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Outpatient vs. inpatient total shoulder arthroplasty: complication rates, clinical outcomes, and eligibility parameters

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Background: Improvements in total shoulder arthroplasty (TSA), fast-track surgery, multimodal anesthesia, and rehabilitation protocols have opened up the possibility of outpatient care that is now routinely practiced at our European institution. The first objective of this study was to define the TSA outpatient population and to verify that outpatient management of TSA does not increase the risk of complications. The second objective was to determine patient eligibility parameters and the third was to compare functional outcomes and identify influencing factors.
Methods: The study included 165 patients who had primary TSA (106 outpatient and 59 inpatient procedures). The operative technique was the same for both groups. Demographics, complications, readmissions, and revisions were collected. American Society of Anesthesiologists, Constant, American Shoulder and Elbow Surgeons, University of California Los Angeles shoulder, and Shoulder Pain and Disability Index scores were obtained preoperatively and at 1.5, 6, and 12 months postoperatively. Satisfaction and visual analog scale pain scores also were documented. Statistical analysis was completed using multivariate linear regression.
Results: Outpatients were significantly younger and had lower American Society of Anesthesiologists scores than inpatients. The rates of complications, readmissions, and reoperations were not significantly different between groups. Outpatient surgery was not an independent risk factor for complications. At 1.5 months, better outcomes were noted in the outpatient group for all scores, and these reached statistical significance. Distance to home, dominant side, operative time, and blood loss were not associated with functional results. Multivariate analysis demonstrated that outpatient care was significantly associated with improved scores at 1.5 months and did not affect functional outcomes at 6 and 12 months.
Conclusion: This study reports the results of routine outpatient TSA within a European healthcare system. TSA performed in an outpatient setting was not an independent risk factor for complications and seemed to be an independent factor in improving early functional results.

The number of total shoulder arthroplasties (TSAs) performed each year is continuously increasing,[12,20] and the indications have been extended to more varied patient profiles,[30,34] with excellent clinical results, lower complication rates, and longer implant survivorships.[13,16,25] Improvements in implant designs and instrumentation as well as surgical techniques have decreased overall complication rates.[2,19,25] In addition, the concepts of fast-track and enhanced recovery after surgery,[5,27,31] as well as recent advances in multimodal anesthesia and rehabilitation protocols with early mobilization, have reduced average lengths of hospital stays.[12,34,15] Thus, the outpatient management of TSA appeared possible and began to be practiced in specialized centers, particularly in the United States. Since those early attempts,[4,7,8,11,14,23,28,36] the management of TSA on an outpatient basis has increased[15] and is supported by several meta-analyses that have shown well-established safety and financial effectiveness of outpatient TSA.[1,3,10,21,22,33]

The first published results described a relatively small series of 21-50 patients,[4,7,8,11,23] and only a few series in the literature included more than 100 patients comparing complications, readmissions, reoperation rates, and clinical outcomes between

This study has been validated by an independent ethics committee (Bordeaux Merignac Sport clinic. Approval number 02202-07).

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outpatient and inpatient TSA.[14,28,36] Although no significant differences have been noted in clinical outcome scores, number of emergency department visits, and surgical morbidity,[14,28] Erickson et al[14] and Willenbring et al[36] reported significantly lower complication rates in outpatient vs. inpatient TSA cohorts (7% vs. 12.7% and 4.1% vs 6.4%, respectively). A recent study by Brolin et al[6] discussed some of the preconceived and real obstacles and financial constraints related to this type of care from a surgeon's perspective; most reasons given for not performing outpatient TSA were insurance contracts, patient age, comorbidities, and social support, and concerns about complications and risk of readmission.[6]

The first objective of this study was to define the TSA outpatient population and compare postoperative complications between outpatient and inpatient TSA to verify that outpatient management does not increase the risk of complications. The second objective was to determine eligibility parameters for outpatient care in TSA, and the third objective was to compare functional outcomes and identify factors that may affect outcomes. The hypothesis was that outpatient care would not increase the risk of complications and would provide better early functional outcomes.

Material and methods

Study design

We prospectively included 165 consecutive primary TSAs performed by a single, senior surgeon (P.H.F.) at the Bordeaux Merignac Sport Clinic, Merignac, France, between January 11, 2019 and April 7, 2021. The inclusion criteria were primary anatomic TSA (aTSA) or reverse TSA (rTSA); hemiarthroplasties and revision TSA were excluded. Patients eligible for primary TSA procedures were routinely treated in outpatient surgery unless the patient's state of health or social support network was considered inappropriate by the surgeon and/or anesthesiologist. This study was validated by an independent ethics committee (approval number 02202-07).

Outpatient selection

Since 2019, outpatient surgery has become the standard of care for everyone undergoing TSA at this institution except the following: patients socially or geographically isolated (social isolation being defined as lack of social support network); patients refusing this type of care; and patients with medical contraindications.

Operative technique

All patients were administered an ultrasound-guided, single-injection interscalene block. Intravenous injection of tranexamic acid was performed in the absence of a contraindication. All procedures were done with the patient in a beach chair position under general anesthesia. A single-platform shoulder system was used in all patients. There was no difference in surgical technique between inpatient and outpatient groups. A deltopectoral approach and a subscapularis tenotomy were used in all patients. The same multimodal pain management program was used for both groups: multimodal analgesia along with the ultrasound-guided interscalene block.

Patient discharge

All inpatients or outpatients were operated on in the same private hospital that has an outpatient department of 40 beds and an inpatient department of 45 beds. All outpatients were discharged on the same day as the procedure after complete recovery from the interscalene block, once pain control was adequate, and patients could ambulate and urinate without assistance. The return-to-home ability was validated using the Postanesthetic Discharge Scoring System described by Frances Chung in 1995 (known as Chung's score) to measure home-readiness of ambulatory surgery patients. This score is based on 5 criteria: vital signs, activity, mental status, pain or nausea and/or vomiting, surgical bleeding, and intake and output. Qualification for discharge included a 9 out of 10 Chung score and the presence of a competent adult to accompany the patient home.[9]

A nurse called the patients the following day to ensure adequate pain control and answer any questions. Inpatients were transferred from the postanesthesia care unit to the hospital floor using the same criteria. Postoperatively, all patients were immobilized in a sling for 2 weeks and started immediate rehabilitation with passive and active mobilization of the shoulder to achieve the goal of early recovery of autonomy for activities of daily living. The protocol included 3 rehabilitation sessions per week and 3 self-rehabilitation sessions per day described in an illustrated sheet that included 5 exercises. A home nurse visited patients daily to perform wound care.

Outcomes measures

All available documents in the medical record, including medication history, intraoperative anesthesia records, and post-anesthesia care unit records, were prospectively recorded. For each patient, complications, readmissions, and revisions were documented. All medical and surgical complications were identified. For comparison of results with the rest of the published literature on this subject, the complications that occurred during the first three months were specifically noted. An American Society of Anesthesiologists (ASA) score was obtained preoperatively.

A Constant score, American Shoulder and Elbow Surgeons (ASES), University of California Los Angeles (UCLA) shoulder score, and Shoulder Pain and Disability Index (SPADI) score were obtained preoperatively and at 1.5, 6, and 12 months postoperatively. Patients also graded their global satisfaction as much better (grade 3), better (grade 2), unchanged (grade 1), or worse (grade 0). Pain was graded using a visual analog scale (VAS). Data were collected by a clinical research coordinator dedicated to the evaluation of shoulder surgery; the outpatient or inpatient designation was not accessible to the research coordinator when collecting these patient-reported outcomes.

Statistical analysis

Numeric variables were expressed as the mean (±standard deviation) and discrete outcomes as absolute and relative (%) frequencies. Two groups were created according to outpatient or inpatient care modality. Group comparability was assessed by comparing baseline demographic data and follow-up duration between groups. Normality and hetereoskedasticity of continuous data were assessed with Shapiro-Wilk and Levene's test, respectively. Continuous outcomes were compared using Kruskal-Wallis tests according to data distribution. Discrete outcomes were compared with Fisher's exact test accordingly. The alpha risk was set to 5%, and two-tailed tests were used.

A multivariate linear regression was performed to assess the relation between postoperative functional score and the explanatory variables: age, ASA score, distance to home, hand dominance, sector of care, operative time, blood loss, and preoperative functional score. Data were checked for multicollinearity with the Belsley-Kuh-Welsch technique. Post hoc power analysis was

Table I
Comparison of baseline demographics and operative parameters.

	Overall	Inpatient	Outpatient	*P* value
Baseline demographics				
Age, m ± SD (range) 95% CI	72.8 ± 6.6 (55-92) [71.8-73.8]	76.1 ± 5.8 (63-92) [74.6-77.6]	71.0 ± 6.3 (55-86) [69.8-72.2]	**<.001***
Sex, n (%)				
Female	103 (62)	42 (71)	60 (57)	.093
Men	63 (38)	17 (29)	46 (43)	
ASA score, n (%)				
ASA 1	34 (21)	6 (10)	28 (26)	**.002***
ASA 2	90 (54)	30 (51)	60 (57)	
ASA 3	41 (25)	23 (39)	18 (17)	
Distance to home (km), m ± SD (range) 95% CI	116.1 ± 81.3 (3-355) [103-128]	109.6 ± 85.5 (3-272) [87-132]	119.7 ± 79.5 (3-355) [104-135]	.581
Social isolation, n (%)				
Yes	50 (30)	38 (64)	12 (11)	**<.001***
No	115 (70)	21 (36)	94 (89)	
Operative parameters				
Type of arthroplasty, n (%)				
rTSA	150 (91)	56 (95)	94 (89)	.261
aTSA	15 (9)	3 (5)	12 (11)	
Side, n (%)				
Left	106 (64)	36 (61)	70 (66)	.634
Right	59 (36)	23 (39)	36 (34)	
Dominant, n (%)				
Yes	62 (38)	36 (61)	67 (63)	.912
No	103 (62)	23 (39)	39 (37)	
Operative time (min), m ± SD (range) 95% CI	69.5 ± 11.7 (49-115) [67.7-71.3]	69.1 ± 12.9 (52-115) [65.7-72.5]	69.7 ± 11 (49-109) [67.6-71.8]	.359
Blood loss (ml), m ± SD (range) 95% CI	130 ± 77.9 (20-350) [117.4-141.4]	130.8 ± 80.7 (20-330) [109.4-152.2]	128.6 ± 76.6 (20-350) [113.7-143.5]	.997

SD, standard deviation; *CI*, confidence interval; *ASA*, American Society of Anesthesiologists; *rTSA*, reverse total shoulder arthroplasty; *aTSA*, anatomic total shoulder arthroplasty.
Results with * are statistically significant and are indicated in bold.

Table II
Comparison of complications between inpatients and outpatients at 1.5-, 6-, and 12-mo follow-up.

	Overall	Inpatient	Outpatient	*P* value
All, n (%)				
Any complications, n (%)	11 (6.7)	6 (10.2)	5 (4.7)	.203
Readmissions, n (%)	8 (4.8)	4 (6.8)	4 (3.8)	.253
Reoperations, n (%)	7 (4.3)	5 (8.5)	2 (1.9)	.099
<3 mo, n (%)				
Any complications, n (%)	7 (4.3)	4 (6.8)	3 (2.9)	.25
Readmissions, n (%)	4 (2.4)	2 (3.4%)	2 (1.9)	.35
Reoperations, n (%)	4 (2.4)	3 (5.1)	1 (0.9)	.131
>3 mo, n (%)				
Any complications, n (%)	4 (2.4)	2 (3.4)	2 (1.9)	.999
Readmissions, n (%)	4 (2.4)	2 (3.4)	2 (1.9)	.291
Reoperations, n (%)	3 (1.8)	2 (3.4)	1 (0.9)	.291

performed to evaluate whether our data had sufficient verification power, and ≥0.8 of power was considered to criteria for validation.[32] Heteroskedasticity and normality of residuals were assessed, respectively, by the Breusch-Pagan test and the Shapiro-Wilk test. A *P* value <.05 was considered statistically significant. Patients with missing data were excluded from the analysis. Statistical analysis was performed using R (version 3.1.2).

Results

Population

The study cohort consisted of 165 primary TSAs (106 [64%] outpatients and 59 [36%] inpatients). rTSA was performed in 150 (91%) and aTSA in 15 (9%) patients. The overall mean age was 72.8 years ± 6.6 (55 to 92). Outpatients were significantly younger (71 ± 6.4; 55-86 years) than inpatients (76.12 ± 5.9; 63-92 years) ($P < .001$). There were 42 (71%) females and 17 (29%) males in the inpatient group vs. 60 (57%) females and 46 (43%) males in the outpatient group ($P = .093$). The ASA score was significantly higher for inpatients ($P = .002$). The distance to home was not significantly different between inpatients and outpatients ($P = .581$). Social isolation was significantly associated with more frequent inpatient care ($P < .001$). Baseline demographics and operative parameters of the population are described in Table I.

All patients (100%) were evaluated postoperatively at 1.5 months, 98% at 6 months, and 85% at 12 months. The main reason given by patients for canceling 12 months postoperatively was the COVID-19 pandemic (direct contagion of the patient or one of their relatives or fear/difficulty in coming to the appointment).

Complications

Overall, 11 (6.7%) patients had a postoperative complication, of which 7 (4.3%) were readmissions and 7 (4.3%) had reoperations. Between inpatients and outpatients, the rates of postoperative complications ($P = .203$), readmissions ($P = .253$), and reoperations ($P = .099$) were not significantly different (Table II).

In the outpatient group, 5 complications occurred (4.7%): early hematoma requiring transfusion (1), postoperative acromial fracture at 3 months managed by conservative treatment (1), postoperative instability at 5 months requiring readmission for closed reduction (1), early surgical site infection treated by débridement, lavage, and antibiotic therapy (1), and late site infection requiring a one-stage revision (1) (Table III).

In the inpatient group, 6 complications occurred (10%): hematoma requiring readmission and reoperation (1), postoperative thromboembolic event at 2 months (1), early surgical site infection requiring reoperation by débridement, lavage, and antibiotic

Table III
Description of complications, treatments, and outcomes.

	Early (<90 d) Late (>90 d)	Readmission Y/N	Reoperation Y/N	Treatment	Outcome
Outpatient complications					
1 hematoma	Early	Yes	No	Transfusion	Good evolution
1 acromial fracture	Early	No	No	Conservative	Good evolution
1 instability	Late	Yes	Yes	Closed reduction under general anesthesia	Good evolution
1 surgical site infection	Early	Yes	Yes	Revision, lavage, antibiotic therapy	Favorable outcome after 5 mo
1 surgical site infection	Late	Yes	Yes	1-stage revision	Good evolution
Inpatients complications					
1 hematoma	Early	Yes	Yes	Evacuation of the hematoma	Good evolution
1 thromboembolic event	Early	No	No	N/A	Good evolution
1 surgical site infection	Early	Yes	Yes	Débridement, lavage, antibiotic therapy	Favorable outcome
2 surgical site infection	Late	Yes	Yes	One-stage revision	Good evolution
1 immediate instability on anatomic TSA	Early	Yes	Yes	Immediate revision to reverse TSA	Good evolution

TSA, total shoulder arthroplasty.

Table IV
Multivariable analysis of factors associated with complication following TSA.

	β coefficient (95% CI)	*P* value
Age	−0.03 (−0.13 to 2.15)	.469
Sex	0.85 (−0.39 to 2.16)	.182
ASA score	0.66 (−0.23 to 1.63)	.158
Distance to home	0.004 (−0.003 to 0.01)	.276
Social Isolation	0.47 (−1.99 to 1.13)	.548
Dominant side	0.31 (−0.83 to 1.56)	.604
Outpatient care	0.04 (−1.35 to 1.50)	.956
Type of arthroplasty	0.48 (−1.70 to 2.39)	.634
Length of procedure	0.03 (−0.02 to 0.09)	.258
Blood loss	0.00003 (−0.008 to 0.008)	.995

ASA, American Society of Anesthesiologists; *CI*, confidence interval; *TSA*, total shoulder arthroplasty.

therapy (1), late site infections requiring one-stage revision (4 months and 6 months after surgery) (2), and an immediate postoperative instability on aTSA requiring an immediate revision to a rTSA (1) (Table III).

Concerning the early complications within the first three months, 7 occurred in total, representing two thirds of the complications. Their frequency was nearly 3% in the outpatient group and 7% in the inpatient group. However, the rates of early postoperative complications (P = 1), reoperations (P = .348), and readmissions (P = .129) were not significantly different between inpatients and outpatients (Table II).

Complications predictive factors

By multivariable analysis, no demographics or preoperative parameters were correlated with complications (Table IV). Outpatient surgery was not an independent risk factor for a postoperative complication (β = 0.04; P = .956).

Functional outcomes

At 1.5 months, there were significantly better outcomes in the outpatient group for all scores: Constant (P = .002), ASES (P = .005), UCLA (P = .006), and SPADI (P = .006). At 6 and 12 months, outcomes were still greater in the outpatient group for all scores, but differences were only statistically significant for the Constant and UCLA scores.

Results of bivariate analysis related to functional outcomes are reported in Table V.

Pain evaluation

Outpatients obtained better outcomes than inpatients, reaching statistical significance in terms of pain at 1.5-month follow-up (P = .027). At 6- and 12-month follow-up, better outcomes were still reported in the outpatient group but differences were no longer statistically significant (Table V).

Satisfaction

In the subjective evaluation of satisfaction at 1.5-month follow-up, 91.3% of outpatients rated themselves as much better or better compared with 86.5% of inpatients; however, this difference was not statistically significant. Satisfaction outcomes at 6- and 12-month follow-up were similar for both groups.

Outcomes predictive factors

Age was associated with a worse Constant score at 12 months (β = −0.372; P = .006). ASA score <2 was associated with a significantly better ASES score (β = 9.08; P = .029) and VAS (β = −1.33; P = .014) at 1.5 months; better ASES (β = 10.66; P = .013), UCLA (β = 2.67; P = .022), and VAS (β = −1.5; P = .003) scores at 6 months; and better Constant (β = 3.9; P = .047) and ASES scores (β = 6.44; P = .029) at 12 months. An ASA score >2 was only associated with a significantly worse UCLA score (β = 1.9; P = .049) at 12 months. Distance to home, dominant side, operative time, and blood loss had no influence on functional results (Table VI).

Multivariate analysis demonstrated that outpatient care was significantly associated with an improvement of Constant (β = −5.44; P = .031), ASES (β = −8.42; P = .021), UCLA (β = −2.29; P = .027), and SPADI (β = 12.56; P = .009) scores at 1.5 months and was not significantly associated with the value of functional outcomes at 6 and 12 months. ASES and SPADI scores at all postoperative time points were significantly correlated with the preoperative score, respectively: (β = 0.201; P = .041) and (β = 0.227; P = .008) at 1.5 months; (β = 0.264; P = .009) and (β = 0.223; P = .009) at 6 months; and (β = 0.216; P = .021) and (β = 0.233; P = .009) at 12 months.

Discussion

In this study, outpatient care in TSA did not increase the risk of complications. Slight differences were found in terms of early functional results, with the outpatient group demonstrating better

Table V
Comparison of functional outcomes between inpatient and outpatient total shoulder arthroplasty.

	Overall	Inpatient	Outpatient	*P* value
Constant, m ± SD (range) 95% CI				
Preoperative	38.6 ± 13.6 (11-81) [36.5-40.7]	36.6 ± 14.2 (11-68) [32.9-40.4]	39.7 ± 13.2 (13-81) [37.1-42.3]	.177
1.5 mo	59.3 ± 13.3 (12-91) [57.2-61.4]	54.6 ± 13.9 (12-79) [50.7-58.5]	61.7 ± 12.4 (32-91) [59.3-64.2]	**.002***
6 mo	71.3 ± 11.9 (17-97) [69.3-73.3]	68 ± 13.3 (17-84) [64.1-72]	72.9 ± 10.9 (37-97) [70.6-75.1]	**.018***
12 mo	76.3 ± 9.2 (45-97) [74.6-77.9]	73.3 ± 8.9 (54-87) [70.4-76.3]	77.5 ± 9.2 (45-97) [75.6-79.5]	**.027***
ASES, m ± SD (range) 95% CI				
Preoperative	35.7 ± 16.3 (7-78) [33.2–38.2]	32.5 ± 16.6 (7-78) [28.1-36.8]	37.5 ± 15.9 (8-73) [34.4-40.6]	.051
1.5 mo	67 ± 19.7 (10-100) [63.9-70.1]	60.4 ± 20.3 (10-98) [54.7-66]	70.4 ± 18.6 (32-100) [66.7-74]	**.005***
6 mo	78.6 ± 18.9 (10-100) [75.5-81.8]	74.6 ± 21.2 (10-100) [68.4-80.8]	80.6 ± 17.6 (27-100) [77-84.2]	.075
12 mo	83.2 ± 17 (32-100) [80.3-86.1]	78.6 ± 21.1 (32-100) [71.7-85.4]	85.2 ± 14.7 (33-100) [82.1-88.2]	.186
UCLA, m ± SD (range) 95% CI				
Preoperative	12.5 ± 4.3 (4-23) [11.9-13.2]	11.5 ± 4.5 (4-23) [10.4-12.7]	13.1 ± 4.2 (5-23) [12.3-13.9]	**.031***
1.5 mo	25.7 ± 5.5 (6-35) [24.8-26.6]	24.1 ± 5.4 (6-35) [22.6-25.7]	26.5 ± 5.5 (11-35) [25.4-27.5]	**.006***
6 mo	29.4 ± 5 (7-35) [28.6-30.3]	28.2 ± 5.7 (7-35) [26.5-29.9]	30.1 ± 4.5 (13-35) [29.1-31]	**.017***
12 mo	30.8 ± 4.1 (13-35) [30.1-31.6]	29.5 ± 4.9 (13-35) [27.9-31.1]	31.5 ± 3.5 (14-35) [30.7-32.2]	**.023***
SPADI, m ± SD (range) 95% CI				
Preoperative	80.8 ± 25.9 (6-124) [76.8-84.8]	83.2 ± 31.6 (6-124) [74.9-91.5]	79.4 ± 22.3 (25-124) [75-83.8]	.095
1.5 mo	43.4 ± 26.4 (2-123) [39.3-47.6]	53.2 ± 28.3 (7-123) [45.3-61.1]	38.5 ± 24.2 (2-104) [33.7-43.2]	**.002***
6 mo	26.5 ± 24.1 (0-112) [22.5-30.4]	32 ± 28.2 (0-112) [23.8-40.3]	23.7 ± 21.6 (0-108) [19.3-28.1]	.142
12 mo	21 ± 22.8 (0-96) [17.1-24.9]	25.8 ± 27 (0-90) [17.1-34.6]	18.9 ± 20.7 (0-96) [14.6-23.2]	.288
VAS, m ± SD (range) 95% CI				
Preoperative	6.5 ± 2 (1-10) [6.2-6.9]	7 ± 1.8 (2-10) [6.5-7.5]	6.3 ± 2.1 (1-10) [5.9-6.7]	**.04***
1.5 mo	2.8 ± 2.6 (0-10) [2.4-3.2]	3.4 ± 2.5 (0-10) [2.7-4.1]	2.5 ± 2.5 (0-9) [2-3]	**.027***
6 mo	1.9 ± 2.3 (0-9) [1.5-2.2]	2.3 ± 2.5 (0-9) [1.5-3]	1.7 ± 2.2 (0-8) [1.3-2.1]	.13
12 mo	1.4 ± 2 (0-8) [1.1-1.8]	1.8 ± 2.4 (0-8) [1-2.6]	1.3 ± 1.8 (0-8) [0.9-1.6]	.465

SD, standard deviation; *CI*, confidence interval; *ASES*, American Shoulder and Elbow Surgeons; *UCLA*, University of California Los Angeles; *SPADI*, Shoulder Pain and Disability Index; *VAS*, visual analog scale.
Results with * are statistically significant and are indicated in bold.

results than the inpatient group. In terms of population, outpatients were significantly younger and had lower ASA scores. Social isolation was significantly associated with more inpatient care but distance to home was not different between the 2 groups. The rates of postoperative complications, readmissions, and reoperations were not significantly different. The safety of outpatient TSA is supported by several studies with low rates of complications, readmissions, and reoperations compared with inpatient TSA, and the current study supports those findings.[1-4,7,10,11,14,15,19,21,22,28,29,31,33,36]

Multidisciplinary care coordination, standardized perioperative protocols, discharge planning, and careful patient selection have led surgeons to increase the number of outpatient shoulder arthroplasties. Population and risk assessment are essential to safe patient selection for outpatient TSA, and some studies have even described risk prediction tools or outpatient selection algorithms.[17,18,26] Several studies suggest that age is a major factor in patient selection for outpatient surgery.[8,14,17,19,26,28,36] In the current study, significant differences were found in baseline patient characteristics between those undergoing outpatient and inpatient TSA. Outpatients were significantly younger than inpatients (71 vs. 76.12 years $P < .001$) which is consistent with the series reported by Nwankwo et al[28] (68.1 years) and Erickson et al[14] (68.9 years), but quite older than earlier series reported by Brolin et al[7] (52.6 years), Leroux et al[23] (60.6 years), or Charles et al[8] (56 years), attesting to an evolution in the selection of outpatients. Greater age is not a contraindication to outpatient care in our practice, and age has not been correlated with a higher risk of complications in the outpatient population.

The presence of associated comorbidities seems to influence whether surgery is performed outpatient or inpatient.[10,17,18,26] As in most published studies, the outpatient TSA group in this study had fewer comorbidities as evidenced by significantly lower ASA scores than inpatients. However, 78 (74%) outpatients had an ASA score ≥2 of which 18 (17%) had an ASA class III, which did not make it a contraindication to outpatient surgery in routine practice.

The lack of a social support network during the first night after surgery is an important limitation to outpatient surgery, as reported in several published series.[1,4,6,11,17,18,21,26,33,35] For some authors, one of the eligibility criteria for outpatient surgery is a distance of less than 100 km between home and the nearest hospital[11] (not necessarily the institution where surgery takes place), but this eligibility criterion is highly variable depending on the authors and the healthcare systems. We did not consider that distance was a contraindication to outpatient surgery in our study, and distance to home was not different between the inpatient and outpatient TSA groups. Moreover, the greatest distance (355 km) was in the outpatient surgery group.

The main objective of this study was to assess the relative safety of outpatient TSA. Several studies have shown an increased rate of complications in TSA patients with comorbidities, which may drive patient selection.[17,18,26] Whereas Basques et al[3] found that the rate of surgical site infections ($P = .002$) and thromboembolic events ($P < .001$) were significantly higher in the inpatient group than in outpatients. Arshi et al[2] found an increase in surgical site infections in an outpatient group (outpatient, 0.90%; inpatient, 0.65%; odds ratio, 1.65; 95% confidence interval, 1.15-2.35; $P < .001$). Erickson et al[14] found that overall complications were significantly more frequent ($P = .023$) in inpatients. Other studies also have found that outpatient TSA has decreased or similar rates of surgical and medical complications compared with inpatient TSA.[10,29,36] The current study supports these findings, as complications, readmissions, and reoperations rates were not found to be significantly different between outpatient and inpatient TSA, although a nonsignificant statistical finding of reduced complications (5% vs. 10%), readmissions (3% vs. 7%), and reoperations (2% vs. 8.5%) rates was noted. Importantly, outpatient TSA was not associated with an increased risk of postoperative complications. No demographic or preoperative parameters were correlated with the onset of complications (Table III). Outpatient surgery and ASA score were not independent risk factors of a postoperative complication onset, and

Table VI
Multivariable analysis of factors associated with short-term functional scores following total shoulder arthroplasty.

β coefficient [95% CI] *P* value	Age	ASA <2	ASA >2	Distance	Dominant	Inpatient care	Preoperative score	Time	Blood loss
1.5 mo									
Constant	−0.132 [−0.5; 0.2] .479	3.75 [−1.9; 9.4] .191	2.89 [−2.5; 8.3] .290	−0.002 [−0.03; 0.03] .873	3.58 [−0.8; 8] .112	−5.44 [−10.3; −0.5] .031*	0.139 [−0.03; 0.3] .098	0.027 [−0.2; 0.2] .807	0.022 [−0.01; 0.05] .182
ASES	0.112 [−0.4; 0.6] .677	9.08 [0.9; 17.2] .029*	3.23 [−4.6; 11.1] .417	−0.012 [−0.05; 0.03] .54	4.66 [−1.7; 11.1] .152	−8.42 [−15.5; −1.3] .021*	0.201 [0.01; 0.4] .041*	0.142 [−0.2; 0.5] .376	0.038 [−0.01; 0.01] .109
UCLA	0.061 [−0.09; 0.2] .430	1.51 [−0.8; 3.8] .202	0.669 −1.6; 2.9] .554	−0.006 [−0.02; 0.01] .286	1.27 [−0.6; 3.1] .172	−2.29 [−4.3; −0.3] .027*	0.174 [−0.03; 0.4] .097	−0.005 [−0.1; 0.1] .916	0.011 [−0.002; 0.03] .093
SPADI	−0.133 [−0.8; 0.6] .711	−6.72 [−17.6; 4.2] .224	−4.81 [−15.3; 5.6] .364	0.018 [−0.04; 0.07] .500	−3.76 [−12.3; 4.7] .384	12.56 [3.1; 21.9] .009*	0.227 [0.06; 0.4] .008*	−0.269 [−0.7; 0.1] .208	−0.022 [−0.08; 0.04] .469
VAS	0.006 [−0.06; 0.07] .852	−1.33 [−2.4; −0.3] .014*	−0.17 [−1.2; 0.9] .744	0.002 [−0.01; 0.01] .429	−0.579 [−1.4; 0.3] .175	0.577 −0.4; 1.5] .227	0.239 [0.04; 0.4] .021	−0.015 [−0.06; 0.03] .488	−0.005 [−0.01; 0.01] .136
6 mo									
Constant	−0.209 [−0.5; 0.1] .232	4.69 [−0.6; 9.97] .082	−2.13 [−7.4; 3.1] .421	−0.016 [−0.04; 0.01] .208	0.418 [−3.8; 4.6] .845	−3.09 [−7.8; 1.6] .196	0.153 [−0.01; 0.3] .060	0.043 [−0.16; 0.25] .683	0.007 [−0.02; 0.04] .639
ASES	0.028 [−0.5; 0.5] .914	10.66 [2.3; 19] .013*	−1.32 [−9.5; 6.8] .749	−0.029 [−0.07; 0.01] .159	−1.48 [−8.2; 5.3] .666	−4.67 [−12.1; 2.7] .215	0.264 [0.07; 0.46] .009*	0.147 [−0.2; 0.5] .382	0.014 [−0.04; 0.06] .569
UCLA	0.047 [−0.1; 0.2] .529	2.67 [0.4; 4.95] .022*	0.545 [−1.8; 2.8] .639	−0.004 [−0.02; 0.01] .512	−0.46 [−2.3; 1.4] .622	−1.76 [−3.8; 0.3] .090	0.205 [−0.01; 0.4] .059	0.013 [−0.08; 0.1] .775	0.001 [−0.01; 0.02] .868
SPADI	0.225 [−0.4; 0.9] .508	−7.77 [−18.6; 3.08] .159	6.6 [−3.9; 17.1] .216	0.022 [−0.03; 0.07] .404	−3.04 [−11.7; 5.6] .489	4.35 [−5.1; 13.8] .366	0.223 [0.06; 0.4] .009*	−0.11 [−0.5; 0.3] .608	−0.013 [−0.08; 0.05] .689
VAS	0.020 [−0.08; 0.04] .522	−1.5 [−2.5; −0.5] .003*	−0.19 [−1.2; 0.8] .698	0.002 [−0.01; 0.01] .313	0.222 [−0.6; 1] .579	0.535 [−0.4; 1.4] .238	0.262 [0.07; 0.4] .007	−0.017 [−0.06; 0.02] .383	−0.002 [−0.01; 0.01] .581
12 mo									
Constant	−0.372 [−0.6; −0.1] .006*	3.9 [0.06; 7.7] .047*	1.29 [−2.8; 5.4] .533	−0.011 [−0.03; 0.01] .242	1.3 [−1.9; 4.5] .423	−2.09 [−5.7; 1.5] .249	0.084 [−0.04; 0.2] .183	−0.057 [−0.2; 0.1] .473	0.020 [−0.003; 0.04] .086
ASES	−0.25 [−0.8; 0.3] .332	6.44 [0.7; 12.2] .029*	6.62 [−1.6; 14.9] .115	−0.014 [−0.05; 0.02] .388	0.916 [−4.9; 6.8] .757	−3.77 [−11.8; 4.2] .351	0.216 [0.03; 0.4] .021*	0.004 [−0.3; 0.3] .979	0.005 [−0.04; 0.05] .811
UCLA	−0.044 [−0.17; 0.08] .477	1.77 [−0.007; 3.5] .051	1.9 [0.01; 3.8] .049*	−0.003 [−0.01; 0.01] .501	0.767 [−0.7; 2.2] .309	−1.54 [−3.2; 0.1] .068	0.11 [−0.06; 0.3] .213	−0.051 [−0.1;0.02] .175	0.005 [−0.01; 0.02] .373
SPADI	0.581 [−0.1; 1.3] .097	−5.5 −15.5; 4.5] .277	−3.51 [−14; 7] .510	0.011 [−0.04; 0.06] .645	−0.894 [−9.2; 7.4] .831	1.0 [−8.2; 10.2] .829	0.233 [0.06; 0.4] .009*	0.009 [−0.4; 0.4] .964	−0.003 [−0.06; 0.06] .932
VAS	0.039 [−0.02; 0.09] .153	−0.625 [−1.4; 0.2] .116	−0.633 −1.5; 0.3] .165	0.002 [−0.01; 0.01] .261	0.17 [−0.5; 0.9] .628	0.316 [−0.7; 1.3] .533	0.117 [−0.02; 0.4] .075	−0.003 [−0.03; 0.04] .866	−0.001 [−0.01; 0.01] .833

ASA, American Society of Anesthesiologists; *CI*, confidence interval; *ASES*, American Shoulder and Elbow Surgeons; *UCLA*, University of California Los Angeles; *SPADI*, Shoulder Pain and Disability Index; *VAS*, visual analog scale.
Results with * are statistically significant.

age was not a risk factor for complications after TSA in the current study.

Few studies have focused on the comparison of functional results between outpatients and inpatients. A systematic review of the literature, conducted by Huddleston et al,[19] found 2 studies on patient-reported outcomes and 1 study on postoperative satisfaction. Charles et al[8] reported significant improvements compared with baseline for the single assessment numeric evaluation, ASES, and VAS scores (all $P < .001$) as well as in forward elevation and external rotation (both $P < .001$). Similarly, Erickson et al[14] reported significant improvements in all clinical outcome scores from preoperative to postoperative in patients who underwent outpatient TSA, with no differences between the outpatient and inpatient TSA groups regarding postoperative clinical outcomes at 12 months (ASES [$P = .103$], VAS [$P = .099$], and single assessment numeric evaluation scores [$P = .302$]). Finally, Leroux et al[23] reported that 84.9% of patients were very satisfied, 12.1% were satisfied, and 3% were adequately satisfied at a mean of 60 weeks postoperatively (16.4-156 weeks). The current study compared the functional outcomes of outpatients and inpatients who underwent aTSA or rTSA at short term and found significantly better outcomes at 1.5 months in the outpatient group for all functional scores. (Table II) The age difference between the two cohorts could explain this difference in short-term results, but this is tempered by the fact that the age difference between the two populations was only 4 years. Our multivariate linear regression analysis found that age, ASA, and preoperative scores were negatively correlated to the functional outcomes. Operative time and blood loss also were not associated with functional results.

Several methodological limitations should be taken into consideration when interpreting the results of the current study. First, this is a study without a randomized control group. Second, there were significant differences in baseline patient characteristics in that outpatients were significantly younger and had lower ASA scores than the inpatients. This difference in patient demographic characteristics reflects trends in current practice, emphasizing that appropriate patient selection is the key to safe and successful outpatient shoulder arthroplasty. To address this, multivariate linear regression was used to control for baseline patient characteristics. Third, with a post hoc power analysis, the comparative analysis of the rate of complications between the outpatient and inpatient groups showed 25% power. Post hoc power analysis has been criticized as a means of interpreting negative study results.[24] Because post hoc analyses are typically only calculated on negative trials ($P \geq .05$), such an analysis will produce a low post hoc power result, which may be interpreted as the study having inadequate power. Nevertheless, the number of patients included in this study is similar to that used in most contemporary relevant studies in outpatient shoulder surgery.[14,28,36] Despite these limitations, we believe that the large sample size, demographic representative data, and prospective nature of the data source outweigh any potential disadvantages.

Conclusion

We report here our experience of routine outpatient TSA management within a European healthcare system. Eligibility to outpatient care was mainly influenced by patient comorbidities and social isolation. A low rate of complications was noted, and outpatient management was not an independent risk factor for complications. Outpatient TSA appears to be a safe alternative to routine hospital admission in appropriately selected patients. Despite the differences between the inpatient and outpatient populations, in particular a slight difference in age, outpatient care seems to be an independent factor for improving early functional results. The relatively large number of patients in the current study encourages us to continue to expand the outpatient management of TSA, including in elderly patients or patients living relatively long distances from the hospital. The results of this study are limited to a single surgeon and a single institution and are not necessarily reproducible in another context. Results depend not only on the surgeon but also on the specialization of the entire healthcare team and their available resources. Larger studies should be performed to confirm these encouraging results.

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