An inconvenient truth

The driving forces behind the use of cemented and uncemented total hip arthroplasties

Every national joint registry since Sweden introduced the first in 1979 has consistently reported that the outcome of cemented total hip arthroplasty (THA) in patients over the age of 65 years (who make up 85% of patients presenting for THA in the UK) outperforms that of uncemented THA. Despite what seems to be very clear evidence in favour of cemented THA and the potential for savings on implant costs (cemented THA is generally less expensive than uncemented THA), there has, in the UK, been a steady upward trend in the use of uncemented implants at the expense of cemented ones over the last decade. This article seeks some of the reasons for this paradox of usage over evidence.

In younger patients the picture is somewhat different and there remains considerable uncertainty about the best performing type of implant, though both the UK National Joint Registry (NJR) and the Australian Joint Registry (AJR) report that the best outcomes of up to ten years are achieved with hybrid hips using a cemented femoral and uncemented acetabular component and a ceramic-on-plastic bearing. As far as possible, this article will not further consider this group of patients.

OUTCOMES AND COST

It is important to establish that cemented hips are genuinely better. The NJR recently reported on 620 400 primary THAs with a maximum follow-up of 10.75 years. Before adjustment for bearing surface, age and gender, cemented fixation was shown to be the most successful with a cumulative percentage probability of revision at ten years of 3.20% (95% confidence interval 3.03 to 3.39). This compares with 7.68% (7.34 to 8.03) with an uncemented, hybrid 3.95% (3.60 to 4.34), reverse hybrid 4.77% (3.07 to 7.37) and resurfacing 13.01% (12.40 to 13.65).[1]

Raw data are probably skewed by the known failings of uncemented metal-on-metal (MoM) bearings (a problem largely avoided by those who stuck to cemented implants), but if only ceramic-on-polyethylene (probably the most successful bearing surface) is considered, using cement the ten-year revision probability was 2.09% (1.73 to 2.52) compared with 3.73% (3.22 to 4.33) with uncemented, and 2.19% (1.68 to 2.86) with hybrid.[1]

This is supported by data from the Nordic Arthroplasty Register Association. This database now holds data on 536 962 hips and dates back to 1995. Data from this again support the use of cemented hip arthroplasty especially in patients over the age of 65 years. In the 65 to 74 age group, percentage survival at 15 years is 89.3% (88.9 to 89.7) in cemented THA, compared with 87.8% (86.4 to 89.0) in uncemented hips. Even in the 55 to 64 age, rates are reported as 84.1% (83.4 to 84.4) in cemented compared with 82.8% (81.7 to 83.8) in uncemented.[2]

Looking at the reasons for revision described in the NJR as number of revisions per 1000 patient years, and trying only to compare cemented and uncemented metal-on-plastic (MoP) bearings to eliminate the biases caused by MoM bearings, cemented hips have significantly lower rates for dislocation, periprosthetic fracture, implant wear and malalignment, with the last three being more than twice as common in uncemented as in cemented hips (Table 1). Indeed there is no category described in the NJR report in which uncemented MoP THA outperforms cemented THA.

These differences may seem to be small. A few percentage points here and there, but the numbers in these joint registries are huge and they translate to significant real-term numbers of premature revisions for patients and additional costs to health services. Griffiths et al[3] performed a cost comparison based on NJR data in 2012. They concluded that even when the extra


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Table I. Comparison of number of patient years at risk for cemented and uncemented THA with metal-on-polyethylene bearings

	Patient years at risk (x 1000)	Number of revisions per thousand patient years for:				
		Implant wear	Dislocation	Infection	Periprosthetic fracture	Malalignment
All Cases	2551.0	0.29 (0.27-0.32)	1.0 (0.96-1.04)	0.81 (0.78-0.85)	0.65 (0.62-0.68)	0.47 (0.45-0.50)
Cemented metal-on-plastic	899.6	0.12 (0.10-0.14)	0.91 (0.85-0.98)	0.76 (0.71-0.82)	0.34 (0.30-0.38)	0.26 (0.22-0.29)
Uncemented metal-on-plastic	314.6	0.39 (0.33-0.47)	1.49 (1.36-1.63)	0.83 (0.73-0.93)	1.04 (0.93-1.15)	0.65 (0.56- 0.74)

data extracted from NJR report 2014

Table II. Factors contributing to improved outcomes in THA

Problem	Changes
Infection Prevention	Antibiotic-loaded cement Ring-fenced wards Prophylactic antibiotics Lamina flow theatres Exhaust body suits
Technique	Cement pressurisation Posterior approach
Materials	Highly cross-linked polyethylene Hydroxyapatite coatings Improved metallurgy
Design	Taper slip cemented stems Circumferentially-coated uncemeted implants Porous-coated uncemented cup backs
Anaesthetics/ Rehabilitation	Greater use of spinals Early mobilisation Reduced blood loss Better DVT prophylaxis

equipment such as the cement and disposables required for its use are taken into consideration, there are substantial savings to be found in both implants and savings on the cost of revisions.[3] In a more detailed work comparing the results of the most common cemented (Exeter/Contemporary) and uncemented (Corail/Pinicle) MoP hips, Baker et al[4] reported an even larger difference in both outcome and financial savings. The cost savings calculated in these papers pale into insignificance when compared with the cost to the NHS and patients from the recent foray into MoM hip replacement. Over the past ten years, 68 797 large head MoM implants have been implanted in the UK, many of which are likely to require premature revision.

The recent drive to save money in the NHS and the 'Get it right first time' initiative has made many UK surgeons more cost aware, and we are beginning to recognise that new and expensive is not always better. As long ago as 1995 Murray et al[5] pointed out that from a health economic perspective, a doubling of the price of an implant required a 90% improvement in outcome at 15 years to justify its use. Clearly, achieving this with a new implant is an impossibility with the sort of outcomes now reported by the best performing implants.

IMPROVING HIP OUTCOMES

All hip surgeons want the best for their patients. Since Charnley implanted his first cemented metal-on-ultra-high-molecular-weight-polyethylene (UHMWPE), low friction arthroplasty in 1962, surgeons have worked successfully to continually improve outcomes. These successes can broadly be considered in terms of: infection prevention, rehabilitation and anaesthesia, surgical techniques, materials and design. The major changes and advances in the 50 years since Sir John Charnley revolutionised hip arthroplasty are summarised in Table II. While readers will have their own ideas about the components of this table, however you look at it, the list of significant advances is quite short.

One could debate which of these drivers has made the greatest contribution to improved outcomes in THA, but in all likelihood it is probably infection control. Design is now arguably the least important of these factors, particularly where hip stems are concerned. In the 1970s and 1980s there were many new hip stem designs produced, some of which have fallen by the wayside. Among them, however, are a few that have stood the test of time and are not only market leaders now but have remained largely unaltered since 1990. These stems include the Exeter (Stryker UK), CPT (Zimmer) and Lubinus SPII (LINK, Germany) cemented stems, and the Furlong (JRI, UK), Corail (DePuy Synthes, UK) and Biometric (Biomet UK) uncemented stems. Since then there have been no hip stems, either cemented or uncemented, that have been shown in any hip registry to have improved on the outcomes reported for these implants (though some have achieved similar outcomes). Despite this, since 1990, an average of 30 new hip stems have been introduced in the UK every five years up until 2009 (Fig. 1). Not a single one of these has demonstrably improved outcomes, but surgeons are faced with a baffling choice of over 150 different stem designs for use in primary hip replacement. Although data on acetabular cups are harder to derive, the best performing cemented cup in the NJR (the Charnley Ogee, DePuy) was first launched in 1982. Cementless cups have performed much more poorly and undergone regular design and materials modifications, which is reflected in the fact that only seven cementless cup brands out of 57 had an ODEP 10A rating and these accounted for only 3% of cementless cups used in England and Wales in 2012.

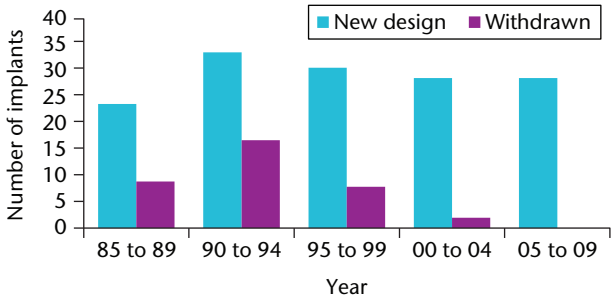

Fig. 1 The number of new femoral stems introduced and withdrawn between 1985 and 2009.

There are of course significant dangers in looking at implants in isolation and not considering the stem, cup and bearing surface as a unit; it is likely that the combination is as important in clinical practice as the design of the individual components themselves. Even when considering the best performing combinations, allowing for an improvement in the bearing to a ceramic head, those designed before 1990 largely remain the most reliable. Only uncemented acetabular cups have changed significantly, and much of that change is reflected in the introduction of highly cross-linked polyethylene, which looks very promising but has not yet stood the test of time.

WHAT IS DRIVING CHANGE?

Despite all this accumulating population-based evidence there has been a trend away from cemented hip arthroplasty. In the UK in 2013, 33.2% of hips were cemented, compared with 60.5% in 2003. Correspondingly, there has been an increase in the use of uncemented THA, from 16.8% to 42.5%. [1]

So why do we continue to use uncemented implants when results suggest that, in the vast majority of patients, cemented implants have superior outcomes? There are a multitude of factors at play here. As surgeons, our natural instinct is to strive to improve outcomes. The use of new technology is appealing to the population in general; the latest gadgets and games fly off the shelves and people queue for hours to have the 'latest model'. Some surgeons are no different and few of them are students of the history of hip replacement. A new implant presented in a shiny new box by a convincing sales representative tempts many to at least 'see what it's like'. In the early phases of using new technology there may be perceived advantages in easier techniques and shorter operating times but, unlike a trauma product where the outcome is known in a year or two, it takes five years to identify a disaster like the ASR, and may take 15 to 20 years to see if a product matches up to the best alternatives, during which time an awful lot of inferior implants can be put into patients.

Using an uncemented stem is a potentially quicker operation. In some circumstances this may have advantages. In the private healthcare sector (in the UK and elsewhere) any saving in time allows more procedures to take place, therefore providing higher financial rewards for surgeon and hospital. Hence it is easy to see how many surgeons may be convinced to use uncemented THA. The effect of remuneration on driving changes in practice has been demonstrated in other orthopaedic settings in the US.[6] While this does not apply in the NHS where there is no reliable evidence of improved theatre productivity through using uncemented THA, surgeons are almost certainly being influenced by what can be achieved in private practice and continue to use the same implants within the NHS.

There have been a number of reports in the press and journals about the risk of using bone cement. Most of these relate to its use in femoral neck fracture and have been refuted by data from the National Hip Fracture Database which show that seven- and 30-day mortality is actually improved in patients with cemented hemiarthroplasty. McMinn et al[8] reported a higher mortality rate in patients undergoing cemented compared with uncemented THA. However, this argument is not supported by data from the NJR which in a recent study showed that the use of cemented and uncemented implants had no effect on mortality at 90 days post-operatively.[1] These concerns have generated a number of anti-cement headlines in the popular press and one cannot help but wonder how they have arisen. It seems similar to the way the anti-global warming lobby has most effectively picked away at individual bits of data without being able to refute the fact that it is warmer than it used to be.

The US is the largest market for THA in the world. They perform approximately 40% of the world's THA procedures but account for about 60% of the profit made by manufacturers. The US moved away from cemented stems in the 1980s when the failure of Harris pre-coat and other composite beam stem designs led to the conclusion in the US that cement didn't work, and a generation later most US surgeons are not familiar with its use. This is in contrast to the UK where cemented design went in the direction of taper slip stems yielding much more favourable outcomes. Uncemented components also allow surgeons to use a wider range of bearing surfaces which probably adds to their popularity, particularly in a competitive environment where surgeons are looking to use their application of the latest technology as a selling point. This is especially prevalent in countries where private practice is the norm and surgeons need to market themselves to patients by offering the latest implant or technique. There is anecdotal evidence that this is happening in private practice in the UK; however, data that would support or refute this conclusion are not published by the NJR. Since the US contributes such a large percentage to manufacturers' profits, it is understandable that manufacturers focus more on developing implants for this market, and having done so need to sell them worldwide. However, this does not wholly explain the huge number of new implants brought to market. Some of this behaviour is no doubt a genuine attempt to improve outcomes, but since no manufacturer has managed to verifiably improve stem design in the last 25 years, one cannot help but wonder if the reason is not more to do with the high mark-ups and profitability that can be commanded with new, 'better' implants, heavily promoted as offering the latest technology, and backed up by subsidised educational visits.

It is a matter of public record that several major implant manufacturers paid heavy fines in the US and UK as recently as 2012 for corrupt practices in connection with illegal payments to surgeons for using their implants in the US, South America and Europe.[9-11] While this has led to significant reforms, it does illustrate the extent to which manufacturers were prepared to go to at that time to increase market share. In the US all payments to surgeons now have to be declared, though in the UK and Europe no such transparency exists, leaving inevitable questions about the extent to which individuals promoting new implants might be benefiting from providing their endorsement.

CONCLUSIONS

Cemented THA performs well and is a very successful procedure. In the majority of patients over 65 years of age, the results of the best cemented stems at ten years are so good that most revisions are accounted for by causes in which the stem has little if any role to play,

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such as acetabular loosening and infection. The number of aseptically loose taper slip stems requiring revision at ten years must be incredibly low; in the authors' hospital most such revisions are cement-in-cement to allow better access to reconstruct a loose acetabulum. One could argue that THA stems are now a mature technology; like the pneumatic bicycle tyre which has remained largely unchanged for more than a century, perhaps future changes and improvements should be sought elsewhere.

As with global warming, there are considerable resources deployed to cast doubt on this conclusion and try to persuade the orthopaedic community that new has to be better. All too often, as has happened with the MoM debacle, like lemmings, many surgeons (the senior author of this article included) have followed the siren voices over the cliff edge, taking their patients with them. Things clearly have to change. Up until now orthopaedic surgeons who actually know their own long-term outcomes have been a rarity, but as we enter the age of information, with mass data collection by the NJR, the ability of a surgeon, implant or manufacturer to shelter behind self-delusion and short-termism is being gradually stripped away. As many surgeons and units are finding out, make a poor implant choice and five to ten years later you may find yourself listed as an outlying performer in the NJR. Suddenly the tables have been turned; the slow burn that is a failing hip (and which for too long allowed us to brush our bad implant choices under the carpet) risks keeping you and your unit languishing on the periphery for much of the rest of your career, laid bare before your patients and colleagues. Surgeons have always accepted that as individuals we are responsible for our technical failings and errors. We need to recognise that we must be held equally responsible and accountable if we make a poor implant choice.

Cemented hip arthroplasty remains, just as it was 30 years ago, the gold standard. It is relatively forgiving, inexpensive and has the best outcomes in most circumstances, particularly in older patients. As has been acknowledged by the welcome introduction of the Beyond Compliance initiative, it should be up to those wishing to change practice to demonstrate the advantages of such a change, before it becomes widespread.

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