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Increasing patient obesity: Do I or do I not operate?

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ABSTRACT

In Australia, one quarter of our population is obese, and over half is overweight, with the upward trend predicted to continue to increase for the next 20 years or so. This summary paper looks at the influence of obesity on the outcome of total joint arthroplasty, including our own experience in particular with 535 consecutive primary cementless total knee replacements. We found obesity makes the surgery more difficult and patients get poorer range of flexion. They do however get good pain relief, and in the medium term, results are similar to non-obese patients.

1. Introduction

Obesity is now a global epidemic, with upward trends seen even in the developing world.

We know the cause is a problem with an individual's energy balance, where energy intake from food and drink is greater than energy expenditure from the basal metabolic rate and level of physical activity. Rudolph Clouse's first law of thermodynamics from 1950 aptly summarizes the situation: "energy can be neither created nor destroyed, it just changes form."

The World Health Organisation defines obesity as those individuals with a BMI greater than or equal to 30 kg/m^2. Obesity is subdivided into 3 different classes: class 1 has a BMI between 30 and 34.9, class 2 between 35 and 39.9 and class 3 has a BMI over 40. In addition to this, the medical literature has further classified patients with a BMI between 40 and 49.9 as morbidly obese and those with a BMI greater than or equal to 50 as super obese.

In 2012, the WHO estimated that 300–400 million adults were obese and 1.5 billion were overweight, with higher rates amongst females and individuals from lower socioeconomic groups. Worryingly, the greatest percentage increase seen is in young adults between the ages of 20 and 39 years, which has implications for both current and future healthcare economics and patient mortality and morbidity [1].

Obesity is an established independent risk factor for several disease processes, including osteoarthritis, which itself is the most common cause of disability in the developed world. A BMI rise of 2 units increases ones chance of developing degenerative joint disease by 36% [2]. As BMI increases, so does the relative risk of requiring a joint replacement [3]. This peaks at a relative risk of approximately 32 times for a total knee arthroplasty and 8.5 times for total hip arthroplasty relative to normal weight individuals in those with a BMI greater than or equal to 40 [4].

2. Obesity and total joint arthroplasty

Current literature is divided as to whether outcomes of total knee arthroplasty are equivalent or inferior in patients with BMIs over 35. A recent retrospective analysis of the American College of the Surgeons-National Surgical Quality Improvement Program between 2005 and 2007 (ACS-NSQIP) looking at 1731 patients demonstrated no significant increase in perioperative complications following total hip and knee arthroplasty across BMI categories [5]. It concluded that patients with a BMI greater

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than or equal to 35 greatly benefited from surgery, leading to improved co-morbidities, quality of life and loss of weight. Another review of prospectively collected data on 3290 patients undergoing total hip arthroplasty revealed that morbidly obese patients received the same if not more benefit from surgery based on WOMAC, HHS and SF-12 scores [6].

However, other studies have shown significantly higher rates of complications when comparing obese to matched control groups. There have been reports, however, of decreased survival in the obese patient group after a longer time period of 10–14 years [7,8].

Several studies have demonstrated significantly higher rates of complications when comparing obese to matched control groups [9–11]. In general, the main complications reported have been superficial wound infections, deep wound infections and DVT. An increase of BMI by 5 points increases the odds ratio for a thromboembolic event by 1.5 [12].

With regard to loss of weight, a recent prospective trial by Dowsey et al. [13] examined 529 obese patients and demonstrated that 13% of patients lost 5% or more of their preoperative body weight, whereas 21% of patients gained weight.

Intraoperatively, an obese patient poses certain extra challenges to the operating surgeon (Fig. 1). Normal anatomic landmarks may be difficult to visualize, which may make correct jig alignment or navigation pin placement less accurate. We believe therefore that computer navigation has a more important role in these patients. Several studies have demonstrated increased blood loss and risk of transfusion, possibly as appropriately sized tourniquets are not always available. A higher incidence of MCL avulsion has also been demonstrated [14]. We use a different surgical incision for our obese patients compared to non-obese. In non-obese patients, we have a curved medial skin incision that overlies the deep fascial incision (Fig. 2, blue line). In the obese patients, we have more of a midline or even a slightly lateral skin incision (Fig. 2, red line), and this is to allow easier eversion of the patella. The patella can be difficult to evert if there is too much skin and fat in the area. A recent survey of 1142 members of the American Association of Hip and Knee Surgeons (AAHKS) revealed 83% actively discouraged at least one patient from a lower extremity total joint arthroplasty because of a high body mass index, with 84% of these surgeons discouraging surgery with concerns over post-operative complications.

Figure 1 – Set up in the operating theatre for an obese patient. (Color version of figure is available online.)

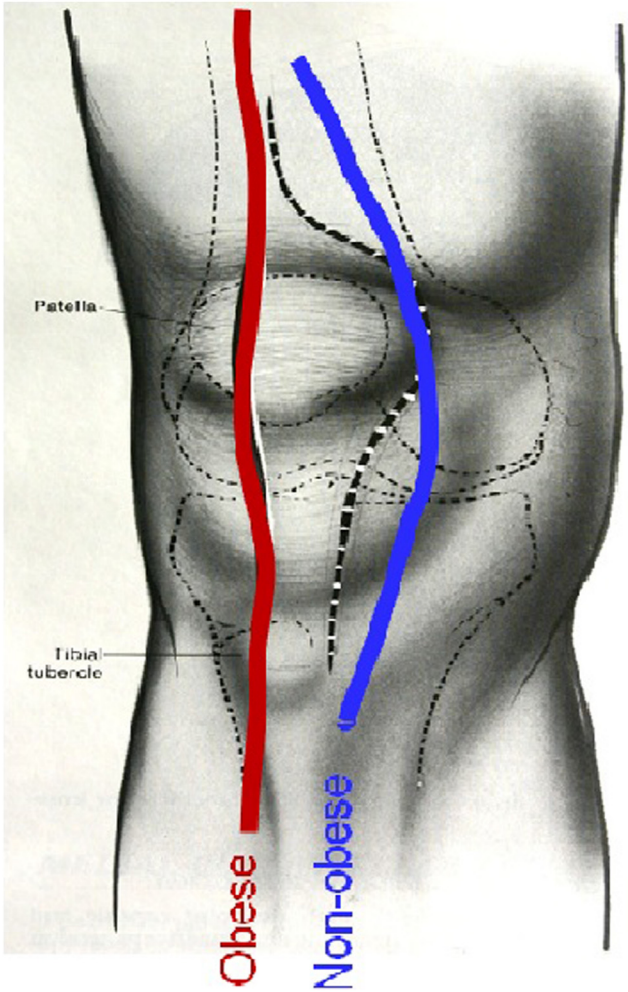

Figure 2 – Skin incisions for the obese and non-obese patients undergoing knee replacement. (For interpretation of the references to color in the text, the reader is referred to the web version of this article.)

Consequently, it is likely that these patients may visit several orthopaedic surgeons before finding one who is willing to treat them.

An increasing subset of these patients are classified as morbidly obese (BMI >40 kg/m^2) or super obese (BMI >50 kg/m^2). Fehring et al. [15] reported a significant increase in the number of patients with morbid obesity undergoing TKR.

A systematic review of medical databases from 1990 to 2009 revealed an improvement in clinical KSS, though to a lesser degree than in non-morbidly obese patients. There was no change in post-operative weight but an increase in deep infection and a higher risk of earlier revision [16].

3. Our experience with obesity and cementless total knee arthroplasty

3.1. *Method*

In our unit, we evaluated 535 consecutive primary cementless total knee replacements implanted in 485 patients between

1995 and 2001. Clinical and demographic data was prospectively collected and anonymously recorded in our arthroplasty database by W.L.W., W.K.W. and B.A.Z. We obtained consent from all patients for their data to be used in the research.

All patients had surgery by 1 of 2 senior arthroplasty surgeons (W.K.W. and B.A.Z.) using comparable techniques in a laminar flow theatre. All patients had a cementless AMK fixed-bearing knee arthroplasty with selective patella resurfacing.

Post-operative protocols were standardized for all patients, including 48 h intravenous antibiotics, 48 h on a continuous passive movement device and thromboprophylaxis with subcutaneous heparin. Early full weight-bearing mobilisation was encouraged with close physiotherapy supervision.

Post-operative standardized weight-bearing anteroposterior, lateral and patellar skyline radiographs were assessed for osteolysis, radiolucent lines and alignment using the Knee Society Total Knee Arthroplasty Roentgenographic Evaluation and Scoring System

The Hospital for Special Surgery (HSS) Knee Rating Score was used to measure clinical outcome, along with post-operative range of motion and patient satisfaction using a visual analogue scale (maximum of 10).

From the data set, 50 obese patients who had a TKR surviving longer than 3 years were matched with 50 non-obese patients by age (within 5 years), gender, preoperative diagnosis, surgeon, side and time to follow-up (within 1 year).

4. Results

The demographic details of all patients are shown in Table 1. The mean age of the obese patient population was significantly lower than that of the non-obese. As with global trends, females accounted for the majority of patients in this group ($p = 0.01$). The mean follow-up was 9.2 years (0.3–12.9) and not significantly different between both groups. None of our patients were lost to follow-up.

Preoperative HSS knee scores were similar but post-operative scores were significantly lower in the obese group ($p < 0.05$). Post-operative function and range of motion were also significantly lower in the obese group ($p < 0.01$). Post-operative satisfaction scores with surgery were similar, as was the incidence of a post-operative fixed flexion deformity, of which only 1 patient in each group had deformity of more than 5°.

Though both groups had an improvement in HSS scores post-operatively as compared to before surgery, the relative improvement in the obese group was significantly less ($p = 0.04$).

Radiological assessment revealed no significant differences in femoral or tibial component alignment in the coronal and sagittal planes. A total of 12 osteolytic lesions and 4 lucent lines were identified in 7 patients (1.3%) with no significant difference between the groups.

Kaplan–Meier survival analysis, with revision for any reason as an end point showed no significant difference between the groups (log rank test, $p = 0.167$, Fig. 1). The cumulative survival rate at 10 years was 96.4% in the obese (95% CI 92–99, standard error 0.16), and 98% in the non-obese (95% CI 95.9–99, standard error 0.07). At 10 years, 68 knees remained at risk in the obese group, and 154 in the non-obese. There were 82 deaths (92 knees) during the follow-up period, with 13/535 (2.4%) patients undergoing revision, 6/153 (3.92%) in the obese group and 7/382 (1.83%) in the non-obese group.

The demographics of the 100 case-matched patients (50 obese and 50 non-obese) are shown in Table 2.

A post hoc power analysis of these patients revealed with 80% certainty a clinically significant (5 points) difference between the 2 case-matched groups, with higher scores in the non-obese group. There was no statistically significant difference between the groups with regard to post-operative pain, function, or range of motion, though scores were consistently higher in the non-obese group.

Only 15/153 (9.8%) of our obese patients were classified as morbidly obese (BMI >40) and thus numbers were too small to meaningfully evaluate this cohort, though none of them needed revision during the assessment period.

5. Discussion

Obese patients transmit increased load through their weight-bearing joints. It is assumed that increased load though a bicondylar knee arthroplasty causes greater peak contact stresses in the polyethylene and greater forces across the implant bone interface leading to premature wear, loosening and increased failure rates.

Our experience shows no significant difference in the midterm survival of knee replacements between the obese and non-obese patient groups with revision for any reason as the end point. Radiological analysis revealed no difference between the groups for findings suggestive of impending implant failure or malalignment which may suggest that though technically demanding, any differences with final implant positioning and fixation is not clinically significant.

Long-term follow-up in our cohort may eventually demonstrate a higher rate of revision in the obese group, but their

Table 1 – Demographic Details of All 535 Primary Uncemented TKR Patients

	All	Non-Obese	Obese
Total	535	382	153
Male	208	162	46
Female	327	220	107
Mean age (range)	71 (41–89)	72 (41–89)	67 (54–87)
Mean BMI (range)	28 (18–46.7)	25.2 (18–29.9)	34.5 (30–46.7)
Mean follow-up	9.2 (0.3–12.9)	9.2 (0.8–12.9)	9.4 (0.3–12.9)

Table 2 – Demographics of the 100 Case-Matched Patients

	Non-Obese	Obese
Total	50	50
Male	12	12
Female	38	38
Mean age (range)	69 (51–81)	69 (55–81)
Mean BMI (range)	25.2 (18–29.9)	34.1 (30–46.7)
Mean follow-up	7.4 (3.5–12.0)	7.2 (3.1–11.5)

reduced activity levels, compared to non-obese patients, may offset the higher load subjected to their artificial joints.

The relatively reduced improvement in clinical outcome scores in the obese patient group may be due to many factors including higher self-reporting of pain, depression, chronic fatigue and insomnia, all of which adversely influence the knee score.

6. Conclusion

Midterm implant survival is comparable in the obese and non-obese patient groups undergoing primary uncemented knee arthroplasty. Overall clinical results for obese patients are excellent. Obese patients do have a reduced range of post-operative flexion compared to non-obese patients, as well as relatively reduced gains in overall clinical result and satisfaction. We believe, given our own experience and current literature, patients requiring a TKR should not be denied surgery based purely on the value of their BMI.

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