Early complications of total hip and knee replacement: a comparison of outcomes in a regional orthopaedic hospital and two independent treatment centres

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ABSTRACT

INTRODUCTION There is anecdotal evidence of poorer outcomes from prosthetic joint replacement performed in independent treatment centres but very few comparative studies.

PATIENTS AND METHODS We compared the early re-operation, dislocation, re-admission, major wound infection and audit rates of 880 total hip (THA) and 874 total knee (TKA) arthroplasties carried out at a regional orthopaedic hospital (Avon Orthopaedic Centre; AOC) with 368 THAs and 365 TKAs from an NHS (WGH) and 67 THAs and 86 TKAs from a private hospital (CNH) independent treatment centre.

RESULTS Early re-operation rates were 9% at CNH, 1.4% at WGH and 0.6% at AOC after THA and 8% at CNH, 1.9% at WGH and 1% at AOC after TKA. After THA, dislocation rates after THA were 6% at CNH and 1.8% at both WGH and AOC. Re-admission rates were 13% at CNH, 0.6% at WGH and 1.2% at AOC. Major wound problems were 20% at CNH, 3.8% at WGH and 0.4% at AOC after THA and 19% at CNH, 1.9% at WGH and AOC (1.1%) after TKA. After TKA, re-admission rates from CNH were 13%, 1% at WGH and 1.1% at AOC. AOC and WGH audited their outcomes. None were available from CNH.

CONCLUSIONS Results and audit from independent treatment centres are variable and patients should be warned of this before undergoing treatment at them.

KEYWORDS

Independent treatment centres – Complications – Joint replacement

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Joint replacement in the UK has traditionally been performed either at National Health Service (NHS) facilities or by NHS consultant orthopaedic surgeons at private hospitals. One of the strategies adopted by the Department of Health to improve access to joint replacement was Independent Treatment Centres (ITCs).

These were variously designated 'Diagnostic and Treatment Centres', 'G. Supp contracts' and 'Independent Sector Treatment Centres'. The intention was that these should provide additional capacity and, therefore, not engage staff currently employed in NHS hospitals.¹ Thus, surgeons were recruited from overseas, often for very short periods.² The service provided differed from NHS hospitals in that ITCs did not provide long-term care for patients with complications in the event of which patients were referred back to their local NHS hospital.²

In this study, patients were listed for either primary total hip (THA) or total knee (TKA) arthroplasty at a regional orthopaedic centre (AOC) but, when their operations could not be performed within times required by central government, were offered surgery at local ITCs. Some of these patients presented with complications to local NHS hospitals. It was recognised that complications occur at all hospitals, so an audit was carried out to compare the early complications of THA and TKA at the AOC with those of two ITCs in adjacent towns to which patients originally scheduled for surgery at AOC had been sent.

Patients and Methods

We recorded the early complications described at the Mayo Clinic⁵ (Table 1) and defined early complication as being

Table 1 Complications (after Coventry *et al.* 1974)

- Re-operation
- Re-admission
- Major wound infection
- Dislocation
- Death
- Pulmonary embolism
- Deep vein thrombosis
- Major cardiopulmonary
- Major neurological
- Minor wound infection
- Miscellaneous

'Miscellaneous' includes urinary tract infections and unexplained pain.

within 2 years of primary arthroplasty.^{3,4} Surgery at AOC was carried out by NHS consultants and their trainees and at the ITCs by surgeons from overseas.

At one ITC (WGH), Swedish surgeons visited for 1–2 weeks in rotation, operated in NHS theatres and their patients were nursed postoperatively in a designated bay in an elective NHS orthopaedic ward. Surgeons with different areas of expertise were flown across depending on the type of surgery required.

At the other ITC (CNH), surgeons operated in one of a national chain of private hospitals. Much of the surgery was carried out by a German surgeon on a long-term contract who performed a wide range of general orthopaedic procedures as well as THA and TKA but other surgeons from the European Union contributed. At WGH, prostheses were all cemented and surgeons implanted the Exeter Universal stem (Stryker, Newbury, Berkshire, UK), the Elite all-polyethylene cup (DePuy, Leeds, UK) and the Kinemax Plus TKA (Stryker, Newbury, Berkshire, UK) as these were the most widely used prostheses at AOC at the time. At CNH, surgeons implanted the uncemented Corail-Duraloc ceramic on ceramic THA and the cemented PFC knee (DePuy) although other cemented devices were used.

Data were collected on an outcome form in out-patient clinics at the AOC and WGH. The returns on these forms were approximately 40% and data collection was completed by the authors by telephone by open questioning using the outcome form. All outcome data from CNH were collected by telephone and all re-operations except the three performed at CNH were validated by reference to AOC records. This review was confined to the outcome of primary THA and TKA to standardise material although a range of other orthopaedic procedures were performed at the ITCs.

The ITCs declined to treat a proportion of patients likely to remain in hospital for more than 5 days because of comorbidity or complexity.

Statistical analysis

Data were analysed by chi-squared test. The variables assessed were early re-operation, dislocation, re-admission, major wound infection and audit rates and complications. Some patients had more than one complication and these were considered as individual events. Thus, the sum of the complications exceeded that of the patients affected by them.

Results

Between 31 October 2003 and 31 March 2005 (17 months), 880 primary THAs and 874 TKAs were performed at AOC. Between 1 April 2004 and 30 September 2005 (17 months), 368 THAs and 365 TKAs were performed at WGH and from 1 April 2003 to 31 March 2005, 67 THAs and 86 THAs were performed at CNH. The retrieval from AOC was 94%, WGH 95% and CNH 100%. The study periods overlap but do not correspond exactly because the comparison was commenced there was increasing awareness of re-admissions of patients with complications from ITCs to the AOC.

Re-operations

After THA, re-operation rates at AOC were 0.6%, WGH 1.4% and CNH 9% (Table 2). Re-operation rates at CNH were significantly higher than AOC (chi-squared 38, $P = 0.000$) or WGH (chi-squared 13.2, $P \leq 0.001$). There were 19 re-operations after THA, of which a little over one-third (eight) were for dislocation and a quarter (five) for deep infection. Six of the 18 re-operations were for deep infection and three of these followed surgery at CNH.

After TKA, re-operation rates at AOC were 1%, WGH 1.9% and CNH 8%. Re-operation rates at CNH were significantly higher than AOC (chi-squared 55, $P = 0.000$) and WGH (chi-squared 97.6, $P = 0.000$). There was no significant difference in re-operation rates between AOC and WGH after either after TKA or THA or the two combined.

Re-admissions

After THA, re-admission rates (Table 3) at CNH (13%) not followed by re-operation at the same admission were 10 times higher than AOC (1.2%) and 20 times greater than WGH (0.6%; chi-squared 62, $P = 0.000$). After TKA, re-admission rates at CNH (13%) were 12 times higher than AOC (1.1%) and 13 times greater than WGH (1%; chi-squared 108, $P = 0.000$).

Major wound infections

After THA, major wound infections (Table 3) at CNH (20%) were 50 times higher than AOC (0.4%) and 5 times greater than WGH (3.8%; chi-squared 76, $P = 0.000$). After TKA, major wound infection at CNH (19%) was 17 times greater than AOC (1.1%) and 9 times greater than WGH (1.9%).

Table 2 Early re-operations after total hip and knee arthroplasty

Patient	Reasons for re-operation: THA
	<i>AOC (5 in total)</i>
1	Anterior instability secondary to complete abductor detachment
2	Recurrent dislocation
3	Deep prosthetic infection
4	Open reduction dislocation
5	Deep prosthetic infection
	<i>WGH (7 in total)</i>
6	Deep infection secondary to haematoma
	Loose cemented acetabular component
7	Chronic dislocation
8	Loose cemented acetabular component
9	Recurrent dislocation
10	Recurrent dislocation
11	Loose stem and recurrent dislocation
	<i>CNH (7 in total)</i>
12	Septic loosening Corail stem
13	Malunion of greater trochanter
14	Loose acetabular component
15	Recurrent dislocation: revision at CNH
16	Failure of abductor repair and haematoma: re-operation at CNH
17	Deep prosthetic infection: debridement
18	Major wound infection: re-operation at CNH
	Reasons for re-operation: TKA
	<i>AOC (5 in total)</i>
19	Instability
20	Instability and malposition of tibial component
21	Deep infection: debridement
22	Deep infection: debridement
23	Aspiration
	<i>WGH (5 in total)</i>
24	Supracondylar fracture following notch
25	Persistent pain
26	Loose tibial component
27	Wound dehiscence
28	Patellar pain: not resurfaced
	<i>CNH (7 in total)</i>
29	Deep infection: two-stage revision
30	Deep infection: two-stage revision
31	Deep infection: two-stage revision
32	Deep infection: two-stage revision
33	Malaligned components
34	Overstuffed knee
35	Deep infection: two-stage revision

Table 3 Early complications after total hip and knee arthroplasty

	AOC(%)	Centre WGH (%)	CNH (%)
Total hip arthroplasty			
Re-operation	0.6	1.4	9
Re-admission	1.2	0.6	13
Major wound problem	0.4	3.8	20
Dislocation	2.1	1.5	6
Death	1.9	0.6	0
Pulmonary embolism	0.8	0.5	0
Deep vein thrombosis	1.7	2.6	3
Cardiac	0.9	0.3	0
Neurological	1	0	3
Minor wound problem	4.8	3.8	7
Miscellaneous	6.8	0.8	4
Total knee arthroplasty			
Re-operation	1	1.9	8
Re-admission	1.1	1	13
Major wound problem	1.1	1.9	19
Dislocation	0.4	0	0
Death	1.4	0	0
Pulmonary embolism	0.8	0.3	2
Deep vein thrombosis	2.9	1.1	1
Neurological	0.2	0	5
Minor wound problem	0	0	5
Miscellaneous	7.3	0	6

Other complications

After THA, WGH (14.6%) reported a significantly lower rate of complications (Table 3) not requiring surgery than AOC (23%; chi-squared 11.7, $P = 0.001$) or CNH (29%; chi-squared 4.8, $P > 0.05$).

There was no difference between AOC and CNH. Rates of dislocation were significantly higher at CNH (6%) than AOC and WGH (mean 1.8%; chi-squared 5.23, $P \geq 0.05$).

After TKA, patients at WGH (4.3%) experienced significantly fewer complications than AOC (7.9%; chi-squared 5, $P = 0.05$) and CNH (29%; chi-squared 27.33, $P = 0.000$).

Case selection

The ITCs performed the procedure for which patients had been listed at base hospital in 67% of cases sent to WGH and 71% at CNH. Reasons for rejection at WGH were co-morbidity in 4.2% and complexity of surgery in 1%. Of patients who had initially agreed to undergo surgery at WGH, 10% subsequently decided to have their operation at AOC.

At CNH, 23.2% were rejected on medical or surgical grounds and 5.6% elected for surgery at AOC.

Audit

AOC and WGH audited their outcomes. No audit data were available from CNH.

Discussion

This study contrasts highly variable performances of two ITCs which excluded patients with greater co-morbidity and complexity but had higher re-operation rates than AOC. Indeed, as approximately one-third of the activity over this period was carried out by ITCs, AOC was likely to have faced a more challenging case mix than before their introduction. In Sweden,⁴ more difficult cases are sent to university hospitals where early re-operations are 76% higher than the national mean; on this basis, AOC should have had the highest early re-operation rate of the three hospitals.

The re-operation rate of AOC and WGH was similar to other comparable studies in Europe. The re-operation rate for THA within one year in five English regions was 2.9%,⁵ in the Trent Hip Arthroplasty Survey 2.3%,⁶ and in Sweden 1.4%.⁴ At AOC and WGH, the re-operation rate for TKA was higher than the mean 0.7% cited by the Scottish Arthroplasty Project⁷ after one year but less than the 2% reported by the Swedish Knee Arthroplasty Survey.⁸ However, re-operation rates after THA at CNH were 3–4 times higher than other English surveys and 6 times greater than those reported in the Swedish Hip Arthroplasty Register and, after TKA, 4 times higher than the Swedish Knee Arthroplasty Survey⁴ and 11 times greater than the Scottish Arthroplasty Project.⁷

After THA, WGH had a lower rate of complications requiring re-operation than both AOC and CNH. Their case mix was probably similar to CNH. Dislocation rates after THA at AOC and WGH were similar to the 1.9% reported in the Scottish Arthroplasty Project 2005⁹ but lower than the 5% report in the Trent Arthroplasty Study⁶ and the 3% in five English regions.⁵ Infection rates at AOC and WGH were comparable to the 1% reported in the Scottish Arthroplasty Project⁷ and the 1.4% reported by the Trent Arthroplasty.⁶ By contrast, CNH had a significantly higher complication rate after total knee replacement than either of the other hospitals in this review or the contemporary published literature.

Variations in outcomes amongst centres and surgeons after joint replacement have been reported for over 25 years. Re-operation after the Charnley THA in the early 1970s varied between 0% in Iowa⁹ and Oxford¹⁰ and 4.3% at the Mayo Clinic.⁵

Variations were even greater with the McKee–Farrar THA when Langenskiöld and Paavilainen¹¹ in Helsinki

reported re-operation rates of 0% compared with 14% in Vancouver.¹² The Vancouver experience was associated with low volumes of surgery performed by a large number of practitioners.

The volume of cases carried out at CNH comprised some six THAs or TKAs per month compared with 103 at AOC and 61 at WGH, yet the crude number of re-operations was the same. Small-volume surgery has been associated with higher relative risks of revision in uncemented THA in Norway¹⁵ and infection^{14,15} and mortality^{14,16,17} after THA in North America. The relative risk of infection in North America, however, ranged between 1.2¹⁵ and 4¹⁴ which was a much smaller differential than amongst the hospitals in this study.

Data acquisition for this study involved many hundreds of hours of telephone calls by the authors indicating that data collection at all these units was inefficient. AOC and WGH used both surgeons in out-patient clinics and NHS audit personnel. Surgeons failed to complete the audit forms in 60% of cases. This probably related to their being hidden in volumes of paper notes and surgeons concentrating on patients problems rather than data collection. WGH initially audited the hospital record of their patients' admissions for the first five postoperative days and follow-up records of those who attended for follow-up. In-patient records, however, were generally for the initial five postoperative days and most of their infections and dislocations presented to patients' local hospitals where they were subsequently followed.

Thus, WGH underestimated their dislocation rate by a factor of 10 and combined infection rate by a factor of 25 on their initial review. Such audit as was carried out by CNH was not made available and this is common to independent sector activity. The Scottish Arthroplasty Project 2005⁷ was unable to capture any records of NHS patients treated in the independent sector. In the Swedish Arthroplasty Register 2005,⁴ no re-operations within 2 years were reported in three of the 71 university, central or rural hospitals (4%) and four of the eight (50%) private ones.

This study has identified an outlying performance by one ITC. Outliers are recorded in Scotland but, whereas the Scottish Arthroplasty Project⁷ identifies these and seeks to assist the hospitals and surgeons concerned, this can only occur if outcomes are reported promptly and honestly. Earlier action at CNH might well have enabled their problems to be rectified before patients were exposed to the major complications that occurred.

The aim of this study has been to compare the short-term complications after total hip replacement and total knee replacement at one NHS hospital and two ITCs. Longer term follow-up of a small number of patients sent from Exeter to four London hospitals revealed revision rate after 10 years of 44% in the London hospitals compared with 4.9% at Exeter.¹⁸ There will need to be further review

of our patients to establish the relative revision burden of this exercise on the patients of our city and the resources of AOC. The revision burden on AOC by the activity at CNH has already included six septic and four aseptic revisions which have cost AOC the equivalent of 30 primary hip and knee replacements.

The Cardiff and Vale NHS Trust reported disproportionately high revision rates after 3 years in patients who had undergone THA and TKR at one of the ITCs studied in this paper.^{21,22} Neither paper gave comparative data for their base hospital.

Apart from improving access to care, one of objectives of the ITCs was to increase patient choice.¹⁹ Private providers do not make their complication rates available, so patient choice before attending such units cannot be informed. The outcome of NHS patients treated in the private sector should either be subjected to the same robust and transparent review made available in the public domain or it should be made quite clear to patients who are approached to be sent to ITCs that the outcome of these units is not generally known and there has been a 15-fold difference in early and a 9-fold in long-term re-operation rates in the only two comparative studies currently available.

References

- House of Commons Health Committee. *Independent Sector Treatment Centres*. Fourth report of session. Volume 1: para 58–59.
- House of Commons Health Committee. *Independent Sector Treatment Centres*. Fourth Report of Session. Volume 1: para 61.
- Coventry MB, Beckenbaugh RD, Nolan DR, Ilstrup DM. 2012 total hip arthroplasties: a study of postoperative course and early complications. *J Bone Joint Surg Am* 1974; **56**: 273–84.
- Swedish Hip Arthroplasty Register. *Annual Report 2005*. Department of Orthopaedics Sahlgrenska University Hospital. August 2006 <<http://www.jru.orthop.gu.se/archive/AnnualReport-2005-eng.pdf>>.
- Williams O, Fitzpatrick R, Hajat S, Reeves BC, Stimpson A, Morris RW *et al*. Mortality, morbidity and 1-year outcomes of primary elective total hip arthroplasty. *J Arthroplasty* 2002; **17**: 165–71.
- Fender D, Harper WM, Gregg PJ. Outcome of Charnley total hip replacement across a single health region in England. *J Bone Joint Surg Br* 1999; **81**: 577–81.
- Scottish Arthroplasty Project *Annual Report 2005*. NHS Scotland. p 21–29 <http://www.show.scot.nhs.uk/arthro/Reports/Scottish_Arthroplasty_Project_Report_2005.pdf>.
- Swedish Knee Arthroplasty Survey 2005 <http://www.knee.nko.se/english/online/uploadedFiles/104_SKAR%202005_eng1.pdf>.
- Johnston RC. Clinical follow-up of total hip replacement. *Clin Orthop* 1973; **95**: 118–26.
- Bentley G, Duthie RB. A comparative review of the McKee–Farrar and the Charnley total hip prostheses. *Clin Orthop* 1973; **95**: 127–42.
- Langenskiöld A, Paavilainen T. Total replacement of 116 hips by the McKee–Farrar prosthesis: a preliminary report. *Clin Orthop* 1973; **95**: 143–50.
- Patterson FP, Selby Brown C. The McKee–Farrar total hip replacement: preliminary results and complications of 368 operations performed in five general hospitals. *J Bone Joint Surg Am* 1972; **54**: 257–75.
- Espehaug B, Havelin LI, Engesaeter LB, Vollset SE. The effect of hospital-type and operating volume on the survival of hip replacements. *Acta Orthop Scand* 1999; **70**: 12–8.
- Kreder HJ, Deyo RA, Koepsell T, Swiontkowski MF, Kreuter W. Relationship between the volume of total hip replacements performed by providers and the rates of postoperative complications in the state of Washington. *J Bone Joint Surg Am* 1997; **79**: 485–94.
- Katz JN, Losina E, Barrett J, Phillips CB, Mahomed NN, Lew RA *et al*. Association between hospital and surgeon procedure volume and outcomes of total hip replacement in the United States Medicare population. *J Bone Joint Surg Am* 2001; **83**: 1622–9.
- Lavernia CJ, Guzman JF. Relationship of surgical volume to short-term mortality, morbidity and hospital charges in arthroplasty. *J Arthroplasty* 1995; **10**: 133–40.
- Taylor HD, Dennis DA, Crane HS. Relationships between mortality rates and hospital patient volume for Medicare patients undergoing major orthopaedic surgery of the hip, knee, spine and femur. *J Arthroplasty* 1997; **12**: 235–42.
- Ciampolini J, Hubble MJW. Early failure of total hip replacement implanted at distant hospitals to reduce waiting lists. *Ann R Coll Surg Engl* 2005; **87**: 31–5.
- House of Commons Health Committee. *Independent Sector Treatment Centres*. Fourth report of session. Volume 1: para 40–41.
- Kempshall PJ, Metcalfe A, Forster MC. Review of Kinemax knee arthroplasty at NHS Treatment Centre, Weston-Super-Mare. *J Bone Joint Surg Br* 2009; **91**: 229–33.
- White SH, John AW, Jones SA. Short term results of total hip replacements performed by visiting surgeons at an NHS treatment Centre. *J Bone Joint Surg Br* 2009; **91**: 1154–7.