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The impact of pre-operative obesity on weight change and outcome in total knee replacement

A PROSPECTIVE STUDY OF 529 CONSECUTIVE PATIENTS

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We carried out a prospective, continuous study on 529 patients who underwent primary total knee replacement between January 2006 and December 2007 at a major teaching hospital. The aim was to investigate weight change and the functional and clinical outcome in non-obese and obese groups at 12 months post-operatively. The patients were grouped according to their pre-operative body mass index (BMI) as follows: non-obese (BMI < 30 kg/m^2), obese (BMI ³ 30 to 39 kg/m^2) and morbidly obese (BMI > 40 kg/m^2). The clinical outcome data were available for all patients and functional outcome data for 521 (98.5%). Overall, 318 (60.1%) of the patients were obese or morbidly obese.

At 12 months, a clinically significant weight loss of ≥ 5% had occurred in 40 (12.6%) of the obese patients, but 107 (21%) gained weight. The change in the International Knee Society score was less in obese and morbidly obese compared with non-obese patients (p = 0.016). Adverse events occurred in 30 (14.2%) of the non-obese, 59 (22.6%) of the obese and 20 (35.1%) of the morbidly obese patients (p = 0.001).

Most patients presenting for total knee replacement (TKR) are obese.[1-3] Obesity has been linked to a poor outcome after TKR in both the short[4] and longer term.[5] However, loss of weight in obese patients awaiting surgery is difficult, partly because the symptoms limit their ability to exercise, and they often believe that joint replacement is crucial for weight loss. Improvements of function and quality of life (QoL) occur within three months of TKR,[6-9] and thus the perceived barrier to weight loss should be removed at this time. There is, however, little information on the impact of TKR on subsequent weight loss, although it has been suggested that this may not occur after TKR.[10,11] These studies have been limited in sample size. One review established that two years after TKR 17% of patients had lost 5% or more of their pre-operative weight.[12] It would be of clinical value to determine if there is a patient profile in which weight loss or gain can be predicted after primary TKR. This would allow appropriate counselling of those patients who are unlikely to lose weight.

Our study had three aims; firstly, to establish the rate of clinically significant weight change in patients 12 months after primary TKR; secondly, to compare the clinical details and characteristics of patients who lost or gained weight after primary TKR with those who did not and, thirdly, to compare the clinical and functional outcome between obese and non-obese patients after TKR.

Patients and Methods

This was a prospective, continuous study of patients grouped according to the body mass index (BMI) for comparison of outcome and weight change. The investigation was undertaken at a 460-bed university-affiliated tertiary-referral centre in Melbourne. All patients admitted for primary TKR between January 1, 2006 and December 31, 2007 were eligible for the study. The treatment and rehabilitation protocol was standardised through the use of validated clinical pathways protocols.[13] This included a daily dose of low molecular weight heparin, antiembolic stockings and mobilisation on the first post-operative day. A diagnosis of deep-vein thrombosis (DVT) was based on clinical suspicion and confirmed on Doppler ultrasound. The rate of asymptomatic DVT was not known. Those undergoing surgery for neoplastic disease or revision TKR and those unable to provide informed consent were excluded. Data was collected prospectively and entered into a dedicated database for analysis. Pre-operative data including age, gender, type of surgery, height, weight, co-morbidities, Charnley classification,[14] functional assessment and the QoL were collected at pre-

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admission examination which occurred within four weeks of surgery. In-patient data including length of stay, complications, and destination after discharge, collected during the admission, and information at the 12-month follow-up was obtained at the orthopaedic outpatient review. Further functional and QoL assessment and measurement of height and weight were undertaken at 12 months.

The SF-12 and IKS questionnaires were posted to patients with instructions to complete them and bring them to their review. The objective components of the IKS were completed by the attending orthopaedic consultant or registrar. Patients who did not bring the questionnaire were subsequently contacted by a health professional independent of the study and the form was completed by telephone. This person was blinded to the patient's height and weight. Adverse events included the following: i) death related to the original procedure; ii) peri-operative medical or surgical complications; iii) post-operative medical or surgical complications resulting in a delay in discharge; iv) problems with wound healing; v) infection of the wound or joint using the Centres for Disease Control definitions[15]; and vi) an unplanned procedure and/or re-admission in the first 12 months after TKR. Deaths in the first 12 months clearly unrelated to the TKR were censored at the date of death.

The same two sets of scales, one in each clinic, were used throughout the study and were calibrated to ensure that they remained concordant at each weighing. Functional assessment was monitored using the International Knee Score (IKS).[16] The QoL was assessed using the Short-Form 12 (SF-12) score, a validated measure of the QoL in joint replacement.[17,18]

We used the BMI to evaluate obesity. The definitions of the World Health Organisation were used.[19] Thus a BMI of < 30 kg/m^2 was considered to be non-obese, of 30 kg m^2 to 39 kg/m^2 as obese and ³ than 40 kg/m^2 as morbidly obese.

A change of ± 5% of a patient's pre-operative weight was considered to be clinically significant. The United States Food and Drug Administration defines clinically significant weight loss as 5% or more of the baseline weight.[20] A 5% weight loss in overweight patients has been shown to be the minimum weight loss required to induce metabolic and cardiovascular health benefits.[12,21]

A total of 573 primary TKRs in 533 patients was performed during the period of study. Three patients were excluded since they were unable to provide informed consent for cognitive (two) and logistical issues (one). We excluded one further patient who had undergone laparoscopic adjustable gastric banding eight weeks before surgery. All the remaining 529 patients were recruited to the study. There were no simultaneous bilateral procedures performed during the study period. A total of 40 patients underwent staged bilateral TKR and in these only the second procedure was included in the study analysis.

Of the 529 patients, 365 were women and 164 men with a median age of 71 years (interquartile range (IQR) 65 to 77) and a median BMI of 31.3 kg/m^2 (IQR 27.5 to 35.8). The right knee was involved in 301. Of the total group 211 (40%) were non-obese, 261 (49%) were obese and 57 (11%) were morbidly obese. The obese groups were more often female, were significantly younger than the non-obese patients and had a higher incidence of cardiovascular co-morbidities and diabetes (Table I).

Statistical analysis. The groups of patients who were non-obese, obese or morbidly obese pre-operatively were analysed for differences in functional and QoL outcomes and adverse events. Patients were also grouped according to weight loss or gain at 12 months for comparison. The data were analysed using SigmaPlot 11 software (Systat Software Inc., Chicago, Illinois). A p-value ≤ 0.05 was considered to be significant. Function, QoL and weight change for BMI groups were compared in a univariate analysis using the rank-sum test. Differences in the groups were expressed using the median and the IQR. Weight-change groups were compared in a univariate analysis using the chi-squared test for categorical data and the rank-sum test for numerical variables. Logistic regression analysis adjusting for age and gender was used to derive the odds ratio (OR) with its 95% confidence interval (CI) associated with increasing BMI and the occurrence of an adverse event.

Sample-size calculation. This was based on the primary outcome of weight change 12 months after surgery. With an alpha value (two-sided) of 0.05, 63 patients in each group were required to provide 80% power to detect a difference of 2.5 kg (SD 5.0) in the mean weight between any two groups.

Results

There were four deaths before the follow-up at 12 months and four patients did not complete the questionnaires at 12 months. Therefore, 521 patients completed the assessment of function and QoL.

Weight change. There was no difference in the median weight change between the non-obese and obese groups at 12 months after surgery: non-obese 0.0 kg (IQR -2.0 to +3.0), obese 0.0 kg (IQR -1.0 to +3.0) and morbidly obese 0.0 kg (IQR (-3.0 to +3.0) (Kruskal-Wallis one way analysis of variance on ranks p = 0.739). Using 5% change from the pre-operative weight as the cut-off point, 73 patients (14%) lost weight, 340 (65%) remained unchanged and 108 (21%) gained weight 12 months after surgery.

A total of 40 (12.6%) of the patients classified as obese and morbidly obese lost weight at 12 months. Increasing age was significantly associated with weight loss at 12 months (Table II). The patients who gained weight at 12 months (n = 107) had a slightly better improvement in functional score at 12 months (Table III). Weight loss or gain could not be predicted by any other pre-morbid characteristic or by improvements in function and physical health.

Functional and QoL outcomes. The median IKS score at 12 months improved in all weight groups, but was lower in obese compared with non-obese patients. There was a ten-point difference in the median IKS change between non-

Table I. Clinical and operative details in the 529 patients

Variable	Non-obese (n = 211)	Obese (n = 261)	Morbidly obese (n = 57)	p-value (chi-squared test)
Median (IQR*) BMI† (kg/m^2)	27 (25 to 29)	34 (32 to 36)	42 (41 to 45)	
Median (IQR) age (yrs)	74 (68 to 79)	70 (64 to 76)	68 (61 to 73)	< 0.001
Gender (%)				
Male	84 (*51*)	68 (*42*)	12 (*7*)	0.001
Female	127 (*35*)	193 (*53*)	45 (*12*)	
Aetiology‡				
OA	193 (*39*)	249 (*50*)	55 (*11*)	0.142
RA	18 (*56*)	12 (*38*)	2 (*6*)	
Charnley class (%)				
A	181 (*40*)	226 (49)	52 (11)	0.308
B	12 (*32*)	22 (*60*)	3 (*8*)	
C	18 (*55*)	13 (*39*)	2 (*6*)	
Co-morbidities (range)	3 (2 to 4)	3 (2 to 4)	3 (2 to 4)	0.642
Cardiovascular disease (%)	144 (*68.2*)	198 (*75.8*)	49 (*86.0*)	0.016
Diabetes (%)	31 (*14.7*)	61 (*23.4*)	14 (*24.6*)	0.043
Gastrointestinal disorder (%)	60 (*28.4*)	74 (*28.3*)	18 (*31.6*)	0.881
Haematological disorders (%)	9 (*4.3*)	11 (*4.2*)	3 (*5.3*)	0.936
Oncological disease (%)	12 (*5.7*)	18 (*6.9*)	1 (*1.8*)	0.323
Respiratory disease (%)	33 (*15.6*)	46 (*17.6*)	15 (*26.3*)	0.173
Type of prosthesis§ (%)				
CR	88 (*40*)	106 (*48*)	25 (*11*)	0.932
PS	119 (*40*)	148 (*50*)	30 (*10*)	
UC	4 (*31*)	7 (*54*)	2 (*15*)	
Patellar resurfacing (%)				
Yes	79 (*45*)	77 (*44*)	20 (*11*)	0.182
No	132 (*37*)	184 (*52*)	11 (*10*)	
Length of stay in days (range)	5 (5 to 6)	5 (5 to 6)	5 (5 to 6)	0.507
Discharge destination (%)				
Home	164 (*39*)	213 (*51*)	41 (*10*)	0.223
Rehabilitation	47 (*42*)	48 (*43*)	16 (*14*)	

* IQR, interquartile range

† BMI, body mass index

‡ OA, osteoarthritis; RA, rheumatoid arthritis

§ CR, cruciate-retaining; PS, posterior-stabilising; UC, ultra-congruent

obese (71, IQR, 47 to 92), obese (60, IQR 39 to 87) and morbidly obese patients (61, IQR 39 to 81) (Table IV). The change in the functional score of the IKS in particular was poorer for obese and morbidly obese patients compared with non-obese patients. There was no significant difference in the change in the median knee score component of the IKS (Kruskal-Wallis p = 0.45) but there was a difference in the median score for pain at 12 months: non-obese (45, IQR 30 to 50), obese (45, IQR 20 to 45) and morbidly obese (40, IQR 20 to 45, Kruskal-Wallis p = 0.021).

There was no statistical difference in the median pre-operative SF-12 physical- or mental-health component scores between the non-obese and obese patients. At 12 months, the physical component score improved to a significantly greater degree (Kruskal-Wallis p = 0.05) in non-obese and obese compared with morbidly obese patients. There was no significant difference in the median mental component score in any weight group (Table V).

Adverse events. These are recorded in Table VI. An adverse event occurred in 20 (35.1%) of the morbidly obese patients compared with 59 (22.1%) in obese and 30 (14.2%) in non-obese patients (chi-squared p = 0.001). A higher re-admission rate was also observed in the obese groups. The rate of prosthetic infection and DVT was also significantly higher in obese and morbidly obese patients (Table VI).

Using the BMI as a continuous variable the OR for the risk of an adverse event was 1.084 (95% CI 1.043 to 1.126) for every unit increase in BMI, adjusted for age and gender.

Potential confounding factors. The presence of both cardiovascular co-morbidities and diabetes was significantly higher in the obese groups (Table I). These

Table II. Variables (median interquartile range when appropriate) tested for an association with weight loss

Variable	≥ 5% weight loss (n = 40)	No weight loss (n = 274)	p-value¶
Age (yrs)	74 (68 to 77)	69 (62 to 75)	0.008
Gender			
Male	8	71	0.542
Female	32	203	
Aetiology			
Osteoarthritis	39	262	0.895
Rheumatoid arthritis	1	12	
Charnley class			
A	34	242	0.466
B	5	20	
C	1	12	
Co-morbidities (range)	3 (2 to 4)	3 (2 to 4)	0.988
Diabetes			
Yes	8	66	0.712
No	32	208	
Cardiovascular disease			
Yes	33	209	0.501
No	7	65	
Respiratory disease			
Yes	8	52	0.951
No	32	222	
Pre-operative IKS* (range)	35 (26 to 43)	31 (23 to 39)	0.184
Function	38 (20 to 50)	35 (24 to 50)	0.965
Total	69 (53 to 86)	69 (55 to 85)	0.796
Pre-operative SF-12† (range)			
PCS‡	23.4 (21.2 to 25.5)	25.4 (22.3 to 29.1)	0.002
MCS§	52.2 (42.4 to 59.3)	52.1 (42.4 to 58.8)	0.782
IKS at 12 months (range)			
Knee	80 (71 to 86)	80 (60 to 90)	0.829
Function	50 (35 to 65)	50 (40 to 70)	0.268
Total	127 (104 to 146)	131 (105 to 155)	0.650
SF-12 at 12 months (range)			
PCS	32.4 (29.1 to 39.5)	36.3 (17.1 to 46.3)	0.306
MCS	48.7 (40.3 to 56.5)	52.5 (41.6 to 59.9)	0.132
IKS change (range)			
Knee	47 (34 to 57)	44 (27 to 61)	0.967
Function	10 (-4 to 35)	15 (0 to 30)	0.364
Total	52 (41 to 80)	61 (38 to 87)	0.545
SF-12 change (range)			
PCS	10.1 (4.8 to 16.2)	9.3 (2.5 to 18.6)	0.609
MCS	-2.0 (-11.5 to 7.4)	0.3 (-7.6 to 7.9)	0.208

* IKS, international knee score

† SF-12. short-form 12

‡ PCS, physical component score

§ MCS, mental component score

¶ categorical variables, chi-squared test; numerical variables, Mann-Whitney rank sum test

variables were individually analysed to determine if any were associated with the rate of adverse events. There was no difference in the rate of cardiovascular co-morbidities (chi-squared p = 0.636) or diabetes (chi-squared p = 0.475) in patients who had an adverse event compared with those who did not.

Discussion

The incidence of obesity in the series was 60%, and of more importance, that of morbid obesity was 11%. Obese patients who underwent TKR were a mean of four years younger and morbidly obese patients were a mean of six years younger than non-obese patients. Our findings are

Table III. Variables (median interquartile range when appropriate) tested for an association with weight gain

Variable	≥ 5% weight gain (n = 107)	No weight gain (n = 414)	p-value¶
Age (yrs)	70 (65 to 76)	71 (65 to 77)	0.281
Gender			
Male	29	132	0.403
Female	78	282	
Aetiology			
Osteoarthritis	99	393	0.465
Rheumatoid arthritis	8	21	
Charnley class			
A	87	367	0.130
B	11	26	
C	19	21	
Co-morbidities (range)	2 (2 to 4)	3 (2 to 4)	0.254
Diabetes			
Yes	17	87	0.295
No	90	327	
Cardiovascular disease			
Yes	88	299	0.165
No	22	115	
Respiratory disease			
Yes	12	80	0.069
No	95	334	
Pre-operative IKS* (range)	29 (25 to 40)	32 (25 to 40)	0.432
Function	35 (20 to 50)	35 (30 to 50)	0.068
Total	67 (53 to 79)	71 (57 to 87)	0.139
Pre-operative SF-12† (range)			
PCS‡	25.1 (22.6 to 29.7)	25.3 (22.2 to 28.8)	0.688
MCS§	52.1 (40.1 to 58.7)	52.7 (44.0 to 58.7)	0.199
IKS at 12 months (range)			
Knee	83 (65 to 91)	82 (63 to 91)	0.716
Function	60 (45 to 80)	55 (40 to 80)	0.348
Total	136 (113 to 172)	134 (109 to 162)	0.543
SF-12 at 12 months (range)			
PCS	37.1 (28.3 to 47.6)	35.6 (28.2 to 44.6)	0.215
MCS	54.0 (42.0 to 59.4)	52.5 (42.1 to 59.9)	0.952
IKS change (range)			
Knee	49 (30 to 61)	46 (30 to 59)	0.412
Function	25 (10 to 40)	20 (4 to 35)	0.011
Total	70 (46 to 95)	64 (40 to 88)	0.088
SF-12 change (range)			
PCS	12.3 (4.0 to 20.7)	9.0 (2.7 to 18.1)	0.174
MCS	2.5 (-6.5 to 9.6)	0.0 (-7.6 to 7.2)	0.091

* IKS, international knee score

† SF-12, short-form 12

‡ PCS, physical component score

§ MCS, mental component score

¶ categorical variables, chi-squared test; numerical variables, Mann-Whitney rank sum test

similar to those of others,[22] and younger obese and morbidly obese patients are likely to add to the challenge of joint replacement in the future. An association between obesity and early prosthetic failure in primary TKR has been shown in some studies[5,23,24] but not in others.[25,26] With a population that is ageing and becoming more overweight, a rapid increase in the rate of revision TKR remains a possibility and continued follow-up of large series is required.

Loss of weight of between 5% and 15% produces significant improvements in cardiovascular and metabolic health and weight loss of 10% over six to 12 months is seen as a realistic goal for individuals trying to lose weight.[18,27] Although weight loss has been reported to occur in some

Table IV. Median (interquartile range) International Knee Score in the three groups

	Non-obese	Obese	Morbidly obese	p-value*
Pre-operative (range)				
Knee	32 (25 to 41)	32 (24 to 40)	28 (24 to 40)	0.329
Function	40 (30 to 50)	35 (30 to 50)	35 (20 to 48)	0.116
Total	72 (58 to 89)	70 (55 to 85)	65 (45 to 86)	0.103
12 months (range)				
Knee	86 (67 to 92)	80 (61 to 90)	76 (62 to 88)	0.006
Function	60 (45 to 80)	50 (40 to 78)	50 (35 to 65)	< 0.001
Total	142 (122 to 173)	133 (106 to 159)	126 (96 to 149)	< 0.001
Change (range)				
Knee	49 (32 to 59)	45 (28 to 62)	44 (23 to 59)	0.450
Function	25 (10 to 35)	15 (0 to 35)	15 (0 to 30)	0.002
Total	71 (47 to 92)	60 (39 to 87)	61 (39 to 81)	0.016

* Kruskal-Wallis one-way analysis of variance on ranks test

Table V. Median (interquartile range) SF-12 physical component score (PCS) and mental component score (MCS) score in the three groups

	Non-obese	Obese	Morbidly obese	p-value*
PCS (range)				
Pre-operative	25.41 (22.42 to 29.82)	25.10 (22.06 to 28.77)	25.07 (22.54 to 28.29)	0.331
12 months	35.84 (29.41 to 45.31)	36.30 (28.05 to 45.80)	31.11 (25.82 to 42.21)	0.050
Change	9.47 (3.24 to 18.84)	9.93 (2.98 to 18.25)	5.32 (1.52 to 18.48)	0.294
MCS (range)				
Pre-operative	53.51 (43.56 to 58.51)	52.08 (42.53 to 58.92)	52.11 (40.84 to 56.96)	0.535
12 months	52.80 (42.20 to 59.87)	52.07 (40.81 to 59.35)	56.69 (44.04 to 60.98)	0.347
Change	0.65 (-7.81 to +7.47)	0.40 (-7.71 to +6.96)	3.29 (-4.85 to +11.82)	0.100

* Kruskal-Wallis one-way analysis of variance on ranks test

patients after TKR,[28] with the exception of one study,[12] weight loss has been based on any level of change from baseline weight, irrespective of the amount lost. For example, a change of as little as 1 kg over one year has been classified as weight loss. There was a higher incidence of weight gain, compared with weight loss in our study and similar findings have been reported by others two years after primary TKR.[12]

The only clinically significant predictor of weight loss 12 months after primary TKR was age. Weight loss tended to occur more commonly in older patients. Weight loss or gain could not be predicted by any other patient pre-morbid characteristic or the functional or QoL score, and did not correlate with improvements in function and QoL 12 months after surgery. Multiple medical comorbidities and generalised arthropathy have been perceived as potential barriers to activity-related weight loss after TKR and based on these beliefs these patients have been excluded from previous studies.[29,30] In our study the level of disability had no influence on weight loss. This is contrary to expectations, since healthier patients would be predicted to have a greater physical activity level and therefore would be more likely to lose weight. However, in the absence of modification of calorie intake, participation in regular exercise does not lead to significant weight loss in overweight individuals.[27,31]

Obese and morbidly obese patients had a poorer functional result from TKR than did non-obese patients. There is wide variation in the literature regarding the impact of obesity on the functional outcome after TKR. A poorer outcome has been reported in obese patients,[24,26] and to a greater degree in morbidly obese patients.[32-34] Some studies have suggested that there are no or only minor differences between obese and non-obese patients, with comparable levels of improvement.[35,36] However, results should be treated with caution when studies have used datasets which exclude up to 75% of patients because of lack of complete data.[35,36] The level of follow-up can be a limiting factor.[37] Patients who do not respond to health questionnaires more often have a poorer functional outcome[38] and are more dissatisfied with the result of joint replacement.[39] Without complete patient representation and follow-up, non-responder bias may limit the interpretation of any findings.

Poorer pain scores may contribute to the poorer functional results expressed by obese and morbidly obese patients compared with non-obese patients. However, obesity is a complex issue and therefore it is likely that improvement in the level of physical activity after TKR in

Table VI. Complications in the first 12 months after primary total knee replacement

Event	Non-obese	Obese	Morbidly obese	p-value
Acute myocardial infarct*	4	2	0	0.357
Acute pulmonary oedema*	0	2	0	0.357
Acute renal failure*	0	2	0	0.357
Bowel obstruction*	1	1	0	0.875
Cerebrovascular accident*	1	0	0	0.470
Deceased within 12 months	2	2	0	0.764
Deep-vein thrombosis*	1	3	3	0.018
Delirium*	7	4	0	0.204
Electrolyte imbalance*‡	1	0	0	0.470
Femoral malalignment† (post-operative coronal alignment on full-length weight-bearing radiograph-valgus 11°)	0	1	0	0.598
Intra-operative fracture†	1	3	0	0.550
Joint infection†	1	4	3	0.031
Pain and locking†§	0	0	1	0.016
Patellar resurfacing†§ (primary resurfacing within the first 12 months of index survey)	0	1	1	0.160
Poor range of movement†§ (flexion less than 90°)	4	8	2	0.372
Pulmonary embolus*	2	3	0	0.716
Respiratory-track infection*	2	2	0	0.764
Respiratory depression*‡	0	1	0	0.598
Ruptured patella tendon†§	0	1	0	0.598
Ruptured quadriceps*†§	1	1	0	0.875
Ventricular tachycardia†§	0	1	1	0.160
Unstable knee†§	0	1	0	0.598
Urinary retention*	1	1	1	0.446
Wound complications (superficial)† (%)	6 (*2.8*)	18 (*6.7*)	9 (*15.7*)	0.001
Total surgical complications (%)	13 (*6.2*)	38 (*14.2*)	15 (*26.3*)	< 0.001
Total medical complications (%)	19 (*9.0*)	22 (*8.2*)	5 (*9.8*)	0.973
Unplanned readmissions (%)	10 (*4.7*)	29 (*10.6*)	13 (*22.8*)	< 0.001
Total adverse events (%)	30 (*14.2*)	59 (*22.1*)	20 (*35.1*)	0.001

* medical complication

† surgical complication

‡ intensive care admission

§ re-operation. One death occurred as a result of a coronary event within six weeks of surgery and was included as an event. All other deaths resulted from causes unrelated to total knee replacement but occurred within 12 months of surgery (complications of; leukaemia in one, prostate cancer in one, bladder cancer in one. These patients were censored at the date of death, but were not counted as an adverse event

obese patients requires a comprehensive approach involving behavioural modification and longer term practitioner support.[27] Current physiotherapy programmes offered after joint replacement are short-term and aim to restore function and mobility. Adaptation of these routines to provide a more comprehensive approach, such as that established for cardiac rehabilitation, warrants consideration.[40]

Despite comparable SF-12 physical health scores before surgery, these were significantly lower in morbidly obese patients at 12 months after surgery. Only one other study has examined the QoL outcome after TKR specifically in morbidly obese patients using the SF-12.[36] In that study the SF-12 physical component score was significantly lower in morbidly obese compared with non-morbidly obese patients both pre-operatively and at 12 months after surgery. However, there was no difference in the change in the SF-12 physical component score between morbidly obese and non-morbidly obese patients and therefore the authors reported that morbidly obese patients had the same benefit after TKR as all other patients.

The incidence of adverse effects within the first 12 months after primary TKR was 35.1% for morbidly obese patients compared with 22.1% in obese patients and 14.2% in non-obese patients. Surgical complications were significantly higher in obese and morbidly obese patients and this may be reflection of technical difficulty.[41] Significantly higher peri-operative and post-operative complications have been reported in obese patients undergoing TKR.[32,42] We have shown that for each unit increase in the BMI the risk of incurring an adverse event increased by 8%, even after adjustment for age and gender. In particular, we noted a higher rate of prosthetic infection and symptomatic DVT in obese patients, consistent with previous reports.[43-45] However, in a recent study it was found that obesity did not confer a higher risk of DVT if patients participated in an early mobilisation programme.[46] We also note that in our study a diagnosis of DVT was initially based on clinical suspicion and subsequently confirmed on Doppler ultrasound and the rate of asymptomatic DVT was not known.

The results of our study implicate obesity as a modulator or a negative outcome in primary TKR. Of concern, one in

five patients gained 5% or more of the pre-operative weight within 12 months of TKR. By contrast, a smaller percentage of obese patients lost the minimum amount of weight to be considered clinically significant and, aside from an association with advancing age, weight loss could not be predicted. Obese patients should be counselled about a poorer functional outcome after TKR as well as the risk of weight gain and a higher risk of adverse events in the first 12 months after surgery. A multitude of complications was recorded in morbidly obese patients in particular and their eligibility for TKR without previous weight loss warrants further consideration.

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