

Supplementary article data

No functional benefit of larger femoral heads and alternative bearings at 6 months following primary hip replacement

Simon S JAMESON^{1,2}, James M MASON², Paul N BAKER¹, Paul J GREGG¹, David J DEEHAN³, and Mike R REED⁴

¹The National Joint Registry for England and Wales; ²School of Medicine, Pharmacy and Health, Durham University, Queen's Campus, Stockton-on-Tees; ³Newcastle Hospitals NHS Foundation Trust, Newcastle upon Tyne; ⁴Northumbria Healthcare NHS Foundation Trust, Ashington, Northumberland, UK.
Correspondence: simonjameson@doctors.org.uk
Submitted 2013-12-10. Accepted 2014-05-19

Supplementary material

The reliability of the multivariable statistical models was explored in a number of ways: covariates found not to be statistically significant were excluded from the model, based on statistical entry ($p < 0.05$) criteria; the same covariates were fitted forward and reverse stepwise manually to ensure findings were not qualitatively affected in the final model, with any inconsistency reported. The final models were then re-evaluated as a directly entered model (non-stepwise), and were assessed by exploring 2-way interactions between covariates.

The purpose of the analysis was hypothesis generating rather than hypothesis testing, consequently there is no adjustment for multiple testing and the choice of level of statistical significance is somewhat arbitrary.

Tests for interaction (multiplicative) between covariates were not statistically significant. Forward and reverse stepwise model construction and varying significance thresholds led to the same final models. BMI data was available for 2,726 procedures (59%). BMI had a significant influence on the OHS change models and the wound complications models; thus, these models analysed fewer procedures than were available from the entire cohort. Despite this, testing with BMI excluded from the model did not qualitatively affect the change scores or significance levels, and so the final models retained the BMI variable. Variables included in the statistical models, and their significance levels within the final models, are shown in Table x and Table y.

Table x. Variables included in the change score analysis of covariance models

	Oxford hip score change		EQ5D index change	
	Head size model	Bearing model	Head size model	Bearing model
Head size	0.930	–	0.976	–
Bearing	–	0.895	–	0.320
Approach	<0.001	0.008	0.003	0.003
Preop. Oxford hip score	<0.001	<0.001	0.002	–
Preop. EQ5D index	–	–	<0.001	<0.001
Preop. general health	<0.001	<0.001	<0.001	<0.001
Preop. disability	0.003	0.001	<0.001	<0.001
Circulatory problems	<0.001	<0.001	<0.001	0.002
History of depression	–	0.001	<0.001	<0.001
BMI ^a	<0.001	0.040	–	0.001
Sex	<0.001	–	–	–
Goodness of fit of model (adjusted R ²)	36%	41%	58%	60%

^a BMI data available for 2,726 implants (59%) therefore final change models analyse fewer procedures than entire cohort. Despite this, testing with BMI excluded from the model did not qualitatively effect the change scores or significance levels. Goodness of fit of a model provides a measure of how well observed outcomes are replicated by the model, as a proportion of total variation of outcomes explained by the model.

Table y. Variables included in the complications multivariable logistic regression models

	Bleeding		Wound		Readmitted		Reoperation	
	Head size model	Bearing model	Head size model	Bearing model	Head size model	Bearing model	Head size model	Bearing model
Head size	0.334	–	0.001	0.014	0.191	–	0.885	–
Bearing	–	0.967	–	0.671	–	0.936	–	0.472
Approach	–	–	0.028	0.033	–	–	–	–
Preoperative Oxford hip score	–	–	–	–	–	–	0.025	0.024
Preoperative general health	–	–	0.009	0.009	0.028	0.027	–	–
History of depression	–	–	–	–	0.024	0.028	–	–
BMI ^a	–	–	0.001	0.001	–	–	–	–
Sex	–	0.067	0.002	0.003	–	–	–	–
Age	–	–	–	–	0.006	0.026	–	–
Type of mechanical VTE prophylaxis	0.013	0.017	–	–	–	–	0.076	0.083

VTE – venous thromboembolic

^a BMI data available for 2,726 implants (59%) therefore final change models analyse fewer procedures than entire cohort. Despite this, testing with BMI excluded from the model did not qualitatively effect the change scores or significance levels.

Table 1. Summary of the demographic and surgical variables available for analysis

	Source	Description
Patient factors		
Age (years)	NJR/PROMs	
Sex	NJR/PROMs	
American Society of Anaesthesiology (ASA) grade	NJR	Grades 1 to 4
Body mass index (BMI) (kg/m ²)	NJR	Only BMI within 15 kg/m ² to 60 kg/m ² included
Comorbidities	PROMs	Recorded by patients as part of the preoperative PROMs questionnaire. Nine comorbidities: i) ischaemic heart disease, ii) respiratory disease, iii) diabetes, iv) hypertension, v) kidney disease, vi) liver disease, vii) circulatory problems, viii) cancer, ix) depression
Preoperative general health	PROMs	Indicates the patient's perception of their own general health with 5 options: i) excellent, ii) very good, iii) good, iv) fair, v) poor
Preoperative disability	PROMs	Indicates whether the patient considers themselves to have a disability
Preoperative Oxford hip score (OHS)	PROMs	Derived from adding the points (0 to 4) together from the response to hip symptom-specific questions on a scale of 0 to 48 (0 worst, 48 best)
Preoperative EQ5D Visual Analogue Score	PROMs	Indicates how well the patient feels on the day of completing the questionnaire on a scale of 0–100 (0 worst, 100 best)
Preoperative EQ5D index	PROMs	Single summary score derived from EQ5D profile (based on response to 5 questions) by applying a formula with appropriate operation specific weightings
Surgical factors		
Lead surgeon grade	NJR	Consultant or other
Surgeon volume	NJR	i) Low, ii) medium, iii) high
Approach	NJR	i) Posterior, ii) direct lateral, ii) other
Patient position	NJR	i) Lateral, ii) supine, iii) not recorded
Type of replacement	NJR	i) Best cemented, ii) Other cemented, iii) Best hybrid, iv) Other hybrid, v) Best cementless, vi) Other cementless, vii) Best resurfacing, viii) Other resurfacing
Anaesthesia	NJR	i) Regional only, ii) general only, iii) general and regional
Chemical venous thromboembolism prophylaxis	NJR	Intended prophylaxis as recorded at time of operation: i) aspirin only, ii) LMWH only, iii) other, iv) none, v) not recorded
Mechanical venous thromboembolism prophylaxis	NJR	Intended prophylaxis as recorded at time of operation: i) Compression stockings (CS) only, ii) combination CS/mechanical pump, iii) foot pump only, iv) intermittent calf pump only, v) other, vi) none, vii) not recorded
Time from operation to postoperative PROMs completion	PROMs	Calculated from the date of operation as recorded on the NJR database to the date of postoperative PROMs as recorded on the questionnaire

NJR – National Joint Registry, PROMs – patient-reported outcome measures, LMWH – low molecular weight heparin

Table 6. Patient-reported outcome scores following primary hip replacement, by bearing (simple and multi-variable analyses)

	Value	Simple 99% CI	p-value	Value	Multivariable 99% CI	p-value
Change in Oxford hip score						
Metal-on-polyethylene	21.3	20.8–21.9	Reference	21.2	20.6–21.8	Reference
Ceramic-on-polyethylene	19.7	18.4–21.0	0.003	20.5	19.1–21.8	0.2
Ceramic-on-ceramic	20.9	20.3–21.4	0.14	21.2	20.6–21.8	1.0
Change EQ5D index						
Metal-on-polyethylene	0.428	0.409–0.448	Reference	0.419	0.402–0.436	Reference
Ceramic-on-polyethylene	0.385	0.337–0.433	0.03	0.404	0.365–0.444	0.4
Ceramic-on-ceramic	0.406	0.386–0.426	0.04	0.411	0.393–0.428	0.4

See Table x in Supplementary data for variables included in models.

Table 7. Patient-reported outcome scores following primary hip replacement, by head size (simple and multi-variable analyses)

	Value	Simple 99% CI	p-value	Value	Multivariable 99% CI	p-value
Change in Oxford hip score						
28 mm	21.6	20.0–22.2	Reference	21.5	20.9–22.1	Reference
32 mm	20.3	19.4–21.2	0.001	20.1	19.2–21.1	0.002
36 mm	20.8	20.3–21.3	0.004	21.3	20.7–21.8	0.5
Change EQ5D index						
28 mm	0.429	0.408–0.450	Reference	0.426	0.408–0.444	Reference
32 mm	0.408	0.377–0.440	0.2	0.388	0.361–0.416	0.004
36 mm	0.407	0.389–0.425	0.05	0.417	0.401–0.433	0.3

See Table x in Supplementary data for variables included in models.

Table 8. Patient-reported complications following primary hip replacement, by bearing (simple and multi-variable analyses)

	%	n	OR	Simple 99% CI	p-value	OR	Multivariable 99% CI	p-value
Bleeding complications								
Metal-on-polyethylene	5.8	125	1			1		
Ceramic-on-polyethylene	4.2	15	0.71	0.34–1.49	0.2	0.70	0.34–1.44	0.2
Ceramic-on-ceramic	5.9	122	1.02	0.73–1.43	0.9	1.00	0.71–1.41	1.0
Wound complications								
Metal-on-polyethylene	7.3	158	1			1		
Ceramic-on-polyethylene	8.6	31	1.20	0.71–2.04	0.4	1.33	0.67–2.62	0.2
Ceramic-on-ceramic	9.9	204	1.40	1.05–1.86	0.002	1.25	0.75–2.08	0.2
Re-admission								
Metal-on-polyethylene	7.2	157	1			1		
Ceramic-on-polyethylene	7.2	26	0.99	0.57–1.76	1.0	1.10	0.61–2.00	0.7
Ceramic-on-ceramic	5.6	115	0.76	0.55–1.05	0.03	0.85	0.58–1.25	0.2
Reoperation								
Metal-on-polyethylene	1.8	40	1			1		
Ceramic-on-polyethylene	1.4	5	0.75	0.22–2.57	0.5	0.75	0.22–2.59	0.5
Ceramic-on-ceramic	2.0	41	1.08	0.61–1.93	0.7	1.12	0.62–2.01	0.6

OR: odds ratio.
See Table y in Supplementary data for variables included in models.

Table 9. Patient-reported complications following primary hip replacement, by head size (simple and multi-variable analyses)

	%	n	OR	Simple 99% CI	p-value	OR	Multivariable 99% CI	p-value
Bleeding complications								
28 mm	4.5	84	1			1		
32 mm	7.9	69	1.83	1.19–2.82	<0.001	1.83	1.19–2.82	< 0.001
36 mm	5.6	109	1.31	0.92–1.89	0.05	1.32	0.90–1.95	0.06
Wound complications								
28 mm	7.7	144	1			1		
32 mm	7.6	66	0.98	0.66–1.46	0.9	1.12	0.65–1.93	0.6
36 mm	9.8	183	1.27	0.96–1.68	0.03	1.68	1.10–2.59	0.002
Re-admission								
28 mm	6.3	117	1			1		
32 mm	7.6	66	1.22	0.81–1.84	0.2	1.26	0.83–1.93	0.16
36 mm	6.2	115	1.00	0.73–1.37	1.0	1.10	0.76–1.60	0.500
Reoperation								
28 mm	2.3	42	1			1		
32 mm	1.3	11	0.55	0.23–1.31	0.08	0.55	0.23–1.32	0.08
36 mm	1.8	33	0.71	0.41–1.26	0.1	0.85	0.46–1.57	0.5

OR: odds ratio.

See Table y in Supplementary data for variables included in models.