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How might the longer-than-expected lifetimes of hip and knee replacements affect clinical practice?

1 - Introduction

Hip and knee replacements are the principal surgical interventions for end-stage degenerative hip and knee conditions, such as osteoarthritis, with the aims of long-term pain relief and restoration of function. Both are effective and generally associated with excellent outcomes [1,2]. Joint replacements are, however, susceptible to failure through various mechanisms including loosening, wear, infection, fracture and instability. Implant failure often leads to revision surgery, which poses a significant economic burden and typically has worse outcomes than primary arthroplasty [3]. It is estimated that more than 7 million people in the USA are living with either a hip or knee replacement and the incidence of primary hip and knee arthroplasty is increasing [1,2,4]; a trend which will inevitably exacerbate the burden of revision surgery.

The typical age of patients undergoing hip and knee arthroplasty remains in the high 60s; however, some believe the incidence of surgery in younger patients is increasing, with patients younger than 65 predicted to account for >50% of patients undergoing this surgery in the USA by 2030 [5]. Bayliss et al. [6] reported the lifetime risk of revision as 5% in those older than 70, rising to 35% in males who underwent surgery in their early 50s. The possible trend for operating on younger patients is therefore concerning and may exacerbate the global burden of revision.

Accurate understanding of implant survivorship has implications for patients, healthcare providers, implant manufactures and medico-legal practitioners. For patients, an understanding of the expected survival of their joint replacement is a key consideration in the informed consent process and the decision to undergo surgery. Thus, the answer to the question “how long do hip and knee replacements last?”, is important and has a direct impact on patient care. In two recent papers, published in the Lancet, we set out to answer this question [7,8].

2 - Expert Commentary

Our studies, in which we report the results for hips and knees in two parallel articles, provide the first generalizable survival estimates for hip and knee replacements at 25 years [7,8]. In each, we conducted a systematic review and meta-analysis of case-series using a single construct reporting survival estimates with mean follow-up of more than 15 years. In both articles, we performed a second meta-analysis of international national joint replacement registry annual reports with the same minimum follow-up. The primary exposure was the joint replacement implant construct and the primary outcome was all-cause revision of any part of the construct. Hip or knee replacement construct survival estimates at 15, 20, and 25 years, assuming that survivorship approximated risk, were pooled with meta-analyses using a fixed effects model. Data from registries were analyzed in

the same way. Our pooled analysis included high numbers of joints from both registries and case-series (total hip replacement (THR): 215,676 and 13,212 respectively; total knee replacement (TKR): 299,291 and 6,490 respectively; unicondylar knee replacement (UKR): 7,714 and 742 respectively). Both sources of information are subject to their own biases but given the more conservative and generalizable estimates provided by registry data, we estimate that approximately 58% of THRs, 70% of UKRs and 82% of TKRs will last 25 years.

Limitations inherent in these articles must be noted, most notably regarding the generalizability of results as all 25-year registry data came from the Finnish Arthroplasty Registry. There may be region-specific differences in both operative technique, implant use and revision thresholds and the availability of data from other countries would go some way to addressing these issues. Furthermore, there was no adjustment for patient age, which has a known impact on the revision rate of hip and knee replacements [6].

3 - Key Issues

3.1 - Informed Consent & Medicolegal Implications

Arguably the most relevant clinical impact of an accurate understanding of the survivorship of a joint replacement are the implications for informed consent. The legal case of *Montgomery v Lanarkshire* (2015) in the UK, makes it is clear that surgeons must take reasonable care to ensure patients are aware of any material risk involved in a recommended treatment in order for a patient to be able to provide informed consent. Surgeons must inform patients of any risk to which 'a reasonable person in the patient's position would be likely to attach significance'. It is reasonable to assume that most patients, given the morbidity and poorer outcomes of revision arthroplasty, would 'attach significance' to the expected survival of their joint replacement.

The longer-than-expected survival is invariably going to positively influence patients' decisions to undergo surgery; however, caution is required in the younger population for whom these survival estimates may be misleading. It was not possible with the pooled estimates reported in our studies to adjust or stratify by age so we were unable to comment on the risk of revision according to age at primary surgery; a risk which younger patients should be made aware of [6]. Furthermore, accurate estimates of implant survival have clear implications for medicolegal cases in which joint replacements may appear to have failed prematurely.

3.2 - Benchmarking

The National Institute of Health and Care Excellence (NICE) set a UK benchmark in 2014, which dictates that individual THR components that form part of a construct are only recommended if they have a lower than 5% revision rate at 10 years. The Orthopaedic Data Evaluation Panel (ODEP) provides ratings of individual components for hips and knees, based on reported

survivorship. ODEP ratings consider the revision rate up to 13 years, as well as the strength of published evidence and are used internationally. They do not, however, provide ratings for construct combinations in hips, which in our opinion is incorrect as there is a clear interaction between stem and cup when considering all-cause revision as clearly demonstrated in recent work by Deere et al. [9]. The upper limit of current benchmarks is limited by the availability of case-series and registry data with sufficient follow-up. Our findings provide the first generalizable estimate of implant survival at 25 years and will contribute to establishing longer-term benchmarks.

3.3 - Implant Design & Component Selection

In 1961, Professor Sir John Charnley predicted that no hip replacement would ever last 30 years, and it is evident that this is now commonly surpassed [10]. It is likely that the major advances in hip and knee implant development have already been achieved and that the best performing implant combinations, in terms of survival, are already in regular use. In the case of hips, the principal factors influencing successful femoral stem design were recognized three decades ago [11].

In our review of registry reports, only four of the THR constructs contributing data, remain in common use. Compared to overall pooled results demonstrating 86% survival at 15 years, we observed survival of 95% in these four constructs (Exeter V40/Trident, Exeter V40/Exeter Contemporary, CPT/Trilogy, and CPT/ZCA). However, these constructs only account for 25% of THRs implanted in England and Wales in 2016 [7]. A recent network meta-analysis concluded that newer THR implant combinations were not superior to a reference implant combination (metal-on-polyethylene, small head, cemented), which may now be considered “old technology” [12]. The same group have subsequently demonstrated the superior cost-effectiveness of this implant combination [13].

The encouraging long-term survival demonstrated in our studies should be reassuring to the developers of the best performing constructs and encourage the appropriate use of cost-effective implant combinations with observed superior longevity. The lower risk of revision of cemented prostheses, in particular femoral stems, is clear and increased use of this “old technology” may benefit patients and health care providers, particularly in areas, such as the USA, where it is not currently common practice.

4 – Five-Year View

While survivorship is a key aspect of successful joint replacement it is not the only outcome of interest. Notably, whilst most TKR recipients have an excellent outcome, it is widely acknowledged that between 15-20% report persistent pain and that the midterm patient-reported functional outcomes for TKRs may be inferior to THRs [2,14]. Thus, functional outcomes assessed through patient-reported outcome measures (PROMs), play a growing role in how we quantify the success of an intervention [15]. Further developments in PROMs capture and analysis, strategies to reduce

the risk of mortality and improved understanding of the risks of revision relevant to individual patient profiles, will play a major role in how we assess the success of joint replacement in the future.

The adoption of stringent long-term benchmarks and systems to monitor performance against these benchmarks is of paramount importance for patients. National arthroplasty registers exist worldwide and their further development and use, particularly in high volume areas such as the USA may be of benefit.

5.0 - Conclusion

The longer-than-expected lifetimes of hip and knee replacements have clear implications for clinical practice. The potential impacts on informed consent, benchmarking, implant design and component selection are perhaps the most relevant. The continued accumulation and re-evaluation of registry data will provide further clarification on these subjects.

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