain adequately is crucial. The medications used listed from most common to least common includes: Acetaminophen [9-12,15,18,22]; Anti-inflammatories (includes Celecoxib, diclofenac, Ketorolac) [9-12,15,22,28], short acting narcotics -mainly used for breakthrough pain [10-12,15,18,28], and pregabalin [10,15,22].

**Conclusion:** Postoperative management is crucial for the success of an outpatient program. This includes a multidisciplinary approach (physiotherapy, nursing, anesthesia and hospitalists) to address all the issues associated with outpatient surgery. Availability of these essential resources might be a barrier in instituting an outpatient surgery program. Pain management postoperatively is a balance between adequately controlling the pain without causing too many side effects that might delay discharge.

**Patient Satisfaction And Postoperative Complications (See Table 5)**

Study name	Complications	Readmission 30 days	Readmission 90 days	Emergency room visits in 90 days
Baker et al. (2021) [18]	No difference in complications (wound/systemic cx)	N/A	N/A	Inpatients had significantly more 90 day ER visits
Husted et al. (2020) [9]	No complications at 90 days	N/A	N/A	N/A
Fransen et al. (2018) [12]	No difference between the groups	N/A	N/A	N/A
Shapira et al. (2021) [15]	N/A	0.34% readmission - seroma + periprosthetic fracture	N/A	N/A
Deng et al. (2019) [31]	ERAS showed statistical significant reductions in postoperative complications mortality, transfusion compared to conventional care;  In RCT's only - no difference in complications/transfusion rate between ERAS group and conventional group in TKA	No statistical difference in 30 day readmission rate	N/A	N/A
Lands et al. [35]	No difference in THA inpatients and outpatients.	N/A	Inpatients in TKA were more likely to have <b>90 day readmission</b> or fall within 90 days	N/A
Lovald et al. [36]	Increased risk for dislocation, infection , wound complications, DVT's,implant loosening in the <b>outpatient/short stay(1-2 days in hospital)</b> groups.  There is an increased mortality risk noted in the outpatient or short stay group.	N/A	<b>90 day readmission</b> - OP -0.9% ; IP 0.6%,	N/A
Berger et al. [37]	N/A	3.6% readmission rate due to anemia, GI bleeding, DVT,wound complications, joint stiffness and nausea.	N/A	N/A
Goyal et al. (2017) [10]	No difference between groups	N/A	NA	No statistical significant difference between groups

Darrith et al. (2019) [20]	No difference in minor or major complications (p.76) - most common complication was hip instability and arthrofibrosis in TKA in both groups	N/A	No diff (P=1.0) - most common reason - superficial SSI	No difference (p=.52)
Lovecchio et al (2016) [27]	Statistical more Cx in OP(6.7% vs 1.4%) vs Fast track (p<0.001) - DVT, transfusion (overall transfusion was similar in both groups but postop OP group had a higher transfusion rate); (pneumonia,MI,sepsis - occurred equally in both groups)	N/A	N/A	N/A
kolisek et al. (2009) [28]	No difference (p=1.000)	0%	0%	0%
Aynardi et al. (2014) [22]	No difference or estimated blood loss	No readmissions	No readmissions	N/A
Springer et al (2017) [11]	N/A	8.8% OP ; 5.7% inpatients (p=.36) - this was all TKA	N/A	16% OP compared to 6.6% (P=.18)
Arshi et al. [38]	Outpatient TKA was more associated with postoperative DVT and acute renal failure; tibial and femoral component revision due to a non infectious cause, irrigation and debridement and stiffness requiring manipulation under anesthesia.	N/A	N/A	N/A
Cassard et al.(2018) [39]	<b>Overall complication rate: OP - 8.2% vs IP - 7.2%(p&gt;0.05)</b>	3.3% <b>30 day readmission rate in OP</b> - knee pain(1 patient) febrile episode (1 patient)		3 patients seen in ER but was not admitted (haematoma, pain, epistaxis)
		4.9% <b>30 day readmission rate in the IP group.</b> (p>0.05)		
Gauthier-Kwan et al.(2018)[40]	N/A	N/A	<b>90 days readmission</b> - 1 inpatient - arthrofibrosis; 1 outpatient - MRSA PJI.	<b>Emergency department visits</b> - 2 IP (syncope) ; 2 OP (syncope); 1 IP (leg swelling); 1 OP (leg swelling); 1 OP - saturated dressing with blood; 1 OP - contac dermatitis around incision; 1 OP - postoperative pain on POD 14.(p=0.771)
Gillis et al. (2018) [41]	N/A	N/A	<b>Readmission</b> (OP - 2.4%) (IP - 4.4%)	<b>ED visits</b> (OP - 13.6%; IP - 13.1%)

<p>Kimball et al. (2020) [27]</p>	<p><b>Minor complications</b> (OP - 2.8% vs IP 5.8%(p=0.002))</p> <p><b>Major complications</b>(OP - 5.2% vs IP 6.7%(p=0.173))</p>	<p><b>30 day Readmissions</b> - statistically equivalent between the IP + OP cohorts</p>	<p><b>90 day Readmissions:</b> OP - 5.1% vs IP 7.3%(p=0.064)</p>	
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The length of stay after a total hip and knee replacement have decreased over the past several decades. This was achieved due to advancements in surgical techniques, pain control, and management of bleeding [35]. This was mainly driven by the goal of decreasing healthcare costs as well as the benefits seen with early mobilization, no compromise in outcome and no associated increase in complications in select patient populations [10,35]. Multiple authors attributed the success of outpatient surgery to strict criteria that were developed and applied to potential candidates for same day surgery. Certain criteria were used more commonly among studies. These include age, BMI, Charlson Comorbidity Index (CCI), support and physical home location in relation to the surgical hospital. Patients were deemed safe to undergo outpatient surgery if their age was less than 75 years of age [10,20,27, 35,42]. Some authors used 80 years of age as their cutoff [41,18]. A body Mass Index (BMI) of less than 40 kg/m<sup>2</sup> was used as a strict criteria [10,11,15,18,27]. One study used a BMI cutoff less than 45 kg/m<sup>2</sup> [41]. Most studies agreed that a low CCI should be used as an uncompromising criterion [9,12-14,20,27,35,39-42]. Patients were more readily considered for outpatient surgery if they had family support at home [9,10,11,14,17,20,22,40,28,39], and if they reside close (within 60 minutes) to their surgical hospital [11,28,40,41,42]. Other factors (albeit not routinely used) also considered in certain studies important for outpatient surgery include: non-complex orthopaedic cases [10,20], opioid naive patients [10], independent functional state [41] and no walker/wheelchair for mobilization [10]. Comparing the complications (minor and major) between outpatient surgery and inpatient surgery is very controversial. The majority of studies however show comparable complication rates between outpatient and inpatient surgery [9,10,11,12,18,22,28,31,35,40,41,42]. These comparable complication rates between inpatients and outpatients were even seen in studies where no, or minimal criteria was used for outpatient surgery [10,20,22]. The majority of the studies however adhered to strict criteria for outpatient surgery.

Some conclusions regarding readmissions can be made comparing the results of all the studies evaluated. Most studies did not demonstrate a difference between readmission rates at 30 days or 90 days post-surgery in both the inpatient and outpatient groups [11,20,22,27,28,31]. This was similar for emergency department visits [10,11,20,22,28]. Total knee replacements done

as outpatients might have a higher readmission rate compared to total hip arthroplasties [35,42]. Generally, the readmission rates for outpatients varied between 0.34% - 5.1% [15,27,37,39,41]. The most common causes for readmission included, but was not limited to gastro intestinal bleeding [18,37], deep venous thrombosis [18,36,37,38], wound complications [18,36,37,38] and stiffness in the operated joint [37,38]. Some studies identified outpatients surgery as the culprit for higher revision rates [36,38,39], due to implant loosening and/or implant malpositioning, although that has not been confirmed by the majority of the studies. In contrast, one study demonstrated a statistical difference in favour of outpatient surgery in regards to minor complications [27]. Limited studies compared pain scores and satisfaction between the outpatient and inpatient surgery group. Four out of the six studies that reported on pain, demonstrated statistically significant improvement in pain in the outpatient surgery group [12,14,27,36], while one study showed no difference [40] and one study demonstrated better pain control in the inpatient group, albeit only on post-operative day 1 [10]. Satisfaction was rated as 80% very satisfied and 20% satisfied in the outpatient surgery group [14,39]. When comparing satisfaction between the inpatient and outpatient surgery group, there was no clinically significant difference [40,42-53].

**Conclusion:** If surgeons embark on outpatient surgery it is imperative to use strict inclusion criteria for the best possible outcomes. The most common criteria used included ASA <3, support at home, BMI <40 and no cardiovascular disease. Outpatient surgeries do show comparable complication rates, satisfaction and pain scores compared to standard inpatient surgery.

### Ten Step Protocol

- Patient selection is crucial : consider using patients younger than 75 (other studies use 80 as their cutoff), BMI < 40kg/m<sup>2</sup> (some studies use 45 kg/m<sup>2</sup> as their cutoff), opioid naive patients, not using a walker /wheelchair; elective unilateral non-complex total joint replacement, no significant medical comorbidities that might require inpatient monitoring; assistance at home, no history of prior pulmonary embolus or a history of a myocardial infarction in the past year. Patients were deemed also to be candidates if they reside within 60 minutes of the operating hospital.

- **Pre-operative care:** Preoperative education and counselling is of utmost importance. Patients should meet with the surgeon and/or physical therapist and/or nurse prior to surgery to discuss all the aspects of the perioperative period and to prepare them for same day discharge. Patients can then practice walking with a walker, crutches or cane. This meeting can also be used to discuss proper pain management postoperatively and hip precautions following a total hip arthroplasty. Patients requiring social services postoperatively should be identified and preparations can be made to meet social services preoperatively should the need arises.

- **Preoperative pain management** on the morning of surgery should be opioid sparing and can include multiple medication combinations with the most common listed as Celecoxib 400mg, acetaminophen 1g and Pregabalin 75mg orally.

- **Anesthesia** should be involved early on in the plan to embark on outpatient surgery. Anesthetists can help with outpatient surgery patients by minimizing medications that could lead to urinary retention, nausea and/or dizziness. Preferably no epidural or intravenous narcotics should be administered during surgery. Currently the jury is not out regarding spinal or general anesthesia and either is acceptable for outpatient surgery. Patients should be adequately hydrated during the surgery to avoid postoperative dizziness. Sedation during the surgery should be in the form of Propofol (short acting agent). Additional intraoperative medications for instance Ondansetron and/or Dexamethasone should be considered to avoid nausea and vomiting postoperatively.

- **Recovery room protocol** should include aggressive treatment focussing on hydration, nausea and vomiting and pain management. This include judicious intravenous fluids (i.e. Ringers lactate), medications directed at nausea (i.e. Ondansetron) and pain management (anti-inflammatories, Acetaminophen) to prevent hypotension, nausea and vomiting and pain respectively.

- **Surgical care:** The surgeon should use techniques that minimizes soft tissue damage. Currently there is no clear evidence to support the superiority of one approach over the other in both hip and knee replacements, and surgeons can safely use the approach they are the most familiar with. Some surgeons choose to use a minimally invasive approach (subvastus approach in total knee arthroplasty), in non complex joint replacements or if their BMI is less than 40kg/m<sup>2</sup>. Timing of surgery (first 1-2 cases of the day) is crucial to optimize pain control and allow enough time for patients to fulfill the day surgery discharge criteria (see Table 7). Even with doing outpatient surgery cases as the first two cases of the day, surgeons should anticipate that each part of the protocol do take time and essential resources (nursing, anesthesia,

hospitalist and physiotherapy) should be scheduled to stay until the patients are discharged. Some surgeons preferred periarticular infiltration, limited or no-tourniquet usage without any clear evidence supporting its widespread usage.

- **Postoperative Ward care:** Patients should be monitored closely, either by a dedicated anesthetist or hospitalist, to address common concerns aggressively. This includes treating nausea and vomiting with medications (i.e. Ondansetron) at frequent intervals and treating hypotension with fluid boluses. Pain management is also of utmost importance, and should be aggressively treated (see Table 7). If a dedicated anesthetist or hospitalist is unavailable then nursing staff assigned to the outpatient surgery patients with clear orders can fulfill the same role. Physical therapy should be started as soon as possible in the ward. Physiotherapy can even be started in the recovery room. Patients should be assessed while on the ward to see if they will fulfill the discharge criteria (see Table 6). Patients should be placed in rooms with other patients also partaking in outpatient surgery to help with motivation to be discharged.

- **Discharge:** Always plan for a small percentage of outpatients to stay longer in hospital. There should be a system in place to deal with patients that is unable to be discharged home. That involves admitting patients to the inpatient ward or having patients transported to a hospital for admission if the patient was operated on at a facility without admission privileges. In the United States of America, virtually all the third-party payers impose a major financial penalty upon the surgical facility if a transfer to an alternative site becomes necessary. Therefore, the site of the surgery should ideally possess the capability of an overnight stay if deemed necessary. A recurring problem for patients who are discharged home is a lack of knowledge about the home environment and the degree of support by suitable family members or friends. Ideally an assessment of the home prior to the surgical procedure should be undertaken but the financial and manpower resources to facilitate that are rarely available.

- **Consider instituting clinical pathways, structured programs or preventative interventions** to decrease length of stay and minimize complications. This will give the new rapid discharge program the best chance to optimize outcomes.

- **Everything should be perfectly executed** to do outpatient total joint arthroplasty - any error or delay from any part of the team will result in failure. Consider starting with a “fast track” program first focussing on total hip arthroplasty or unicompartamental knee replacements. Once a “fast track” program is instituted and running smoothly should one decide to embark on outpatient surgery.



Discharge criteria
• Able to ambulate 80-100 feet
• Nausea and vomiting well controlled
• VAS pain score < 3 at rest and < 5 with mobilization
• Hemodynamically stable
• No signs of dizziness
• Able to climb up and down stairs independently
• Toilet independently
• Able to get in or out of bed safely
• Patient should have home support

**Table 6:** Discharge criteria that need to be fulfilled prior to discharge.

Pain management postoperatively
• Acetaminophen 1gram q6h P.O.
• Ketorolac 15-30mg IVI q6h while in hospital. 30mg for patients <70 and 15mg for patients > 70 without renal disease.
• Upon discharge patients can continue with Celecoxib 100-200mg BID P.O.
• Pregabalin 50-75 mg BID P.O.
• Short acting narcotics can be given for breakthrough pain. I.e. Hydromorphone 2mg q4-6h P.O.
• Cryotherapy or icing

**Table 7:** Pain management options postoperatively.

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