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Length of stay following primary total hip replacement

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ABSTRACT

INTRODUCTION Much of the cost of primary total hip arthroplasty (THA) comprises the length of stay in hospital. Given the increasing drive for cost-effective surgery in today's National Health Service, the aim of this investigation was to determine the patient and surgical factors that most influence the length of stay following surgery.

PATIENTS AND METHODS A large, population-based study of 675 consecutive patients in a regional orthopaedic centre in the South West of Britain.

RESULTS The median length of stay was 8 days. The majority of patients (81.5%) left hospital within 2 weeks, 13.6% within 2–4 weeks and 4.9% after 4 weeks. On multivariate analysis, age above 70 years, ASA grades 3 and 4, prolonged operations and long incisions were highly significantly associated with hospital stay of over 2 weeks.

CONCLUSIONS Prolonged stay after THA is largely predetermined by case mix and this should be taken into account when units are compared for performance and in the remuneration they receive for providing this service. Slick surgery through limited incisions may reduce the length of stay.

KEYWORDS

Primary total hip replacement – Length of stay – Cost

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Total hip arthroplasty (THA) is one of the most effective interventions in modern medicine.[1] It is predominantly performed in older patients who represent an increasing proportion of the population. It is this group that makes the greatest demand on total hip arthroplasty.

Healthcare budgets are finite; if total hip arthroplasty is to be provided satisfactorily, it must be delivered in a cost-effective manner. Much of the cost of total hip arthroplasty comprises the length of stay in hospital which healthcare organisations naturally seek to shorten. The length of stay after THA has declined over the past decade from a mean of 3 weeks[2] to 4 days.[3,4]

The length of stay should describe the duration of hospital admission after surgery but between 48%[5] and 89%[3] of patients in North America have required a mean of 11 days at a rehabilitation unit after acute admission. Thus length of stay in the literature often does not define the total cost of the residential care component after THA.

In previous studies, the variables associated with prolonged length of stay included advancing age,[3,6,7] social deprivation,[3] medical co-morbidity,[3,7] gender,[3,6] obesity[2,3] and longer, rather than shorter, surgical incisions.[8] Associations with obesity[9,10] and length of skin incision[4,5,11,12] have not been reproduced in some studies.

Most studies investigating length of stay after hip arthroplasty suffer from small numbers, retrospective data, mixed populations of hip and knee replacement, incorrect assumptions that data are normally distributed and failure to control for confounding factors. As age, social deprivation, medical co-morbidity and elevated American Society of Anesthesiologists (ASA) grade often co-exist, the most critical factors affecting the length of stay after THA are best defined by multivariate analysis of a large population with a complete data set.

The aim of this study was to recruit, prospectively, a population of patients undergoing primary total hip replacement to identify the most important variables affecting length of stay after THA whilst controlling for potential confounding factors.

Patients and Methods

A total of 675 consecutive patients who underwent primary total hip replacement in a regional orthopaedic centre in the South West of Britain were recruited prospectively.

Table 1 Length of stay and patient factors: univariate analysis

Factor	Group	Non-parametric descriptors				% Long stayers (> 14 days)		
		N	Median	IQR	*P*-value	*n/N*	%	*P*-value
BMI (kg/m²)								
	Normal (18.5–24.9)	157	8 days	[6–11.8]		23/157	14.6	
	Overweight (25–29.9)	268	8 days	[6–11.8]		42/268	15.7	
	Obese (30–34.9)	141	8 days	[6-13]		27/141	19.1	
	Morbidly obese (> 35)	78	11.5 days	[7–17]	0.004[c]	25/78	32.1	0.005[b]
Age (years)								
	< 60	169	7 days	[6–10]		15/169	8.9	
	60–69	202	7 days	[6–10]		22/202	10.9	
	70–79	203	9 days	[7-14]		49/203	24.1	
	> 80	101	13 days	[8–19]	<0.0001[c]	39/101	38.6	< 0.0001[b]
Gender								
	Male	248	8 days	[6–13]		18/248	7.2	
	Female	427	8 days	[6–13]	0.02[a]	86/427	20.2	0.005[b]
ASA								
	ASA 1	116	6.5 days	[6–10]		8/116	6.9	
	ASA 2	455	8 days	[6–13]		75/455	16.5	
	ASA 3+4	103	13 days	[8–18]	< 0.00013	41/103	39.8	< 0.00012

[a]Mann–Whitney test; [b]chi-squared test; [c]Kruskal–Wallis test.

The variables recorded were age, gender, body mass index (),[13] ASA grade, social deprivation, nursing practice, surgical approach, length of incision, type of prosthesis and duration of operation (Tables 1 and 2). Length of incision less than or equal to 10 cm was taken to be a 'mini' incision based on UK National Institute for Health and Clinical Excellence (NICE) guidelines.[14]

The ASA grade represented medical co-morbidity. Social deprivation was measured by the Townsend Deprivation Score based on postal code.[15] Patients were admitted in general the day before surgery but the length of stay was calculated from date of surgery to discharge home. The patients were nursed in a unit that performs over 1200 lower limb joint replacements per annum. Physiotherapy was commenced within 2 days of surgery and implemented daily. Discharge was nurse-led when patients could negotiate stairs with a stick and wash and dress themselves.

The length of stay varied from 2–196 days and was heavily skewed. Data were, therefore, analysed by non parametric methods using medians and inter-quartile ranges. The Mann–Whitney test was used to look at significant differences between two groups and the Kruskal–Wallis test for more than two groups.

To permit comparison of short with protracted length of stay, data were reduced to two groups comprising 2–14 days for short stays and 15–196 days for long. The choice of a 2-week cut-off was based on what seemed a normal distribution of length of stay followed by a lengthy tail of patients staying much longer. A univariate analysis of all the predictors using a chi-squared test was, therefore, presented alongside the non-parametric results. When an expected cell was less than 5, the Fisher's exact test was used. The multivariate analysis used a logistic regression model, the dichotomy of length of stay was the dependent variable. Predictors were deemed significant at the 5% level and a backward step selection procedure was used. The statistical software package used was SPSS.

Results

The mean length of stay was 11.4 days, an over-estimate compared to the median length of stay of 8 days which more correctly reflects the skewed nature of the distribution and the general experience of patients in the unit. The majority of patients (81.5%) left hospital within 2 weeks, 13.6% within 2–4 weeks and 4.9% after 4 weeks.

Univariate analysis

PATIENT FACTORS

Data are summarised in Table 1. Both males and females had a median length of stay of 8 days but almost three times

Table 2 Length of stay and factors during surgery: univariate analysis

Factor	Group	Non-parametric descriptors				% Long stayers (> 14 days)		
		N	Median	IQR	*P*-value	*n/N*	%	*P*-value
Cup								
	Un-cemented	501	8 days	[6–11]		66/501	13.2	
	Cemented	174	10 days	[7–17]	<0.0001[a]	59/174	33.9	< 0.0001[b]
Prosthesis								
	Cemented	560	8 days	[6–13]		112/560	20.0	
	Un-cemented	101	8 days	[6–11]		10/101	9.9	
	Resurfacing	6	6 days	[4.5–14.3]	0.68[c]	1/6	16.7	0.06[d]
Length of incision (cm)								
	≤ 10	83	6 days	[5–9]		6/83	7.2	
	> 10	590	8 days	[6–13]	<0.0001[a]	119/590	20.2	0.005[b]
Surgical approach								
	Posterior	459	8 days	[6–12]		71/459	15.5	
	Transgluteal	103	8 days	[6–15]		27/103	26.2	
	Omega	113	10 days	[8–14]	< 0.0001[c]	27/113	23.9	0.01[b]
Operating time (min)								
	< 90	140	7 days	[6–11]		21/140	15.0	
	90–99	107	8 days	[6–11]		12/107	11.2	
	100–109	126	9 days	[6–13]		21/126	16.7	
	110–119	78	9 days	[6–14]		17/78	21.8	
	120–129	81	8 days	[7–13]		17/81	21.0	
	130–139	57	7 days	[6–11]		7/57	12.3	
	> 140	84	10.5 days	[7–18]	0.001[c]	30/84	35.7	0.004[b]

[a]Mann–Whitney test; [b]chi-squared test; [c]Kruskal–Wallis test; [d]Fisher's exact test.

as many females (20.2%) stayed longer than 14 days, compared to the men (7.2%). Patients of 80 years or more had a median stay of 13 days, compared to the stay in the younger patients ($P < 0.0001$). Of this group, 39% stayed for more than 2 weeks which was significant compared to the long-staying younger patients ($P < 0.0001$). Morbidly obese patients with BMIs of 35 kg/m2 and over, stayed a median of 11.5 days ($P = 0.004$) and twice as many (32.1%) stayed more than 2 weeks compared with obese/normal patients with BMIs of 34 kg/m2 and under ($P = 0.005$). The median length of stay in patients with ASA grades 3 and 4 was 13 days which was twice as long as those with ASA grade 1 ($P < 0.0001$).

SURGICAL FACTORS

Data are summarised in Table 2. Patients whose hips were implanted through an extensive transgluteal approach (Omega approach[16]) had a median stay of 10 days compared with 8 days after posterior or other transgluteal approaches ($P < 0.0001$). Between 24–26% of patients whose surgery had been performed through a transgluteal or Omega approach stayed more than 2 weeks compared with 15.5% of patients who were long stayers after the posterior approach ($P = 0.01$).

Incisions of less than 10 cm were associated with a median stay of 6 days and those of 10 cm or more 8 days ($P < 0.0001$). A fifth of patients with incisions longer than 10 cm remained in hospital for more than 2 weeks compared to 7.2% of patients with incisions less than 10 cm ($P = 0.005$). There was no pattern or significance with incisions greater than 10 cm in relation to age, ASA grade or BMI. There was, however, a significant difference ($P = 0.02$) between the morbidly obese, who tended to have fewer small incisions, than the lighter patients who had more small incisions.

Patients in whom a cemented cup was implanted remained in hospital 2 days longer than those with an uncemented cup ($P < 0.0001$) and 34% of these patients remained in hospital for more than 2 weeks compared with 13% of those in the uncemented group ($P < 0.0001$).

Patients whose operation took longer than 140 min had a median length of stay of 10.5 days which was significantly

Table 3 Length of stay and all factors significant in the univariate analysis. Logistic regression model for the five most significant variables

Factor	Group	Long stayers (> 14 days)				
		n/N	%	OR	[95% CI]	*P*-value
Age	> 80 years	39/101	38.6	6.27	[3.57–11.02]	< 0.0001
Anaesthetic fitness	ASA 3&4	41/103	39.8	3.34	[2.05–5.43]	< 0.0001
Age	70–79 years	49/203	24.1	2.86	[1.75–4.67]	< 0.0001
Operating time	≥ 2 h	54/222	24.3	2.11	[1.36–3.28]	0.0009
Length of incision	> 10 cm	119/590	20.2	4.13	[1.64–10.36]	0.003

longer when compared with those with shorter operations ($P = 0.001$). Morbid obesity was associated with longer operating times but this finding was not significant.

Social deprivation, nursing practice and type of prostheses apart from cemented cups were not associated with length of stay after THA.

Multivariate analysis

The most significant variables are ranked in Table 3. After multivariate analysis, age of 70 years or above ($P < 0.0001$), ASA grades 3 and 4 ($P < 0.001$), operating time more than 120 min ($P = 0.0009$) and length of incision of more than 10 cm ($P = 0.003$) were highly significantly associated with length of stay over 14 days.

Of patients who stayed in hospital longer than 2 weeks, 90% demonstrated two or more of the variables of age of 70 years or more, ASA grades 3 and 4, prolonged surgery and longer incisions, compared to the 55% with similar variables who went home in 2 weeks or less. Almost three times as many (44%) of those staying longer than 2 weeks demonstrated three or more of these variables compared to similar patients staying 2 weeks or less (15%) (Table 4).

Table 4 Proportion of patients characterised by the four significant factors*

Factors present	Patients stayed ≤ 2 weeks		Patients stayed > 2 weeks	
	n/N	%	*n/N*	%
None	27/546	4.9	0/124	0
One	215/546	39.4	12/124	9.7
Two	222/546	40.6	57/124	46.0
Three	75/546	13.7	46/124	37.1
Four	7/546	1.3	9/124	7.3

*Aged 70 years or older; anaesthetic fitness, ASA 3 or ASA 4; operating time ≥ 2 h; and incision > 10 cm.

Discussion

This is the first study to record all the published variables[2,3,6–8] associated with length of stay prospectively and to subject the data to multivariate analysis.

Multivariate analysis excluded variables such as cemented cups which, in general, were implanted in older patients and obesity which is anecdotally associated with a longer operating time and slower postoperative recovery.

The findings of this study are consistent with the remainder of the literature in terms of age[3,6,7] and ASA grade.[3,7] Advanced age and poor fitness for anaesthesia were the variables most powerfully associated with protracted stay after hip arthroplasty and these are predetermined.

The surgeon variables included protracted operating time which may relate to the complex arthroplasty carried out in a specialist centre. In this study, 51% of the primary hip replacements with operating time over 140 min were complex cases and the majority of these (61%) were performed by senior consultants. These patients required more extensile surgical access through longer incisions. The short skin incisions were employed by some surgeons using the posterior approach and had a trend to a shorter length of stay. This finding is the least consistent with the published literature and, in particular, with the randomised prospective controlled trial from Belfast[4] which affords more robust data than this study. These patients may have been thinner making surgical access and procedure easier. Expeditious surgery through shorter incisions was associated with a slightly shorter length of stay. This does not imply that speedier surgery and short incisions should be used at the expense of careful surgical technique.

The anecdotal evidence that obese (BMI 30–34.9 kg/m^2) patients take longer to rehabilitate is not confirmed by data in this study with the implication that excluding patients on grounds of obesity is unlikely to influence the median length of stay although weight reduction in BMIs of 35 kg/m^2 or over should, theoretically, reduce some of the long stays.

Mean length of stay is a variable much cited by healthcare organisations whose interest is to contain the costs of service provision. The measure is blunt, fails to take account of case mix and is easily magnified by a small number of patients with very long length of stay, particularly in small units. Median length of stay is a more rational assessment of the efficiency of a unit and the age of the population and ASA grade should be considered when judging the performance of a unit. Fixed remuneration for primary hip arthroplasty is likewise blunt and is already leading to patient selection as units seek to optimise the financial returns from primary hip arthroplasty.

Conclusions

The variables associated with prolonged length of stay after total hip arthroplasty are largely predetermined by case mix especially age and medical co-morbidity before surgery. Such variables should be taken into account when units are compared for performance and in the remuneration they receive for providing this service. Quicker operations through shorter incisions seem to be advantageous in reducing hospital stay.

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