

Predictors of length of stay and patient satisfaction after hip and knee replacement surgery

Fast-track experience in 712 patients

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Background and purpose Very few studies have focused on patient characteristics that influence length of stay (LOS) in fast-track total hip (THR) and knee arthroplasty (TKR). The aim of this prospective study was to identify patient characteristics associated with LOS and patient satisfaction after total hip and knee replacement surgery.

Patients and methods Between September 2003 and December 2005, 712 consecutive, unselected patients (440 women) with a mean age of 69 (31–91) years were admitted for hip and knee replacement surgery at our specialized fast-track joint replacement unit. Epidemiological, physical, and perioperative parameters were registered and correlated to LOS and patient satisfaction.

Results 92% of the patients were discharged directly to their homes within 5 days, and 41% were discharged within 3 days. Age, sex, marital status, co-morbidity, preoperative use of walking aids, pre- and postoperative hemoglobin levels, the need for blood transfusion, ASA score, and time between surgery and mobilization, were all found to influence postoperative outcome in general, and LOS and patient satisfaction in particular.

Interpretation We identified several patient characteristics that influence postoperative outcome, LOS, and patient satisfaction in our series of consecutive fast-track joint replacement patients, enabling further attention to be paid to certain aspects of surgery and rehabilitation.

(i.e. fast-track surgical procedures) have been published. The aims of these fast-track regimens have been reduction of perioperative morbidity, physiologically optimized anesthesiological procedures, optimized pain management, and aggressive mobilization. Endpoints, or success criteria, have uniformly been reduction in postoperative length of stay (LOS), shorter convalescence, and rapid functional recovery (Kehlet and Wilmore 2002). The investigators have approached these criteria differently, however. Extraordinary resources have been allocated to fast-track units, patients have been transferred to more or less intensive rehabilitation units shortly after surgery instead of being discharged directly to their homes, and few, if any, specific determinants or predictors of patient characteristics of early or delayed recovery have been identified (Wang et al. 1998, Weingarten et al. 1998, Dowsey et al. 1999, Watkins et al. 1999, Hayes et al. 2000, Pearson et al. 2000, Healy et al. 2002).

The present prospective series of 712 consecutive, unselected patients admitted between 2003 and 2005 for either total hip replacement (THR) or a total knee replacement (TKR) focus on LOS, patient satisfaction, rate of re-admission, and attempts to determine which elements of the accelerated surgical regimen make a difference. The study had three aims: (1) to establish whether (if at all) unselected patients of all age groups could accomplish an accelerated track with a planned median LOS of 5 days before discharge to their homes, (2) to monitor general patient satisfaction,

Several studies on the optimized or accelerated perioperative course of standard surgical proce-

Table 1. The Hvidovre fast track protocol (ANORAK-HH)

Information
– oral and written information on intended maximum LOS of 5 days and motivation of the patient to be active.
– detailed information to patients and relatives meeting at a preoperative multidisciplinary patient clinic, on hospital stay, goals, and discharge.
Staff and logistics
– dedicated staff. Physiotherapy once a day at weekdays. Nurse staffing identical to that of rest of ward (0.98 nurses per bed during weekdays, 0.80 during weekends).
– setting up of a specialized ward where all THR and TKR patients are admitted.
– patients admitted on day of surgery.
Operation and pain treatment
– use of regional analgesia: spinal for patients undergoing THR; combined spinal and epidural for patients undergoing TKR (2 days for primary TKR and revision TKR, 1 day for single knees, and 3 days for bilateral TKR).
– opioid in tablet form $\times 4$ until discharge, paracetamol $\times 4$ and NSAID $\times 1$ (which is also used after discharge).
Drains
– not used (no effect, and increases the sickness role).
Blood transfusion
– is standardized (postoperative drop by 25% compared to preoperative level of Hb and clinical manifestation).
KAD
– patients operated on with TKR use a catheter for 1 day.
Antithrombotic prophylaxis
– low-molecular-weight heparin $\times 1$ daily, starting 6 h postoperatively and given only until discharge.
Discharge criteria
– unchanged; the patients must be independent, able to walk with crutches or better, able to get in and out of bed, and into and up from a chair. Sufficient pain treatment. Accept of discharge.
– all patients are discharged to their homes.
Monitoring: 22 patient characteristics and 11 patient satisfaction parameters were registered in a database in order to monitor the stays continuously:
– Patient characteristics: age, sex, living situation, weight, height, body mass index (BMI), smoking, American Society of Anaesthesiology (ASA) score, pre- and postoperative hemoglobin (second day), preoperative use of walking aid, intraoperative and total blood loss, blood transfusion, type of surgery, co-morbidities, surgeon, day of surgery and case number that day (1st, 2nd, 3rd), mobilization on the day of surgery, preoperative use of opioids, and participation in the patient meeting preoperatively.
– Patient satisfaction parameters: information, patient meeting, operating room stay, recovery ward stay, nursing, doctors' rounds, pain treatment, physiotherapy, LOS, physical conditions in the ward, and the entire stay.

and (3) to identify which parameters or individual patient characteristics influenced LOS and satisfaction with the surgical regimen.

Material and methods

Between September 2003 and December 2005, 712 unselected, consecutive patients with a mean age of 69 (31–91) years (272 men) received a total hip or knee replacement at our dedicated fast-track joint replacement unit. The unit has implemented standardized surgical regimens for THR and TKR using a multidisciplinary, optimized approach to all aspects of large joint replacements: oral and written information, a detailed introduction for patients and relatives before the actual surgery, anaesthesiological procedures, and rapid postoperative mobilization (Table 1). All patients had surgery performed using spinal analgesia and the

postoperative pain management regimen was unaltered compared to earlier. Standard surgical procedures were performed: a posterolateral approach to the hip joint, and midline incision for the knee joint with median parapatellar quadriceps splitting (no MIS). All TKRs were performed using a pneumatic tourniquet (100 mm Hg > systolic blood pressure). Before skin incision, 10 mg per kg body weight of tranexamic acid was administered intravenously. THRs were both hybrid (uncemented acetabular cup) and uncemented, and TKRs were tricompartmental and cemented.

All patients were admitted on the day of surgery (7 a.m.) and LOS was recorded in full number of days until discharge (at doctors' rounds at 8 a.m. on all mornings prior to discharge). All patients were discharged to their homes. Our strict, objective discharge criteria are summarized in Table 1. All surgical procedures were performed by the 4 orthopedic consultants in the unit, and no

Table 2. Distribution of 712 patients regarding type of surgery, age, LOS, readmissions, blood transfusions, and overall patient satisfaction

Operation	n	Age		LOS		Discharged (%)		Readmissions		Blood transfusions (%)	Overall satisfaction, mean
		mean	range	mean	range	by the fifth day	third day	without surgery	with surgery		
THR	370	69	31–91	3.8	1–17	93	43	18 (4.9)	7 (1.9)	22	9.4
TKR	342	69	33–91	3.9	1–17	92	39	19 (5.6)	8 (2.3)	12	9.3
THR+TKR	712	69	31–91	3.8	1–17	92	41	37 (5.2)	15 (2.1)	17	9.4

extraordinary resources or extra staff were used after implementation of the fast-track regimen (as compared to the unit's resources before September 2003). After surgery, the patients were all monitored for some hours in the recovery unit. If at all possible, the patients were encouraged to walk unaided on the day of surgery. Physiotherapy took place once daily, except at weekends (only patients operated on Fridays had physiotherapy on Saturdays). Blood transfusions were administered if a postoperative reduction of more than 25% of the initial hematocrit was observed on the first postoperative day. Re-admission within 3 months was registered.

A database was established, registering 33 variables on each patient: 22 patient characteristics and 11 patient-satisfaction parameters regarding specific parts of their stay (Table 1). Patients returned a questionnaire in writing, regarding satisfaction (verbal analog scale, 0–10) upon discharge.

Statistics

Objective variables and patients' satisfaction with their stay were analyzed using bivariate analyses. The correlations between continuous data such as age, BMI, pre- and postoperative hemoglobin, blood loss, and LOS were analyzed using Spearman's test. Discrete data (sex, marital status, comorbidity, preoperative use of a walking aid, preoperative use of opioids, the need for blood transfusion, mobilization on the day of surgery, smoking, and participation in the patient clinic) were analyzed regarding LOS or satisfaction using the Mann-Whitney test. The Kruskal-Wallis test was used for analysis of the influence of the following parameters on LOS or satisfaction: week-day of surgery, surgeon, ASA score, number of blood transfusions, and case number on the day

of surgery. Multivariate logistic regression analyses were performed in order to identify significant parameters influencing LOS and patient satisfaction. The significance level was set at $p < 0.05$; all tests were two-tailed.

Results

Most patients (92%), whether they had received a THR or a TKR, were discharged to their own homes within 5 days, and about 41% of the patients were actually able to leave the unit after 3 days. We found no statistical differences in LOS or patient satisfaction between the groups of patients who underwent THR or TKR (Table 2).

Regarding the preoperative information meeting in the clinic for patients and their relatives, 88 of 712 patients chose not to attend. We found no difference in LOS between patients who had participated in the information meeting and those who had not ($p = 0.5$) (Table 3). There was no significant difference between patients who had been operated by different surgeons or between patients who were operated early or late on the day of surgery.

LOS of 3 days or less

In multivariate logistic regression analyses, the following patient characteristics were significantly associated with an LOS of 3 days or less.

Age ($p = 0.01$) (OR 1.02, CI: 1.01–1.05); for each year of age, the probability of staying more than 3 days increased by 2.4% per year of increasing age or 27% per decade.

Sex ($p = 0.01$) (OR 0.6, CI: 0.39–0.81); women had almost 40% greater probability of staying more than 3 days than men.

Table 3. Significance of patient characteristics for length of stay (LOS) and overall satisfaction

Variable	Test	P-value for LOS satisfaction	
Age	Sp	0.001	0.008
Sex	MW	0.001	0.2
BMI	Sp	0.2	0.2
Living situation	MW	0.001	0.02
Co-morbidities	MW	0.03	0.2
Preop. walking aid	MW	0.001	0.2
Preop. opioid	MW	0.3	0.02
Weekday surgery	KW	0.001	0.5
Surgeon	KW	0.7	0.4
ASA score	KW	0.001	0.6
Preop. hemoglobin	Sp	0.001	0.8
Postop.	Sp	0.001	0.5
Blood loss	Sp	0.5	0.3
Blood loss perop. (THA)	Sp	0.04	0.2
Blood transfusion	MW	0.001	0.7
Blood transfusion, number	KW	0.001	0.6
Mobilization, day of surgery	MW	0.001	0.1
Smoking	MW	0.3	0.1
Case number (1st, 2nd, 3rd)	KW	0.8	0.06
Patient clinic	MW	0.5	0.7

Sp: Spearman's test; MW: Mann-Whitney test;
KW: Kruskal-Wallis test.

Marital status ($p = 0.02$) (OR 0.7, CI 0.56–0.93); patients living alone had 25% greater probability of staying more than 3 days than those who had a spouse.

Preoperative use of walking aids ($p = 0.004$) (OR 1.3, CI: 1.07–1.71); patients walking with an aid had a 40% greater probability of staying more than 3 days.

Weekday of surgery ($p = 0.001$) (OR Monday-Friday 0.5, CI: 0.33–0.89; OR Tuesday-Friday 0.2, CI: 0.11–0.31; OR Wednesday-Friday 0.43, CI: 0.13–1.02, OR Thursday-Friday 4.07, CI: 1.18–9.83), with Friday set at 1.0 for patients staying longer than 3 days. This probability was reduced by 45% for patients operated on Mondays, 80% for patients operated on Tuesdays, 60% for patients operated on Wednesdays, and increased by 400% for patients operated on Thursdays.

ASA score ($p = 0.04$) (OR ASA1-ASA3 0.4, CI: 0.26–0.84; OR ASA2-ASA3 0.8, CI: 0.57–1.46, ASA3 set at 1); patients with an ASA score of 1 or 2 had probabilities of 60% and 20%, respectively, of staying less than 3 days compared to ASA3.

The need for blood-transfusion ($p = 0.001$) (OR 3.4, CI 2.61–4.25); patients requiring blood trans-

fusion had an almost quadrupled probability of staying more than 3 days.

LOS of more than 5 days

About 8% of the patients stayed more than 5 days. These patients were generally female, had a higher than average ASA score in general, were older, and had a higher need for blood transfusion (Table 3).

Primary unilateral arthroplasty and satisfaction

A correlation existed between LOS and certain aspects of satisfaction, i.e. the shorter the LOS, the more the patients were satisfied with information ($p = 0.03$), operating room stay ($p = 0.004$), nursing ($p = 0.01$), pain treatment ($p = 0.001$), doctors' rounds ($p < 0.001$), LOS ($p = 0.001$), and the entire stay ($p = 0.001$).

Overall satisfaction was associated with increasing age ($p = 0.01$), being married ($p = 0.02$), and there being no need for opioid pain killers preoperatively ($p = 0.02$). Patients without co-morbidities were more satisfied than those who had at least one co-morbidity, both with the pain treatment ($p = 0.01$) and LOS ($p = 0.02$).

Re-admission

About 5% of the patients with primary THA were re-admitted within 3 months and 2% needed additional surgery (18 patients). Re-admissions were due to dislocation (10, 3 of which had previous osteosynthesis of proximal femoral fractures), deep infections (3), wound problems (2), fractures (2), and pain (1). In all, 183 hospital days were used for hip re-admissions.

With regard to TKR, 19 (6%) of the patients were re-admitted within 3 months and 2% needed additional surgery. Re-admissions were due to suspected DVT (6, but none found), deep infections (5), suspected infection (4, none found), wound problems (3), and DVT (1). In total, 170 hospital days were used for knee re-admissions.

Blood transfusion

22% and 12% of the patients who underwent THR and TKR, respectively, needed blood transfusions. Blood transfusion was associated with increasing age ($p = 0.001$), lack of mobilization on the day of surgery, co-morbidities ($p = 0.002$), low levels of

hemoglobin pre- and postoperatively ($p = 0.001$), and increased ASA score ($p = 0.001$).

Discussion

After implementation of our fast-track procedures for primary hip and knee replacement surgery, mean LOS was reduced from 8 to 3.8 days according to unchanged, strict discharge criteria. We found no association between LOS and participation in the information meetings held in the clinic for patients and their relatives prior to admission. This is in accordance with a Cochrane review, where pre-operative patient education did not influence LOS after large joint replacement surgery (McDonald et al. 2004). However, we found a positive association between reduced LOS and overall satisfaction, and conclude that it may not be the patient meeting itself that is of importance. Rather, it is the sum of information given before and during the admission—regarding the intended regimen, the intended short LOS, and the motivation of the patient to actively participate—that results in shorter LOS compared to conventional surgical tracks.

We found that LOS was associated with certain patient characteristics. Increasing age was found to correlate with increasing LOS, which is in accordance with other, comparable studies (Kim et al. 1993, Wang et al. 1998, Watkins et al. 1999, Hayes et al. 2000). Women had longer stays than men and patients living alone stayed longer, which has also been shown in most studies (Rissanen et al. 1996, Liebergall et al. 1999, Watkins et al. 1999, Hayes et al. 2000). There is no clear-cut explanation for this finding. Co-morbidities resulted in increased LOS—a finding shared by others (Wang et al. 1998, Wasielewski et al. 1998, Hayes et al. 2000). Preoperative use of walking aids was associated with increased LOS. One possible explanation is differences in muscular strength and gait-pattern between patients with and without walking aids (Wang et al. 1998, Wasielewski et al. 1998).

Weekday of surgery was associated with LOS—with Tuesday, Wednesday, Monday, Friday, and Thursday ranking (in that order) as the days of surgery that were followed by the fastest discharge. The difference can be explained by the reduced personnel at weekends, when no physiotherapy

took place. Both patients and staff were inclined to discharge no later than Friday, and patients operated on Tuesdays thus had one day less in hospital than patients operated on Mondays. Patients operated on Wednesdays were so advanced in their progress that appointments for discharge during the weekend could usually be made on Fridays. Patients operated on Fridays had bed exercise on Saturdays and were first evaluated again by their surgeon and physiotherapist the following Monday (day 4), where sufficient progress led to discharge the following day. Patients operated on Thursdays had mostly only bed exercises on Fridays and were left to exercise by themselves—and with the reduced staff—during the weekend. Evaluation thus took place on the fifth day, followed by discharge.

Increased ASA score was associated with longer LOS, as could be expected. This reflects the association with co-morbidities, but other authors have not been able to corroborate this association (Wasielewski et al. 1998).

There was a correlation between blood transfusion and both pre- and postoperative hemoglobin levels on the one hand and LOS on the other, which conflicts with the findings of the only other report on this association (Kim et al. 1993). Not all patients can achieve reduced LOS. We found by regression analysis that longer LOS was associated with increased ASA scores and the need for blood transfusions.

Blood transfusion was the most important predictor of discharge around the third day of admission, as patients receiving blood had a 3-times increased risk of staying more than 3 days. These data can be used to predict which patients are expected to stay less than 3 days, and can thus facilitate the planning of patient flow.

Patient satisfaction with all parts of their stay was very high: median 10 and mean 9.4 of 10 covering the entire stay. We find this highly satisfactory and believe this parameter to be one of the most important parameters for evaluation of any hospital stay, as it provides a patient-based assurance of quality. Increased satisfaction with information, nursing, pain treatment, doctors' rounds, and LOS associated with these short stays indicates that it is possible to give satisfactory information, care, and treatment during a short hospital stay and that patients

are satisfied with this shortened length of stay. The older patients were more satisfied. However, as increasing age was associated with quite a few patient characteristics that resulted in increasing LOS, older patients should receive special attention to reduce the risk of longer hospitalization.

Re-admissions within 3 months were fewer than or comparable to other studies—both for conventional stays and accelerated stays (Weingarten et al. 1998, Dowsey et al. 1999, Scranton 1999, Pearson et al. 2000, Mahomed et al. 2003), and there is no indication that an LOS of 5 days or less causes more complications. We cannot confirm a previous report of increased risk of hip dislocation associated with a reduction in LOS (Mauerhan et al. 2003), as we had a dislocation rate of only 2%. 10 of 19 re-admissions after TKA were under suspicion of DVT or infection, which were not found.

In conclusion, implementation of an accelerated track is capable of leading to reductions in LOS for unselected THR and TKR patients. 92% of our patients were discharged before or on day 5, with a mean LOS of 3.8 days. High patient satisfaction was found for all parts of the stay. The re-admission rate was similar to or less than reported in other studies.

Contributions of authors

HH and GH: collection, analysis, and interpretation of the data and preparation of the manuscript. SJ: analysis and interpretation of the data and preparation of the manuscript.

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