POSITION STATMENT ON ARTHROPLASTY IN OBESITY

The Arthroplasty Society of Australia is the peak body representing clinicians and researchers in the management of Hip and Knee Arthroplasty in Australia. For many years, obesity has been recognized as a major concern in the field. There is evidence of increased rates postoperative complications, and the AOANJRR reports increased revision rates in obese patients.

The decision on when to perform arthroplasty surgery on patients with an increased Body Mass index (BMI) is difficult and is made with great caution. The key facts, as a guide to making this decision, are:

1 – The prevalence of osteoarthritis, particularly at the knee, increases with increasing BMI. In obesity, the age that arthroplasty becomes indicated decreases.

2 – Arthroplasty surgery in obese patients has a higher incidence of postoperative medical and surgical complications. This is greater following knee arthroplasty compared to the hip.

3 – Hip and knee arthroplasty in obesity has a reduced survivorship, with increased rates of revision, compared to the non-obese.

4 – A clear explanation of these risks and encouragement to lose weight, together with maximum evidence based non-surgical management is recommended before considering arthroplasty surgery.

5 – Bariatric surgery can reduce the BMI, but the ideal timing of subsequent arthroplasty surgery remains unclear.

6 – There is evidence that many obese patients are also malnourished. This malnutrition can be aggravated by attempts at weight loss or bariatric surgery.

7 – Nutritional screening and supplementation may reduce the risk of surgical complications in obese patients.

Shared and informed decision making is recommended, taking in to account the risks, balanced against the disability and the impact on quality of life produced by arthritis of the hip or knee. Obesity alone is not a contraindication, and obese patient obtain improvements in pain, function and quality of life following arthroplasty.

Appendix 1

Summary and comments on the published literature

Introduction

Hip and knee arthroplasty continue to be amongst the most successful medical interventions for improving quality of life for our patients. However, these require a balance of benefit and exposure to risk in a surgical setting.

Numerous patient related factors have been shown to affect the risk of complications or result in a worse clinical outcome. Obesity has become an important comorbidity, affecting the general health of patients, their anaesthetic risk and the risk of surgical complications. Delayed wound healing, as well as surgical site and periprosthetic infections are more common (1).

As well as developing osteoarthritis at a younger age, obesity results in earlier arthroplasty with an increased risk of complications and with reduced survivorship of implants.

Obesity

Obesity is commonly defined using the Body Mass Index (weight in kilograms divided by the square of height in meters) with a positive value being >30. The World Health Organization uses this definition and sub divides obesity into Classes I, II and III for BMI 30 to <35, 35 to <40 and 40 or greater, respectively. (2) Other definitions of obesity have been proposed. These include percentage body fat and lower limb weight measurement. Percentage body fat is predictive of both medical and surgical complications. Lower limb weight correlates with operative time and complexity of surgery. These may be better predictors of surgical complication and clinical outcomes than BMI following knee arthroplasty (3).

Increasing Prevalence

Obesity is increasing worldwide and has been described as a ‘worldwide pandemic’. In Australia 64% of the adult population is now obese with an increase from 56% in 1995. Men are more commonly affected than women with higher rates of both obesity and being

overweight with a BMI of 25–30. (4) Prevalence of obesity is higher in 55-74 years of age peaking in the mid 70's then decreasing in the more elderly. (4) The average age for hip and knee arthroplasty in Australia currently 68.5 years which is in the center of the 'obesity peak'. (5)

Obesity and Osteoarthritis

The timing of the occurrence of obesity has an effect on the development of osteoarthritis. An individual's 'maximum lifetime BMI' is correlated with the overall risk of developing osteoarthritis. The 'current' obesity is also associated with an increased risk of osteoarthritis of the knee (6,7,8). Knee osteoarthritis is accelerated by the mechanical effect of body weight, and increased adipose tissue also leads to a low grade systemic inflammatory response which is destructive to the joint and cartilage (9,10). The average BMI for a patient undergoing surgery has not changed in recent years with average BMI 29.6 for hip arthroplasty and 32.2 for knee arthroplasty (5).

There is a strong correlation between a BMI >30 and the development of knee osteoarthritis. This correlation is weaker in hip osteoarthritis (11). Patients with a BMI of 20–25 have a 0.1% incidence of developing osteoarthritis of the knee. In comparison, the incidence is 13.6% in patients with a BMI >36. (11) Even in individuals who are not obese, the risk of osteoarthritis doubles when comparing a BMI 20–24 with BMI 17–19 in a cohort of male manual workers. In this group, an increase of the BMI by 5 kg/m^2 doubles the relative risk of severe osteoarthritis requiring joint replacement (12). In females there is 10.51% relative risk of developing knee OA requiring TKA surgery in BMI >30 compared to BMI <22. (13) Obesity also reduces the age of total joint arthroplasty. This is 7 years earlier, when comparing a BMI >35 with a BMI <25 (14).

In summary, a higher BMI results in an increased risk of developing osteoarthritis of the hip and knee. This effect seems to be more than the biomechanical effect of increased body weight. There is a correlation between obesity, inflammation and cytokine production that can lead to joint damage (9,10). In addition, there may be a genetic association, with several regulatory genes linked to BMI and osteoarthritis (15).

Perioperative Complications

Published studies show dramatic differences in wound healing and the incidence of infection in obese patients who have developed severe osteoarthritis, undergoing arthroplasty surgery (1, 41). Local and systemic complications increase in the Obese and Super Obese (BMI >50). (1,16) The Incidence of infection increases from 0.37% in normal BMI to 4.66% in the morbidly obese, a 12x increase in risk. (17) In the Super Obese, the relative risk of infection increases by 18.3 times compared to patients with BMI >50 (p>0.0001). (18)

When considering revision as the outcome of interest, reported in the AOANJRR 2021 Annual Report, arthroplasty patients with ASA 1 have a lower risk of revision for all causes. The cumulative percent revision for infection increases with ASA Class. Early revisions <1.5 years post-op are significantly higher in ASA 4 compared to ASA 1 (p<0.001). A higher rate of revision for infection is seen in ASA 4. (44)

AOANJRR data also reports that patients in BMI class 3 (>40) have a higher rate of revision in TKA (p<0.001). (19) Revision rates in hip arthroplasty also increase with increasing BMI. CPR in Obese Class 3, compared with normal BMI is significantly higher (p<0.001). (19)

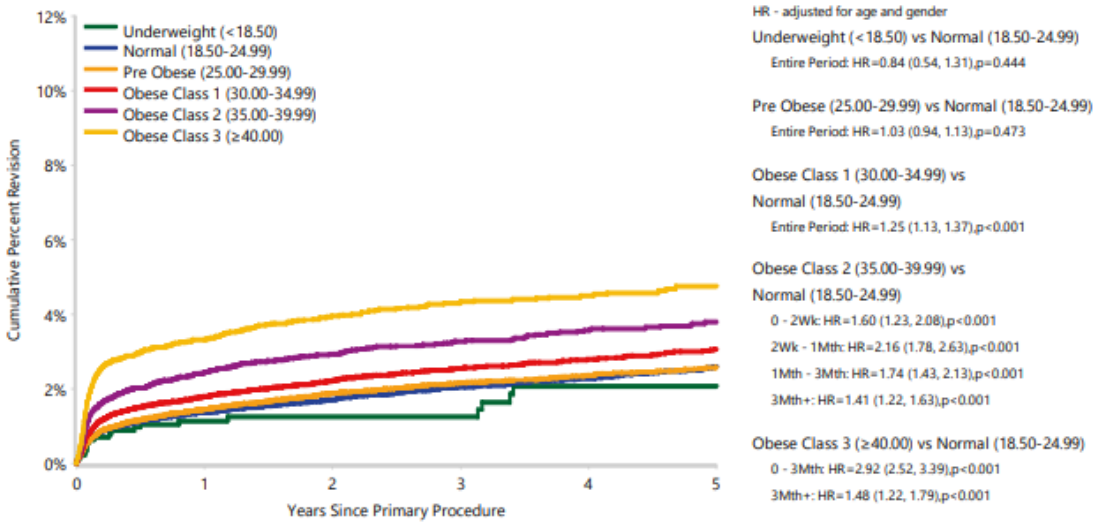

Figure 1: Cumulative Percent of Revision of Primary Total Hip replacement by BMI class (Primary Diagnosis OA) (20).

The Swedish Hip Arthroplasty Registry reported that an increased BMI results in an increase in 2-year and 5-year re-operation and revision rates. All-cause mortality at 90 days was also increased, with infection being the main contributor (21). Obesity has a correlation with obstructive sleep apnoea, cardiac disease and sudden death in patients undergoing hip or knee arthroplasty. OSA is also associated with serious post-op complications (22).

Arthroplasty Outcomes

Poorer outcomes are reported for obese arthroplasty patients compared to non-obese. Identifying the threshold BMI, where an effect is observed, is not straightforward, especially when using the Obese Class grouping. Patients with BMI >30 may not have an increased revision rate in hip arthroplasty. With a BMI >40, however, there is a 5x increase in revision rate at 10 years post-op when compared with non-obese patients (23). Super Obese patients are 4.5 times more likely to require revision hip surgery at 6 years post-op, when compared to patients with BMI >30 (24). In knee arthroplasty, when considering 2 stage revision for infection, obese patients are much more likely to fail treatment and require further surgery when compared to non-obese patients (p=0.007). These failures are further compounded by the presence of other comorbid factors of ASA 3 and above and Charlson Comorbidity Index ≥2 ($P \leq .001$) (25).

Infection in obesity may be due to under-dosage of antibiotics, poorer perfusion and oxygenation of adipose tissue, increased risk of hematoma, prolonged surgical time and increased nasal colonization with *S.aureus*. Surgical time is increased by 22 mins in hip arthroplasty and 10 mins in knee arthroplasty (26,27). Patients with a higher BMI have an increased length of inpatient treatment, with a 2.9% increased LOS for each kg/m^2 increase in the BMI. A high BMI is associated with increases in hospital deaths and ICU admissions following hip arthroplasty (28).

Implant Survivorship

Obese patients have lower demand and take less steps per day but mechanically load the joint more per step. This, and the issues outlined previously may affect implant survivorship.

Similar 5-year knee arthroplasty survival was reported in the Obese Class 1 and non-obese (p=0.025). However, higher revision rates are seen in Class 3 obese patients compared with normal BMI(19). However, a BMI >35 was associated with a 2-fold increase in the rate of tibial loosening in knee arthroplasty, despite good mechanical alignment (29). Knee arthroplasty survivorship related to Obesity Class is shown in *figure 2* below. In hip arthroplasty, Class 3 obese patients have a higher rate of revision than patients with normal BMI at all time points up to 5 years (20).

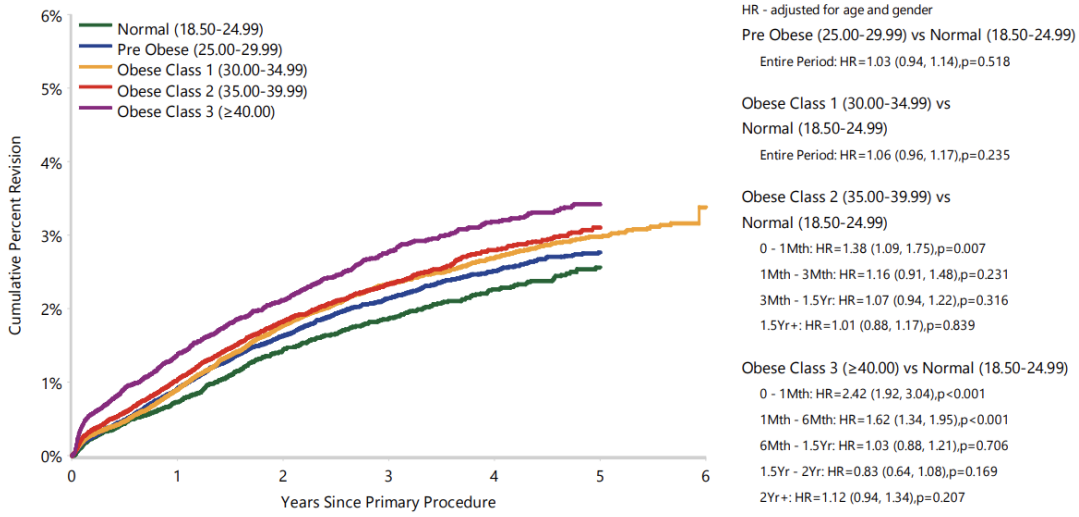

Figure 2: Cumulative Percent Revision of Primary Total Knee Replacement by BMI Category (Primary Diagnosis OA) (19)

Arthroplasty Function

Knee arthroplasty in obesity is associated with a reduced knee flexion range, when compared with the non-obese (30). Many patients also do not lose weight after arthroplasty surgery (37). Morbidly obese patients are likely to have co-morbidities, other arthritic joints and mental health issues which may affect their function and satisfaction scores even with a well-functioning knee prosthesis in situ. However, despite this, studies have shown that

obese patients have similar pain and satisfaction scores with good improvement in functional scores following knee arthroplasty (31).

Nutritional Status

Obese patients commonly exhibit signs of chronic malnutrition, with low albumin levels, low transferrin and low total lymphocytes. Low albumin levels are associated with increased mortality, infection and other complications after surgery. Weight loss prior to surgery may make this situation worse (32).

Achieving weight loss over 4 years produced a significant reduction in disease progression on MRI scans. Weight loss of only 5% had a positive effect on osteoarthritis progression. 10% weight loss was much better, with much reduced progression of cartilage abnormalities (33). Diet control has a more pronounced effect than exercise alone. Comparing 3 groups of diet, diet and exercise, and exercise alone: both diet groups showed significantly lower inflammatory markers. In a patient group who find it difficult to exercise, the effect of well managed weight loss with diet, while reducing the effects of malnutrition, may be more helpful than increased activity (32). Nutritional screening and supplementation may improve outcomes for arthroplasty patients with regards infection however further studies on this issue are currently ongoing. (43)

Bariatric Surgery

Bariatric surgery remains controversial. It has its own complications and comes with a cost to the healthcare system. Bariatric surgical intervention has been shown to reduce BMI and produce an improvement in walking distance and stride length (34). The timing of arthroplasty surgery after a bariatric procedure and reduction in BMI remains unclear (34).

Following bariatric surgery, a catabolic state persists for two years. During this period arthroplasty is associated with an increased rate of readmission and revision procedure. A minimum delay of 6 months is recommended, but some studies have failed to demonstrate any reduction in knee arthroplasty surgery complications following bariatric surgery. The evidence is varied, with conflicting reports (35). Financial modeling shows that bariatric surgery two years prior to knee arthroplasty is more cost effective than knee arthroplasty

surgery alone in patients with BMI >35 (36). Controversy still exists as to whether patients lose weight after knee arthroplasty in the absence of bariatric surgery pre-operatively. There is no convincing evidence identified by a systematic review of available studies (37). Some authors have shown an increase in arthroplasty surgical complications following bariatric surgery, This makes it difficult to routinely recommend this pathway, prior to undergoing arthroplasty (42).

Other Consensus Statements

The International Consensus on Orthopaedic Infections has reviewed the evidence on this complex issue. They recommended that all patients with a BMI >30 are at increased risk following arthroplasty surgery. In total knee arthroplasty, at the threshold BMI >40, major complications may outweigh the functional benefits. In total hip arthroplasty, with a BMI >40, the consensus is less clear. Patients should still be encouraged to lose weight (38). A BMI of 30–40 is considered to be a relative contraindication whereas BMI 40–50 is an absolute contraindication (39). Bariatric surgery was considered by the workgroup to be controversial. The reduced risk of periprosthetic joint infection associated with weight loss may be offset by the increased risk of malnutrition., which is also a risk factor for infection. Improved stratification for malnutrition may improve risk stratification and clinical results (39).

The tipping Point

Avoiding surgery in high BMI patients will clearly reduce complications, but many patients will have been denied surgery that could be complication free. In a study of 27,671 cases: if BMI >40 was used as a cut off, 1148 patients would have been denied their surgery, to prevent 83 patients having a major complication. At this level of BMI 14 patients are denied surgery to prevent one major complication. At a BMI 30-40, the positive predictive value of a major complication is no different to tossing a coin. Ethically, the refusal-to-treat issue here is complex. At a of BMI in the 30's patients should not be denied surgery. At BMI > or equal to 40 the decision to treat is complex based on these results and the severe implications of complications, when they occur. The authors suggest that the real tipping point with respect to complications may be BMI >45, in arthroplasty surgery. This remains controversial (40).

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