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Successful same-day discharge in 88% of patients after unicompartmental knee arthroplasty: a systematic review and meta-analysis

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Abstract

Purpose The purpose of this study was to evaluate the effectiveness of day-case unicompartmental knee arthroplasty (UKA) by assessment of successful same-day discharge (SDD), readmission, complication and reoperation rates in the recent literature.

Methods For this systematic review and meta-analysis, PubMed, Embase and Cochrane Library were comprehensively searched to identify all eligible studies reporting outcomes of day-case UKA. Studies with intended same-day home discharge after UKA were included. A meta-analysis of proportions, using a random-effects model, was performed to estimate overall rates of successful SDD and adverse events. Subgroup analyses were performed for studies including selected patients (i.e., patients had to meet certain patient-specific criteria to be eligible for day-case UKA) and unselected patients (i.e., no additional criteria for day-case UKA), as well as for clinical and registry-based studies. Additional outcomes included reasons for the failure of SDD and patient satisfaction.

Results A total of 29 studies and 9694 patients were included with a mean age of 66 ± 9 years and mean follow-up of 59 days (mean range 30–270 days). Based on 24 studies (2733 patients), the overall successful SDD rate was 88% (95% confidence interval [CI] 80–92). These rates were 91% (95% CI 84–95) across studies with selected patients and 76% (95% CI 55–89) across studies with unselected patients. Overall readmission, complication and reoperation rates were 3% (95% CI 1.9–4.4), 4% (95% CI 2.8–5.2) and 1% (95% CI 0.8–1.3), respectively. Inability to mobilize, nausea and uncontrolled pain were frequently reported reasons for failed SDD. The overall patient satisfaction rate was 94%.

Conclusion This systematic review with meta-analysis found an overall successful SDD rate of 88% after UKA in a heterogeneous cohort of selected and unselected patients. Readmission, complication and reoperation rates suggest UKA can be performed safely and effectively as a same-day discharge procedure.

Level of evidence Level IV, systematic review of level III and IV studies.

Keywords Day-case arthroplasty · Unicompartmental knee arthroplasty · Outpatient · Knee · Clinical pathway

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Abbreviations

ASA	American society of anesthesiology score
ASC	Ambulatory surgery center
BMI	Body mass index
CI	Confidence interval
HOP	Hospital outpatient pathway
MINORS	Methodological Index for non-randomized studies
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
SDD	Same-day discharge
UKA	Unicompartmental knee arthroplasty

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Introduction

Unicompartmental knee arthroplasty (UKA) is a successful procedure for reducing pain and improving the function of patients with isolated compartment osteoarthritis of the knee [23, 34]. The consistently growing demand for knee arthroplasty [37] and recent disruptions of elective orthopedic programs worldwide due to the Covid-19 pandemic [6] demonstrate a need for reorganization of clinical pathways in orthopedics.

Same-day discharge protocols or so-called day-case pathways are designed to discharge elective patients on the day of surgery and could allow for better resource allocation, improved quality of care, reduced costs and alleviation of a burden on healthcare systems [8, 24, 36]. Due to its minimally invasive character and potential for rapid recovery [34], UKA lends itself well to a day-case setting. Indeed, multiple studies have demonstrated satisfactory outcomes following day-case UKA, reporting high patient satisfaction and low complication rates [5, 8, 15, 18].

Some systematic reviews have described successful outcomes following day-case hip and knee arthroplasty [3, 19]. However, these reviews mostly present combined outcomes for joint arthroplasty or only a small, separate subset of UKA procedures. Considering the recent proportional growth of day-case UKA [16], a systematic review of successful same-day discharge (SDD), readmission and complication rates would be of interest to identify evidence with regard to the effectiveness and safety of this relatively new clinical pathway. Such an overview could facilitate surgeons in clinical and shared decision-making and serve as a supportive aid to provide realistic expectations for patients. Additionally, a better understanding of success rates and complications could help to further refine day-case pathways and promote a widespread practice.

The purpose of this systematic review and meta-analysis was to evaluate the effectiveness of day-case UKA and provide an overview of reported success, readmission, complication and reoperation rates. Based on prior reports [3, 16], it was hypothesized that day-case UKA would yield high SDD rates with low readmission and complication rates.

Methods

This systematic review with meta-analysis was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement [33]. This systematic review was not registered.

Literature search

A systematic search of the literature was performed in the databases of PubMed, Embase and Cochrane library since inception. The last search was performed on June 18, 2022. Search algorithms were designed for each database to identify all relevant original clinical studies or registry studies reporting on clinical outcomes after day-case UKA. The algorithms included various combinations of key terms: "unicompartmental knee arthroplasty", "same-day discharge," "day-case," "outpatient surgery," "ambulant," "fast-track," and "enhanced recovery." The complete search strategy is provided in Appendix I. After combining search results and removing duplicates, studies were screened independently by two reviewers (TB and LR) by title and abstract. Eligible studies were evaluated for inclusion by full-text review according to the inclusion and exclusion criteria. References of included studies were screened for additional studies. Inclusion criteria consisted of: (I) UKA performed as day-case procedure (i.e., intended discharge on the day of surgery with a description of the day-case pathway, or registry-based studies compiled from such studies), (II) reporting of rates of successful SDD, complication, readmission or reoperation, and (III) a minimum 30-days follow-up for studies reporting complications, readmissions or reoperations. Studies were excluded if they: (I) included revision procedures or simultaneous bilateral cases, (II) did not report outcomes separately for the study arm of interest, (III) were based on cohorts with incidental SDD, or (IV) were publications based on the same cohort or database. Systematic reviews, case reports, commentary letters and abstracts were not considered. If publications were based on the same cohort or database, the largest study was selected for inclusion.

Methodological quality assessment

Methodological quality of studies was assessed by one reviewer (TB) using the Methodological Index for Non-Randomized Studies (MINORS) criteria [41]. Non-comparative studies were graded using the first 8 criteria and all 12 criteria were used to grade comparative studies. Level of evidence was determined for each study using the Oxford Centre for Evidence-Based Medicine [45].

Data extraction

Data were extracted and collected in a standardized format in Excel 2019 (Microsoft Corp) by one reviewer (TB). Data verification was performed on a random sample by a second reviewer (LR). First author, publication year, journal,

study design, study period, follow-up, number of UKA day-cases, clinical setting, type of UKA, anesthesia, selection criteria for day-case surgery, reasons for failed SDD and patient characteristics (gender, age, body mass index [BMI] and American Society of Anesthesiology [ASA] score) were recorded. Additionally, rates of successful SDD, readmission, complication, reoperation and patient satisfaction were extracted.

Statistical analyses

Proportions of successful SDD were calculated as the number of patients successfully discharged on the day of surgery, divided by the total number of day-case patients. Similarly, rates of readmission, complication and reoperation were calculated. A meta-analysis of proportions, a method that allows estimation of an overall proportion from studies reporting a single proportion, was used to combine proportional outcomes across studies. To allow for variance stabilization and an accurate estimate of summary proportions, a logit transformation was first applied to the observed proportions [26]. Studies containing proportions equal to zero were augmented with 0.5 to the observed data [44]. Summary effect sizes and 95% confidence intervals (CI) were estimated with a random-effects model using the DerSimonian and Laird estimator [10]. Transformed summary effect sizes and 95% CI were converted back to proportions thereafter. Subgroup analyses were performed for selected patient cohorts (i.e., patients had to meet certain criteria to be eligible for day-case surgery) and unselected cohorts (i.e., no additional criteria for day-case surgery other than standard UKA indications), for clinical and registry-based studies, and for studies performed in the setting of a hospital outpatient pathway (HOP) or ambulatory surgery center (ASC). Heterogeneity in subgroup analyses was quantified using the I^2 measure. Due to insufficient comparative studies to perform statistical analysis between subgroups, outcomes were reported for groups without statistical comparison. Pooled means of patient characteristics and satisfaction rates were calculated. When not reported, standard deviations were calculated according to previously defined methods [43]. Analyses were performed in R version 4.1.2. (R Foundation for Statistical Computing, Vienna, Austria).

Results

Search results

After removal of duplicates and selection based on title and abstract, 67 studies were full text reviewed. A total of 29 studies met the inclusion criteria (Fig. 1). Agreement on study selection was reached for all studies, hence

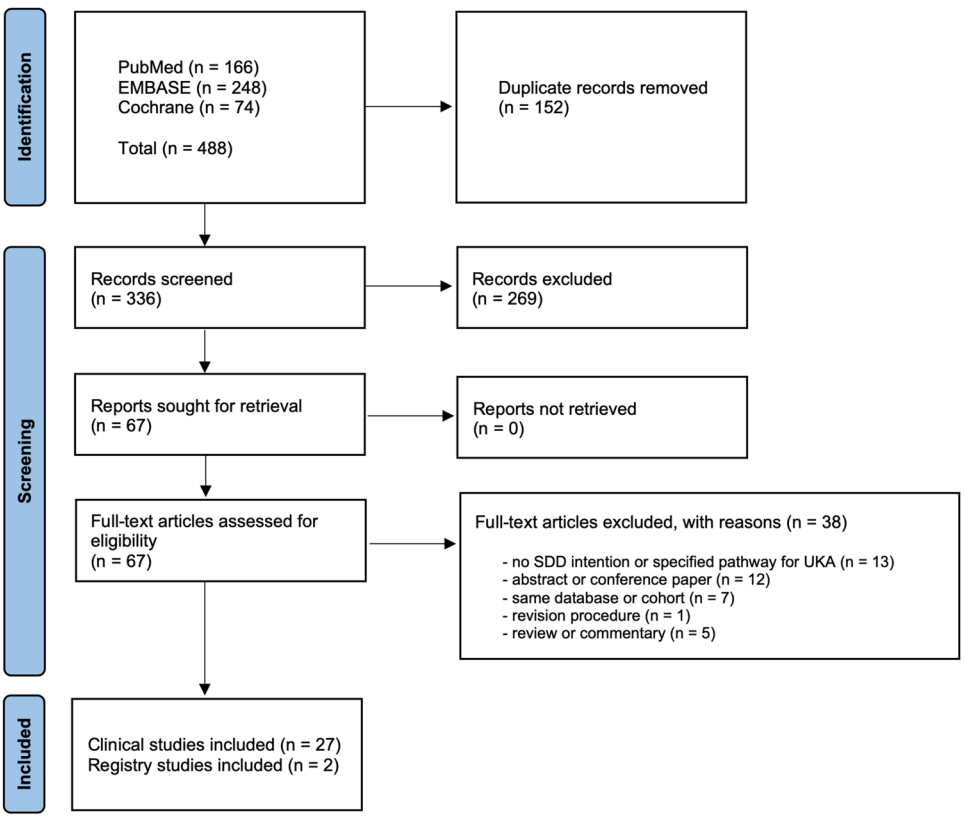

Fig. 1 PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flowchart of the inclusion and exclusion of studies [33]

Table 1 Summary of study characteristics

Authors	Year	Study design	Setting	Day-cases	Follow-up (days)	Female	Mean Age, y (SD)	Mean BMI (SD)	ASA 1–2	Patient cohort	Pre-operative education
Clinical studies											
Berger et al. [4]	2009	Consecutive case series	HOP	25[a]	90	n/r	n/r	n/r	n/r	Unselected	Yes
Dervin et al. [11]	2012	Prospective observational	HOP	24	180	42%	57.5 (6.7)[b]	29.9 (4.0)	100%	Selected	Yes
Cross et al. [8]	2014	Retrospective case series	HOP	105	90	40%	67.5 (7.9)	27.5 (4.6)	87%	Unselected	Yes
Gondusky et al. [16]	2014	Case–control	ASC	160[a]	60	35%	65.3 (8.1)	27.7 (3.4)	n/r	Selected	Yes
Bradley et al. [5]	2017	Consecutive case series	HOP	72	31	54%	62.3 (9.9)	n/r	n/r	Selected	Yes
Hoorntje et al. [18]	2017	Case–control	HOP	20[a]	90	44%	62.2 (5.5)	27.8 (3.7)	100%	Selected	Yes
Kort et al. [24]	2017	Case–control	HOP	20[a]	90	35%	60.5 (5.7)	29.1 (3.9)	100%	Selected	Yes
Richter et al. [36]	2017	Retrospective cohort	HOP and ASC	12[a]	90	42%	67.2 (9.2)	28.7 (5.1)	83%	Selected	n/r
Cody et al. [7]	2018	Retrospective cohort	ASC and HOP	569	90	54%	63 (9) / 63 (9)[c]	29.4 (5.4) / 30.2 (5.6)[c]	n/r	Selected	n/r
Frisch et al. [13]	2018	Prospective case series	HOP	5[a]	n/a	n/r	68.0 (7.7)	25.3 (2.1)	n/r	Selected	n/r
Ruiz et al. [38]	2018	Retrospective cohort	HOP	50	30	34%	66.7 (8.0)	28.4 (4.9)	90%	Selected	Yes
Darrith et al. [9]	2019	Retrospective cohort (matched)	ASC	89[a]	90	n/r	n/r	n/r	n/r	Selected	n/r
Jenkins et al. [20]	2019	Consecutive case series	HOP	669	42	51%	69 (8.8)	n/r	n/r	Unselected	Yes
Rytter et al. [39]	2019	Consecutive case series	HOP	229	90	53%	63.5 (7.6) / 65.1 (8.1)[c]	n/r	100%	Selected	Yes
Ford et al. [12]	2020	Retrospective cohort	ASC	48[a]	90	69%	58.8	34.3	n/r	Selected	Yes
Jensen et al. [21]	2020	Consecutive case series	HOP	100	n/a	57%	67 (10.8)	30 (6.4)	80%	Unselected	n/r
Matsumoto et al. [29]	2020	Retrospective case series	HOP	158	42	54%	69.5 (8.5)	29.6 (5.1)	47%	Unselected	Yes
Nakasone et al. [31]	2020	Retrospective case series	HOP	90	90	51%	70.0 (8.4)	30.5 (5.5)	52%	Unselected	Yes
Barrie et al. [1]	2021	Consecutive case series	HOP	83	30	42%	66.6 (7.6)	n/r	88%	Selected	Yes
Keulen et al. [22]	2021	Retrospective cohort	HOP	158[a]	90	51%	62 (6.9)	29 (4.0)	99%	Selected	Yes

Table 1 (continued)

Authors	Year	Study design	Setting	Day-cases	Follow-up (days)	Female	Mean Age, y (SD)	Mean BMI (SD)	ASA 1–2	Patient cohort	Pre-operative education
Lovasz et al. [27]	2021	Consecutive case series	HOP	46[a]	42	39%	62.3 (7.0)	30.2 (4.3)	100%	Selected	Yes
Mouli et al. [30]	2021	Prospective case series	HOP	10[a]	n/a	n/r	n/r	n/r	n/r	Selected	n/r
Patel et al. [35]	2021	Retrospective case series	ASC	21	270	57%	66.8 (8.5)	n/r	100%	Selected	Yes
Saunders et al. [40]	2021	Case–control (matched)	HOP	24[a]	30	50%	67 (8.5)	30.6 (5.4)	100%	Selected	Yes
Tveit [42]	2021	Prospective case series	HOP	33	90	52%	65.6 (8.3)	28.0 (3.2)	95%	Unselected	Yes
Yang et al. [46]	2021	Retrospective cohort (matched)	ASC	267[a]	90	n/r	n/r	n/r	n/r	Selected	n/r
Gao et al. [14]	2022	Prospective case–control	HOP	23	90	43%	63.1 (6.8)	29.3 (4.2)	100%	Selected	Yes
Registry-based studies											
Gruskay et al. [16]	2019	Retrospective cohort (matched)	Database, Pearl-Diver 2007–20,016	2600[a]	90	72%	n/r	n/r	n/r	n/r	n/r
Lan et al. [25]	2021	Retrospective cohort (matched)	Database, ACS-NSQIP 2009–2018	3984[a]	30	n/r	n/r	n/r	n/r	n/r	n/r
			Studies	Day-cases	Follow-up	Female	Age	BMI	ASA 1–2		
Clinical studies			27	3110	72	50%	66 (9)	29 (5)	85%		
Registry-based studies			2	6584	54	n/a	n/a	n/a	n/a		
Overall			29	9694	59	61%	66 (9)	29 (5)	85%		

ASA American Society of Anesthesiology, *ASC* ambulatory surgery center, *ACS-NSQIP* American College of Surgeons National Surgery Quality Improvement Program, *BMI* body mass index, *HOP* hospital outpatient pathway, *n/a* not applicable, *n/r* not reported or not reported for the study arm of interest, *SD* standard deviation, *y* year

[a] Study arm including day-case unicompartmental knee arthroplasty (UKA) patients

[b] Mean age was calculated from median age and range[43]

[c] Means are reported separately for two study arms

Table 2 Quality assessment of included studies using MINORS criteria

Authors	Year	Journal	LoE	MINORS criteria												
				1	2	3	4	5	6	7	8	9	10	11	12	Total
Berger et al. [4]	2009	Clin Orthop Relat Res	IV	2	2	2	2	0	2	2	0	–	–	–	–	12
Dervin et al. [11]	2012	J Arthroplasty	IV	2	2	2	2	0	2	2	0	–	–	–	–	12
Cross et al. [8]	2014	Int Orthop	IV	2	2	1	2	0	2	2	0	–	–	–	–	11
Gondusky et al. [15]	2014	J Arthroplasty	III	2	2	2	2	0	2	2	0	2	1	1	2	18
Bradley et al. [5]	2017	Bone Jt J	IV	2	2	2	2	0	2	2	0	–	–	–	–	12
Hoorntje et al. [18]	2017	Knee Surg Sports Traumatol Arthros	III	2	2	2	2	0	2	2	2	2	2	1	2	21
Kort et al. [24]	2017	Knee Surg Sports Traumatol Arthros	III	2	2	2	2	0	2	2	2	2	1	2	2	21
Richter et al. [36]	2017	Orthop J Sports Med	III	2	2	1	2	0	2	2	0	2	2	2	2	19
Cody et al. [7]	2018	J Arthroplasty	III	2	1	1	2	0	2	2	0	2	2	1	2	17
Frisch et al. [13]	2018	Arthroplast Today	IV	2	2	2	2	0	2	2	1	–	–	–	–	13
Ruiz et al. [38]	2018	Orthop Traumatol Surg Res	IV	2	2	1	2	0	2	2	0	–	–	–	–	11
Darrith et al. [9]	2019	J Arthroplasty	III	2	2	1	2	0	2	2	1	2	2	2	2	20
Gruskay et al. [16]	2019	Knee	III	2	1	1	2	0	2	2	0	2	1	1	2	16
Jenkins et al. [20]	2019	Physiotherapy	IV	2	2	2	2	0	2	2	0	–	–	–	–	12
Rytter et al. [39]	2019	Dan Med	IV	2	2	2	2	0	2	2	0	–	–	–	–	12
Ford et al. [12]	2020	Orthop Clin N Am	III	2	1	1	2	0	2	2	0	2	1	2	2	17
Jensen et al. [21]	2020	Acta Orthop	IV	2	2	2	2	0	2	2	0	–	–	–	–	12
Matsumoto et al. [29]	2020	Knee	IV	2	2	1	2	0	2	2	0	–	–	–	–	11
Nakasone et al. [31]	2020	Knee	IV	2	2	1	2	0	2	2	0	–	–	–	–	11
Barrie et al. [1]	2021	Knee	IV	2	2	2	2	0	2	2	0	–	–	–	–	12
Keulen et al. [22]	2021	J Arthroplasty	III	2	2	1	2	0	2	2	0	2	2	2	2	19
Lan et al. [25]	2021	J Bone Joint Surg	III	2	2	1	2	0	2	2	0	2	2	2	2	19
Lovasz et al. [27]	2021	J Orthop Surg Rel	IV	2	1	1	2	0	2	2	0	–	–	–	–	10
Mouli et al. [30]	2021	Sensors	IV	2	1	2	2	0	2	2	0	–	–	–	–	11
Patel et al. [35]	2021	Knee	IV	2	2	1	2	1	2	2	2	–	–	–	–	14
Saunders et al. [40]	2021	BJO	III	2	1	2	2	0	2	2	0	2	2	1	2	18
Tveit [42]	2021	Plos One	IV	2	2	2	2	0	2	2	2	–	–	–	–	14
Yang et al. [46]	2021	Bone Jt J	III	2	1	1	2	0	2	2	0	2	1	2	2	17
Gao et al. [14]	2022	Musculoskeletal Care	III	2	2	2	2	0	2	2	1	2	2	2	2	21

LoE level of evidence, *MINORS* Methodological Index for Non-Randomized Studies. MINORS criteria: 0 points when not reported, 1 when reported but not adequate, and 2 when reported and adequate; maximum for comparative studies. (1) A clearly stated aim: the question addressed should be precise and relevant in the light of available literature. (2) Inclusion of consecutive patients: all patients potentially fit for inclusion (satisfying the criteria for inclusion) have been included in the study during the study period (no exclusion or details about the reasons for exclusion). (3) Prospective collection of data: data were collected according to a protocol established before the beginning of the study. (4) Endpoints appropriate to the aim of the study: unambiguous explanation of the criteria used to evaluate the main outcome, which should be in accordance with the question addressed by the study. In addition, the endpoints should be assessed on an intention-to-treat basis. (5) Unbiased assessment of the study endpoint: blind evaluation of objective endpoints and double-blind evaluation of subjective endpoints. Otherwise, the reasons for not blinding should be stated. (6) Follow-up period appropriate to the aim of the study: the follow-up should be sufficiently long to allow the assessment of the main endpoint and possible adverse events. (7) Loss to follow-up \5%: all patients should be included in the follow-up. Otherwise, the proportion lost to follow-up should not exceed the proportion experiencing the major endpoint. (8) Prospective calculation of the study size: information on the size of detectable difference of interest with a calculation of 95% CI, according to the expected incidence of the outcome event, and information about the level for statistical significance and estimates of power when comparing the outcomes. (9) An adequate control group: having a gold standard diagnostic test or therapeutic intervention recognized as the optimal intervention according to the available published data. (10) Contemporary groups: control and studies group should be managed during the same period. (11) Baseline equivalence of groups: the groups should be similar regarding the criteria other than the studied endpoint. Absence of confounding factors that could bias the interpretation of the results. (12) Adequate statistical analyses: whether statistics were in accordance with the type of study with a calculation of confidence intervals or relative risk

Table 3 Successful same-day discharge rates after unicompartmental knee arthroplasty

Authors	Day-cases	SDD rate	Mean age, y (SD)	Mean BMI, (SD)	ASA 1–2	Medial UKA	Anesthesia	Selection criteria day-case UKA
Selected patient cohort								
Dervin et al. [11]	24	100%	57.5 (6.7)[a]	29.9 (4.0)	100%	79%	RA	ASA ≤ 2, adequate social and home environment
Gondusky et al. [16]	160	100%	65.3 (8.1)	27.7 (3.4)	n/r	91%[b]	RA	ASA ≤ 3, cardiac clearance, adequate social and home environment
Bradley et al. [5]	72	85%	62.3 (9.9)	n/r	n/r	n/r	GA	Stable comorbidities, adequate social and home environment
Hoorntje et al. [18]	20	90%	62.2 (5.5)	27.8 (3.7)	100%	n/r	GA or RA	ASA ≤ 2, age < 70, BMI ≤ 35, medical history, home close to physiotherapist
Kort et al. [24]	20	85%	60.5 (5.7)	29.1 (3.9)	100%	n/r	GA or RA	No severe comorbidities, adequate social and home environment, patient motivation
Richter et al. [36]	12	100%	67.2 (9.2)	28.7 (5.1)	83%	100%	GA or RA	No severe comorbidities, adequate social and home environment, live within in close proximity of surgical center
Cody et al. [7]	569	100%	63 (9)/63 (9)[c]	29.4 (5.4)/30.2 (5.6)[c]	n/r	85%	RA	No severe comorbidities, adequate social and home environment
Frisch et al. [13]	5	100%	68.0 (7.7)	25.3 (2.1)	n/r	n/r	RA	Not specified
Ruiz et al. [38]	50	94%	66.7 (8.0)	28.4 (4.9)	90%	86%	GA	ASA ≤ 3, Age < 80, no oral anticoagulant
Rytter et al. [39]	229	59%	63.5 (7.6)/65.1 (8.1)[c]	n/r	100%	96%	GA or RA	ASA ≤ 2, adequate social and home environment
Ford et al. [12]	48	100%	58.8	34.3	n/r	100%	GA or RA	ASA ≤ 3, mentally and physically fit per surgeons' selection
Barrie et al. [1]	83	76%	66.6 (7.6)	n/r	88%	58%	RA	No severe comorbidities, BMI, ASA, age, adequate social and home environment
Keulen et al. [22]	158	85%	62 (6.9)	29 (4.0)	99%	n/r	GA or RA	No severe comorbidities, patient motivation, adequate social and home environment

Table 3 (continued)

Authors	Day-cases	SDD rate	Mean age, y (SD)	Mean BMI, (SD)	ASA 1–2	Medial UKA	Anesthesia	Selection criteria day-case UKA
Lovasz et al. [27]	46	89%	62.3 (7.0)	30.2 (4.3)	100%	100%	RA	ASA ≤ 3, no severe comorbidities, patient motivation, adequate social and home environment
Mouli et al. [30]	10	100%	n/r	n/r	n/r	n/r	RA	No severe comorbidities, adequate social and home environment
Saunders et al. [40]	24	67%	67 (8.5)	30.6 (5.4)	100%	n/r	GA or RA	ASA ≤ 2, no comorbidities, adequate social and home environment
Gao et al. [14]	23	100%	63.1 (6.8)	29.3 (4.2)	100%	n/r[b]	n/r	Surgeon's assessment of comorbidities, social and phycological factors
Unselected patient cohort								
Berger et al. [4]	25	96%	n/r	n/r	n/r	n/r	RA	n/a
Cross et al. [8]	105	100%	67.5 (7.9)	27.5 (4.6)	87%	89%	RA	Logistical: operation before noon
Jenkins et al. [20]	669	39%	69 (8.8)	n/r	n/r	n/r	RA	n/a
Jensen et al. [21]	100	22%	67 (10.8)	30 (6.4)	80%	100%	GA or RA	n/a
Matsumoto et al. [29]	158	84%	69.5 (8.5)	n/r	47%	98%	GA	n/a
Nakasone et al. [31]	90	72%	70.0 (8.4)	30.5 (5.5)	52%	n/r	GA	n/a
Tveit [42]	33	88%	65.6 (8.3)	28.0 (3.2)	95%	100%	GA	Logistical: operation before noon

	Day-cases	SDD (95% CI)	Age	BMI	ASA 1–2
Selected patient cohort	1553	91% (84–95)	63 (8)	29 (5)	97%
Unselected patient cohort	1180	76% (55–89)	69 (9)	29 (7)	68%
Overall	2733	88% (80–92)	65 (9)	29 (5)	85%

Successful same-day discharge (SDD) rates are reported per study and pooled for selected and unselected overall cohorts, as well as for the total cohort. Patient characteristics are reported as mean and standard deviation (SD), or as frequencies. Selection criteria for day-case unicompartmental knee arthroplasty (UKA) patients are reported for studies including selected patients

ASA American Society of Anesthesiology, *BMI* body mass index, *CI* confidence interval, *GA* general anesthesia, *n/a* not applicable, *n/r* not reported or not reported for the study arm of interest, *RA* regional anesthesia, *y* years

[a]Mean age was calculated from median age and range[43]

[b]Cohort includes three to four patellofemoral arthroplasties

[c]Means are reported separately for two study arms

consultation of a third reviewer was not necessary. A summary of excluded studies is provided in Appendix II.

Methodological quality

A total of 27 clinical studies and 2 registry-based studies were included (Table 1). Thirteen studies were comparative level III studies and 16 were non-comparative level IV studies (Table 2). The average MINORS score was 18.7 (78% of the maximum score) for comparative studies and 11.9 (75% of the maximum score) for non-comparative studies.

Study characteristics

A total of 9694 patients were included with a mean age of 66 ± 9 years and mean follow-up of 59 days (mean range

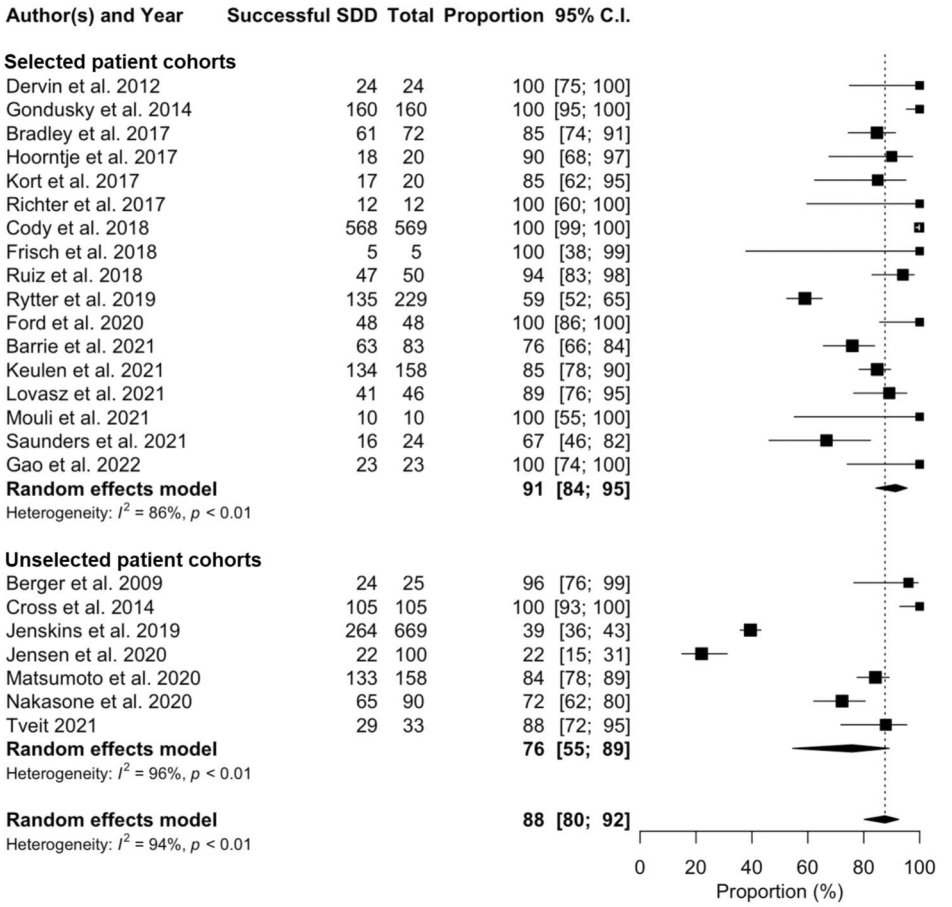

Fig. 2 Proportional meta-analysis to estimate the overall successful same-day discharge (SDD) rate after day-case unicompartmental knee arthroplasty (UKA) and SDD rates of subgroups consisting of studies with selected patients (i.e., patients had to meet certain patient-specific criteria to be eligible for day-case UKA) and unselected patients (i.e., no additional criteria for day-case UKA)

30–270 days) (Table 1). Mean BMI was 29 ± 5, 85% of patients were classified as ASA 1–2, and 61% were female. Of studies reporting SDD rates, 17 included a selected patient cohort and 7 studies included an unselected patient cohort. A summary of study characteristics is presented in Table 1.

Successful same-day discharge

SDD rates were reported in 24 studies (2733 patients) (Table 3). The overall successful SDD rate across these studies was 88% (95% CI 80–92; $I^2 = 96\%$) (Table 3; Fig. 2). Subgroup analysis demonstrated an SDD rate of 91% (95% CI 84–95; $I^2 = 86\%$) across studies with selected patients (1553 patients), and an SDD rate of 76% (95% CI 55–89; $I^2 = 96\%$) across studies with unselected patients (1180 patients) (Fig. 2). Patient characteristics per subgroup are displayed in Table 3.

Reasons for failure to successful same-day discharge

The most frequently reported reasons preventing patients from SDD were inability to mobilize (due to pain, muscle weakness, nausea or other reasons), postoperative nausea and vomiting, inadequate pain control, and lack of confidence from the patients' perspective or lack of adequate support at home (Table 4). Logistical issues (e.g., surgery did not start before noon) were additional considerable barriers to SDD. Other reasons were mostly related to wound concerns, urinary retention and co-morbidities.

Readmissions, complications and reoperations

Readmission, complication or reoperation rates were reported in 26 studies (Table 5). The overall readmission rate was 3% (95% CI 1.9–4.4; $I^2 = 80\%$) across all studies (8753 patients, mean follow-up 60 days) (Fig. 3). Clinical studies (2169 patients, mean follow-up 78 days) and registry-based (6584 patients, mean follow-up 54 days) studies had readmission rates of 3% (95% CI 1.7–4.4; $I^2 = 0\%$), and 3% (95% CI 1.2–9.4; $I^2 = 99\%$), respectively. Complications occurred at an overall rate of 4% (95% CI 2.8–5.2; $I^2 = 72\%$) across all studies (8843 patients, mean follow-up 60 days) (Fig. 4). Complication rates were 4% (95% CI 3.0–5.9; $I^2 = 42\%$) for clinical studies (2259 patients, mean follow-up 78 days) and 3% (95% CI 1.3–5.1; $I^2 = 96\%$) for registry-based studies

Table 4 Common reasons for the failure of same-day discharge after unicompartmental knee arthroplasty

Authors	Day-cases	Failed SDD	Reasons for failure of SDD							
			Inability to mobilize	Pain control	Nausea and vomiting	Logistical	Wound issues	Urinary retention	Patient confidence or social environment	Other
Selected patient cohort										
Bradley et al. [5]	72	15%	27%	18%		45%	9%			
Hoorntje et al. [18]	20	10%				50%				50%
Kort et al. [24]	20	15%		67%					33%	
Cody et al. [7]	569	0.2%	100%							
Ruiz et al. [38]	50	6%			100%					
Rytter et al. [39]	229	41%	40%			14%	27%		19%	
Lovasz et al. [27]	46	11%	20%					40%	20%	20%
Saunders et al. [40]	24	33%	13%	25%	50%			13%		
Unselected patient cohort										
Berger et al. [4]	25	4%			100%					
Jenkins et al. [20]	669	61%	27%	8%	13%	8%	5%		11%	29%
Jensen et al. [21]	100	78%	81%	19%	6%		3%	18%		1%
Matsumoto et al. [29]	158	16%			18%					
Tveit [42]	33	12%			25%			25%		50%
	No. Failed SDD									
Selected patient cohort	127		34%	5%	6%	15%	21%	2%	16%	2%
Unselected patient cohort	516		34%	9%	12%	6%	4%	3%	9%	23%
Overall	643		34%	8%	11%	8%	8%	3%	10%	19%

Common reasons for the failure of same-day discharge (SDD) after day-case unicompartmental knee arthroplasty (UKA) reported in included studies were classified as "inability to mobilize" (i.e., not able to mobilize due to pain, nausea, reduced muscle strength, active anesthesia or other reasons), "pain control," "postoperative nausea and/or vomiting," "logistical" (i.e., delay in surgical schedule); wound issues (i.e., leakage or other concerns), "urinary retention," "patient confidence or social environment" (i.e., lack of confidence or concerns from the patient's perspective, or lack of adequate support at home), or "other" (e.g., undefined medical reasons, co-morbidities, delay in radiographic or physiotherapy protocols interfering with discharge)

Table 5 Rates of readmission, complication, reoperation and patient satisfaction

Authors	Setting	Day-cases	Follow-up, days	Readmissions	Complications	Reoperations	30-day complications	Patient satisfaction
Clinical studies								
Berger et al. [4]	HOP	25	90	0.0%	0.0%	0.0%	0.0%	
Dervin et al. [11]	HOP	24	180	8.3%	8.3%	4.2%	4.2%	100%
Cross et al. [8]	HOP	105	90	1.0%	1.0%	1.0%	0.0%	
Bradley et al. [5]	HOP	72	31	0.0%	0.0%	0.0%	0.0%	100%
Hoorntje et al. [18]	HOP	18	90	0.0%	5.6%	0.0%	5.6%	
Kort et al. [24]	HOP	20	90	5.0%	5.0%	5.0%	0.0%	
Cody et al. [7]	HOP	281[a]	90	2.8%	6.4%	1.4%		
Ruiz et al. [38]	HOP	47	30	2.1%	0.0%	0.0%	0.0%	96%
Jenkins et al. [20]	HOP	264	42	4.9%	3.4%	1.1%	3.4%	90%
Rytter et al. [39]	HOP	94	90	2.1%	2.1%	0.0%		
Nakasone et al. [31]	HOP	90	90		0.0%			
Barrie et al. [1]	HOP	83	30	1.2%	3.9%		0.0%	100%
Keulen et al. [22]	HOP	134	90	3.7%	9.0%	0.7%	3.7%	
Lovasz et al. [27]	HOP	41	42	2.4%	2.4%	0.0%		
Saunders et al. [40]	HOP	24	30	4.2%	0.0%	0.0%	0.0%	86%
Tveit [42]	HOP	29	90	6.9%	6.9%	0.0%	0.0%	93%
Gao et al. [14]	HOP	23	90	0.0%	0.0%	0.0%	0.0%	
Gondusky et al. [16]	ASC	160	60	1.3%	3.1%	1.3%		93%
Cody et al. [7]	ASC	288[b]	90	1.7%	4.2%	0.7%		
Darrith et al. [9]	ASC	89	90	2.2%	13.5%	1.1%		
Ford et al. [12]	ASC	48	90	0.0%	2.2%	0.0%	0.0%	
Patel et al. [35]	ASC	21	270	4.8%	9.5%	0.0%		100%
Richter et al. [36]	ASC	12	90	0.0%	0.0%	0.0%	0.0%	
Yang et al. [46]	ASC	267	90	2.6%	2.6%	1.1%		
Registry studies								
Gruskay et al. [16]		2600	90	6.6%	3.7%		2.3%	
Lan et al. [25]		3984	30	1.7%	1.8%	0.9%	1.8%	
		Day-cases	Follow-up	(95% CI)	(95% CI)	(95% CI)	(95% CI)	
Clinical studies		2259	78	3% (1.7–4.4)	4% (3.0–5.9)	1% (0.9–1.9)	3% (1.9–4.3)	94%
Registry studies		6584	54	3% (1.2–9.4)	3% (1.3–5.1)	n/a	2% (1.7–2.4)	n/a
HOP setting		1374	71	4% (2.6–4.8)	4% (2.5–5.9)	1% (0.9–2.3)	n/a	94%
ASC setting		885	89	2% (1.4–3.4)	5% (2.9–8.2)	1% (0.6–2.1)	n/a	94%
Overall		8843	60	3% (1.9–4.4)	4% (2.8–5.2)	1% (0.8–1.3)	2% (1.8–2.4)	94%

Rates of readmission, complications and reoperations are reported per study, subgroup and as overall cohort. Patient satisfaction is reported as the proportion of patients who were either satisfied or very satisfied with the procedure

ASC ambulatory surgery center, *CI* confidence interval, *HOP* hospital outpatient pathway, *n/a* not applicable, *SDD* same-day discharge

[a] Study arm with day-cases performed in HOP setting

[b] Study arm with day-cases performed in ASC setting

(6584 patients, mean follow-up 54 days). The overall reoperation rate was 1% (95% CI 0.8–1.3; $I^2 = 0\%$) for all studies (8670 patients, mean follow-up 60 days) and 1% (95% CI 0.9–1.9; $I^2 = 0\%$) for clinical studies (2086 patients, mean follow-up 79 days) (Fig. 5). The overall 30-days complication rate was 2% (95% CI 1.8–2.4; $I^2 = 0\%$) across all studies (7512 patients), 3% (95% CI 1.9–4.3; $I^2 = 0\%$)) for clinical studies (928 patients), and 2% (95% CI 1.7–2.4; $I^2 = 48\%$) for registry-based studies (6584 patients) (Fig. 6). Estimated rates of readmission, complication and reoperations are reported separately for studies performed in HOP setting and ASC in Table 5.

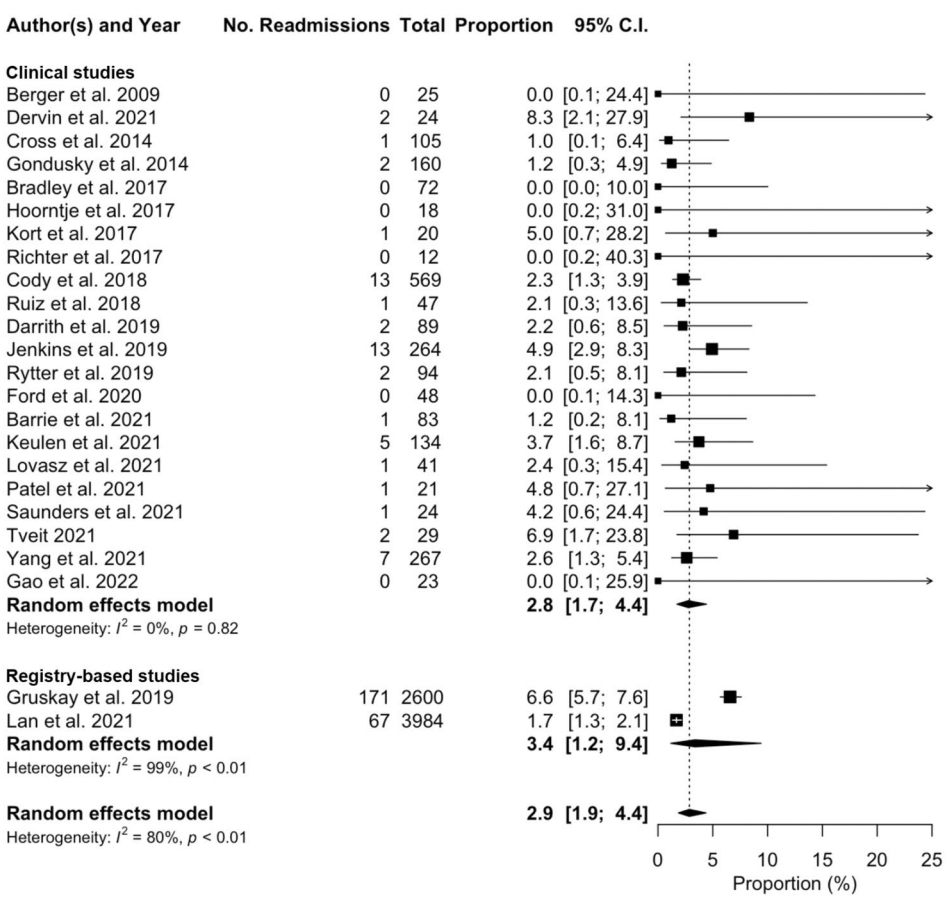

Fig. 3 Proportional meta-analysis to estimate the overall readmission rate after day-case unicompartmental knee arthroplasty and readmission rates of subgroups consisting of clinical studies and registry-based studies

Patient satisfaction

Overall patient satisfaction (688 patients) was 94%, reflecting the proportion of patients who were satisfied or very satisfied with the procedure (Table 5). Satisfaction rates across selected (395 patients) and unselected cohorts (293 patients) were 96% and 90%, respectively.

Discussion

The most important finding of this systematic review and meta-analysis was that day-case pathways for UKA resulted in an 88% successful SDD rate in a heterogeneous cohort of patients selected for day-case surgery and unselected patients. Successful SDD rates across studies with selected patients and unselected patients were 91% and 76%, respectively. Overall readmission, complication and reoperation rates were low and overall patient satisfaction was high (94%). These findings suggest that UKA can be performed safely and effectively as a day-case procedure, confirming our hypothesis. However, it should be noted that this applies primarily to patients who were preselected for day-case surgery, mainly based on their overall health status, motivation and support at home.

Over the years, joint arthroplasty services have shifted towards enhanced recovery models. Optimization of perioperative protocols and surgical techniques have largely overcome traditional reasons for hospital admission after joint arthroplasty (e.g., pain, decreased mobility), paving the way for same-day home discharge after such procedures [4]. Several day-case UKA pathways have demonstrated excellent results in terms of success rates and adverse events [1, 4, 12, 18, 27, 38]. However, most of these studies were performed with carefully selected patients, and the current literature remains divided on the feasibility of day-case UKA without preselection of patients [3, 8]. Given the controversy in the literature, analyses of SDD rates in this study were performed separately for selected and unselected patients. The overall SDD rate of 76% across unselected patients appears to be lower compared to 91% SDD across selected patients. Furthermore, selected patient studies showed less variability in SDD rates compared to unselected patient studies, suggesting that outcomes may be more predictable in selected patients. Although no statistical comparison was performed, it could be argued that differences in outcome may have resulted from strict selection criteria for day-case

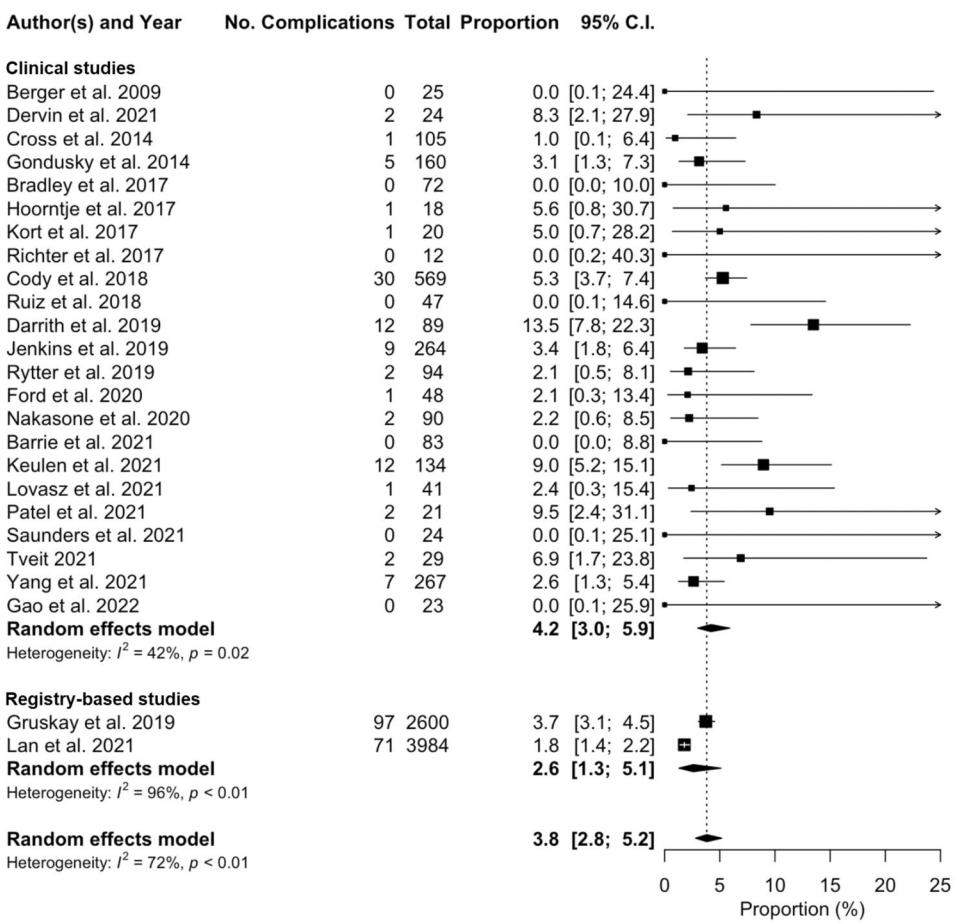

Fig. 4 Proportional meta-analysis to estimate the overall complication rate after day-case unicompartmental knee arthroplasty and complication rates of subgroups consisting of clinical studies and registry-based studies

surgery applied by these studies. Nonetheless, several unselected patient studies [4, 8, 42] had high individual SDD rates (range 88–100%), suggesting the feasibility of day-case surgery in a larger percentage of UKA patients. It should be noted, however, that these studies [4, 8, 42] were conducted at centers with extensive experience in fast-track protocols. It is therefore plausible that these outcomes cannot be extrapolated to less experienced centers intending to enroll unselected patients for day-case UKA.

Commonly reported reasons for failed SDD can serve to refine day-case pathways. Decreased mobility, nausea and uncontrolled pain were frequently reported reasons for SDD failure. These findings are in line with common barriers to SDD for day-case hip and knee arthroplasty [17], and essentially reflect the traditional rationale for hospital admission after joint arthroplasty. Saunders et al. [40] found a failure of SDD was strongly associated with the use of opioids in spinal anesthetics, whereas Kort et al. [24] reported uncontrolled pain as the main factor for failed SDD, using an opioid-sparing pain protocol. These findings emphasize the complexity of perioperative protocols for SDD pathways and demonstrate a need for improved anesthesia and multimodal pain control strategies. Additionally, a lack of patient confidence and logistical issues were important reasons for failed SDD. In particular, reserving morning slots for day-case procedures appeared critical to allow patients and staff sufficient time to prepare for home discharge [5, 18, 20]. In studies analyzing characteristics of patients who failed SDD, it was further found that these patients were significantly older [29, 42], more frequently female [22, 29], and had higher ASA scores (> II/III) [22, 42] compared to patients with successful SDD. As noted by Tveit [42], these characteristics reflect some of the commonly reported selection criteria to determine eligibility for day-case UKA [15, 18, 38], thereby affirming the relevance of these criteria.

Although a shorter length of stay following UKA could prevent hospital-acquired complications, a few authors have raised concerns about the safety of day-case pathways following increased rates of adverse events compared to inpatient pathways [28, 32]. Nonetheless, larger and more recent

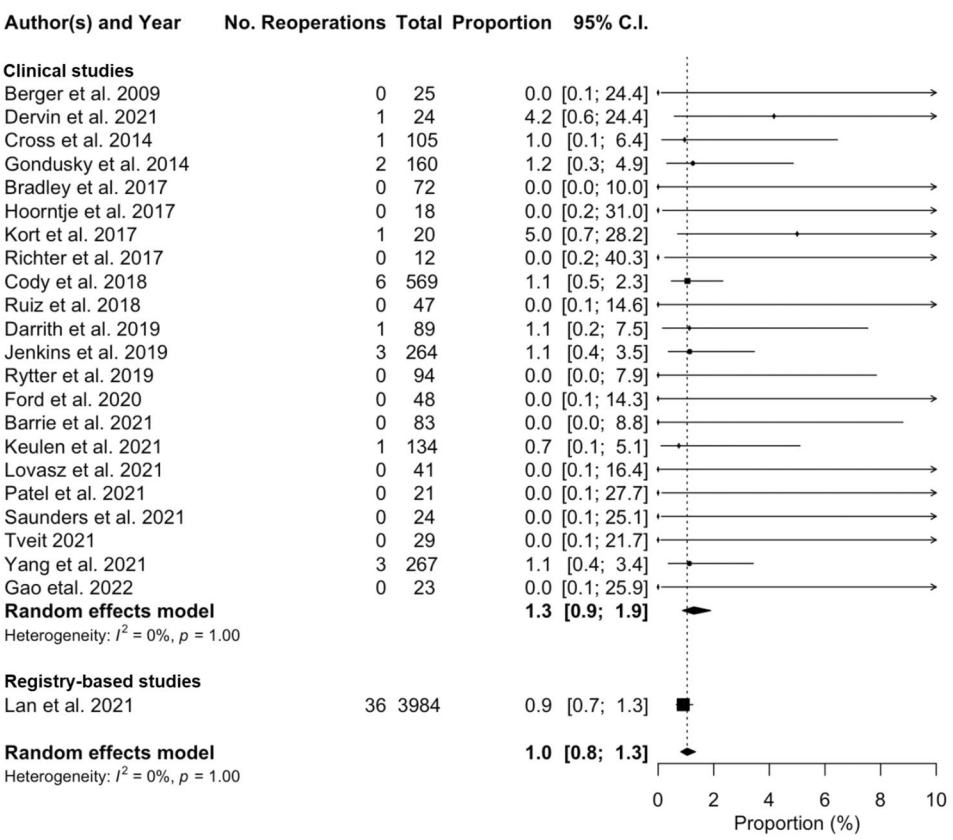

Fig. 5 Proportional meta-analysis to estimate the overall reoperation rate after day-case unicompartmental knee arthroplasty and reoperation rates of subgroups consisting of clinical studies and registry-based studies

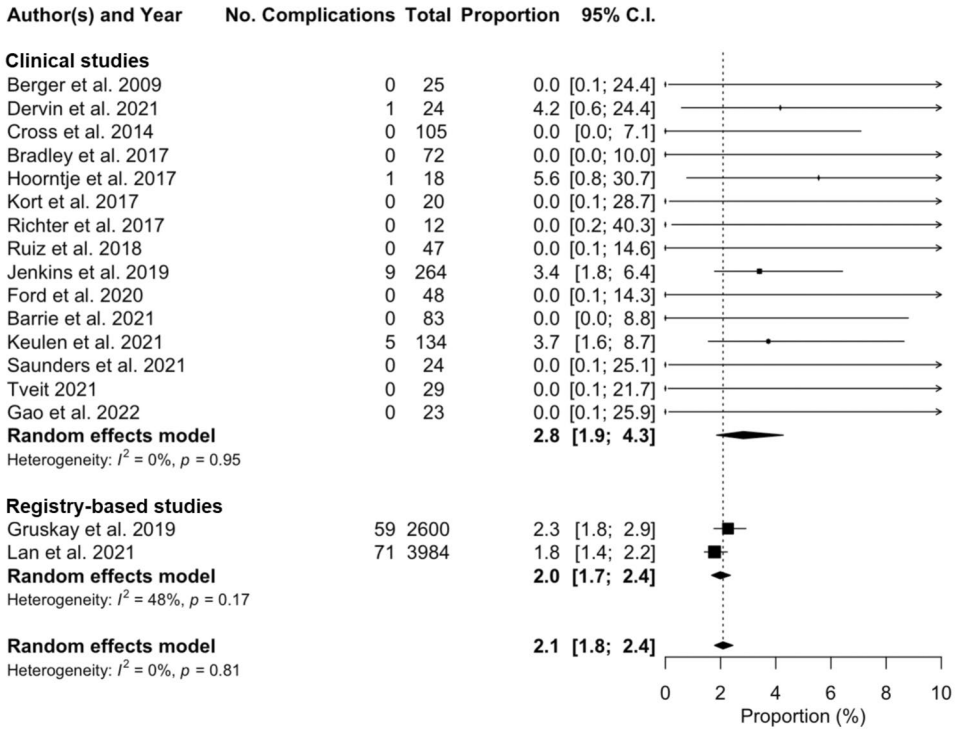

Fig. 6 Proportional meta-analysis to estimate the overall 30-day complication rate after day-case unicompartmental knee arthroplasty and 30-day complication rates of subgroups consisting of clinical studies and registry-based studies

studies have demonstrated that day-case arthroplasty leads to similar [3], or reduced rates [16, 25] of readmission and complication compared to (matched) inpatient controls. The current study found readmission, complication and reoperation rates, comparable to those reported for inpatient UKA [2, 16, 25]. Interestingly, subgroup analyses of these outcomes for clinical and registry-based studies revealed differences in heterogeneity, with no or little heterogeneity across clinical studies. This suggests heterogeneity across clinical studies was likely caused by sampling error rather than true between-study differences and contributes to the robustness of these results. Additionally, we reported complication rates separately for studies performed in an ASC or HOP setting. Due to the unique setup of ASCs, which are commonly not affiliated with inpatient hospitals and often have limited resources, it is important to appreciate outcomes independently for each setting. Readmission, complication and reoperation rates were low for both settings, suggesting day-case UKA can be performed safely in either ASC or HOP setting.

Overall, UKA appears to be an effective and safe day-case procedure. Key factors to ensure successful results lie mainly in the foundation of a well-designed multidisciplinary protocol, educational programs to inform patients, and logistic strategies to prioritize day-case procedures. Improvements are to be made in the consideration of anesthetics and strategies to optimize mobilization, prevent nausea and control pain [20, 24, 29, 40]. Unless clinical teams already have extensive experience with fast-track or day-case UKA, it seems advisable to use carefully considered criteria for the selection of day-case patients [4, 42]. Finally, it is worth noting that a day-case pathway may cause a shift of patient care responsibility from healthcare systems to patients' social environments, potentially necessitating caregiving during the early postoperative period [4, 8]. This further emphasizes the relevance of patient selection and preoperative education. Further research on the generalizability of day-case protocols with regard to both patient selection and hospital setting is needed, ultimately leading to a clinical tool to help determine suitability for day-case UKA.

This study recognizes several limitations. First, this is a systematic review of level III and IV studies with an inherent risk of methodological bias, as was reflected in the suboptimal MINORS scores and may have influenced the results of this study. Second, included series were largely performed by experienced surgeons in devoted fast-track settings. Patients selected for day-case UKA (even when labeled as unselected) may often be healthier than average arthroplasty patients. It is likely that a selection bias inherent to the included studies is present, limiting generalizability to less experienced centers. Third, analyses of readmission, complication and reoperation rates were not adjusted for the follow-up period. Nevertheless, the majority of studies had a follow-up period around 90 days and a separate analysis was performed for studies reporting 30-day complication rates. Fourth, there was substantial statistical heterogeneity in the analysis of SDD rates, resulting in decreased certainty of the estimated overall effect and effect estimates of each subgroup. Although random-effects models were undertaken to incorporate heterogeneity among studies, the observed heterogeneity should be considered when interpretating these results. Finally, due to a lack of direct comparative studies of selected and unselected patients, it was not possible to statistically compare subgroups. Therefore, outcomes were only described per group. Nonetheless, this study provides a clear overview of success and complications rates after day-case UKA and may serve as a supportive aid for clinicians.

Conclusion

This systematic review with meta-analysis found an overall successful SDD rate of 88% after UKA in a heterogeneous cohort of selected and unselected patients. Readmission, complication and reoperation rates suggest UKA can be performed safely and effectively as a same-day discharge procedure.

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Author contributions TB: study design, data screening and extraction, data interpretation, and manuscript preparation. JPL: study design, data interpretation, and manuscript preparation. LR: data screening and extraction, data interpretation, and manuscript preparation. HAZ: study design, data interpretation, and manuscript preparation. GMMJK: study design, data interpretation, and manuscript preparation. ADP: study design, data interpretation, and manuscript preparation. All authors have read and approved the final manuscript.

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Declarations

Conflict of interest All authors declare no conflict of interest.

Ethical approval Ethical approval was not applicable for this study.

Informed consent Informed consent was not applicable for this study.

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