Session Number: CC

Session Title: Trends in Total Joint Arthroplasty - Are They Supported by the Evidence?

Session Type: Symposium

Location: Room 20D

Date & Time: 03-13-2025, 11:00 am - 12:30 pm

INSTRUCTORS WHO CONTRIBUTED TO THIS HANDOUT: as of 2/20/2025

Moderator(s):

William J. Maloney, MD, FAAOS

Faculty:

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Robotics, An Advantage in Total Hip Arthroplasty:

Outline:

- Total hip arthroplasty is an excellent operation that generally has outstanding results
    - Instability is still not completely solved
    - Leg lengths can still be difficult to match accurately
    - Offset is typically difficult to measure
- Robotics in Total Hip Arthroplasty can address each of these issues and can improve supply chain management and intra-operative efficiency

Pre-operative CT based Planning:

- Pre-operative CT based planning is more accurate than x-ray templating for component sizing
- 3D impingement modelling can help assess the risk of instability and adjust component positions to reduce the risk of instability
- Supply chain can be greatly improved with more accurate templating

Intra-operative efficiency:

- Although pin placement and registration do add time to the procedure, the improved efficiency of single reaming makes up for the time taken with registration
    - This was proven when novel users (fellows) were measured compared to standard techniques
- Knowledge of impingement modeling outcomes can decrease the time needed for trialing

Outcomes:

- Accurate placement of components (hip center, femoral length, femoral offset, acetabular orientation, femoral version) allow the surgeon to recreate the pre-operative plan that has been tested and adjusted with impingement modeling software to minimize the risk of instability
- Data on over 3000 robotic assisted total hip arthroplasties will be reviewed with a dislocation rate of 1/1000

Seth Jerabek

Robotics: A Big Advantage in TKA

- Key Takeaways
    - Surgeons are deviating from neutral mechanical alignment in TKA
    - Most mechanical guides are designed to implant TKAs in neutral mechanical alignment
    - Appreciating a patient's constitutional alignment provides insights to an individual's optimal TKA reconstruction
    - Robotic platforms allow for intraoperative assessment of both alignment and balance/ligament laxities
    - Robotics allows for adjustments to the surgical plan to achieve an optimized alignment and balance in all planes
    - Robotics has proven to be accurate at hitting alignment targets in TKA
    - Large studies or registries will be needed to determine if robotics is significantly improving outcomes in TKA

AAOS Symposium: Trends in Total Joint Arthroplasty: Are they Supported by Evidence
Talk Title: Robotics: A Must Have for UKA

Robert L. Barrack, M.D.
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TAKE HOME KEY POINTS:

- The major issue leading to suboptimal results in total joint arthroplasty is inconsistency in component placement.
- There is a substantial learning curve, results are better with high volume surgeons yet most procedures are performed by low volume surgeons.
- UKA is a prototype of this problem with 5-10 year results showing revision rates of 15-20% even in the hands of experienced surgeons.
- This data is consistent throughout numerous national registries outside of the US as well as the Medicare database and private insurance databases.
- Robotics solves the problem with inconsistency of component placement.
- This has resulted in much lower revision rates at major centers as well as in national datasets such as Pearl Diver and the Australian Registry.
- There is evidence that hitting multiple targets results in higher quality results in terms of patient reported outcomes as well as in lower revision rates.
- Robotic UKA is highly more accurate than manual and eliminates almost all outliers. This has been documented in multiple high quality publications.
- Manual instruments are crude and inaccurate resulting in inconsistency in component placement in the hands of most surgeons. This is largely avoidable with current generation robotics and it is therefore past time to consider adoption of robotic technology for total joint replacement and the prototype for which the data is most compelling, if not undeniable, is UKA.

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Trends in Total Joint Arthroplasty – Are They Supported by the Evidence?
Symposium CC
Thursday, March 13, 2025
11:00 AM - 12:00 PM

Robotics in TJR – Let's Put Things in Perspective

Daniel J. Berry, MD
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I. The Trends:

A. The AJRR and other data sources demonstrate rapid adoption of robotics in UKA and TKA in the US. Internationally there is great variation by country.

B. Adoption in THA is in its early phases worldwide.

II. The Promise:

A. Robotics and other digital technologies offer a number of tantalizing and potentially very powerful benefits in TJR.
   1. More accurate and more reproducible bone preparation than can be performed with hand instruments.
      a. This could reduce alignment outliers that are associated with poor outcomes in TKA and THA.
      b. This speed the learning curve for surgeons to reproducibly align implants within optimal alignment parameters.
      c. By providing great accuracy and precision robotics and other digital technologies may allow surgeons to fine tune customized implant alignment to provide better kinematics (knee), or better stability (hip).

III. The Risks:

A. If surgeons become dependent on robotic instrumentation, what happens when the robotic instruments malfunction or are not used properly?
   1. Will surgeons recognize the problem intraop?
   2. Will surgeons have the skills to convert back to hand instruments if required?

B. Robotic instruments have some unique complications associated with them (pin track fractures for example).

IV. The Outcomes (to date):

A. UKA: Limited data suggest robotics may improve implant alignment and positioning and also may be associated with reduced early complications. This is not surprising because standard hand instruments for UKA do not provide highly reliable outcomes.

B. TKA:
   1. There is a lot of data, but most of it is (a) of low quality, (b) subject to many biases including which patients get the surgery, which surgeons/hospitals do the surgery, (c) observer bias by patients (who want to believe in robotics) or surgeons (who want to prove the technology is valuable). To date it has been very difficult to demonstrate substantial improvements in clinical outcomes of robotics vs hand instrumented TKA.
   2. Why is this the case?
      a. Possibly there is little difference in expert hands (who mostly do the studies) between the two technologies.
      b. Possibly our outcome instruments don't detect subtle differences in outcomes.
      c. Possibly in large cohorts done by all-comer surgeons followed for long periods the reduction of alignment outliers will lead to better long-term outcomes for robotics.

C. THA: There is too little data thus far to comment except to say surrogate outcomes (such as implant alignment) look favorable in some series.

V. The Cost:

A. The cost or robotics is enormous.

B. One can reasonably ask whether, with at most small differences in outcomes, the cost/benefit analysis is favorable.

C. Practically speaking, though, the technology seems deeply embedded enough in practice (due to surgeon/patient interest; marketing; training) that it is likely to continue to be used.

D. Hopefully refinements can reduce cost and improve the value equation.

Dual Mobility for all High-Risk Patients

Mark W. Pagnano, MD

The risk of dislocation after primary THA has dropped over the past decade, in large part due to the more routine use of larger diameter femoral heads and to some changes in surgical technique, but remains a stubborn problem. Recent registry studies and large institutional database studies suggest at least a 1% risk of dislocation in the first year postoperatively when the data from broad groups of patients and broad groups of surgeons is included. Extensive work has been undertaken in the last decade to identify those groups of patients at highest risk with particular attention being given to patients with lumbar spine disease. The hip-spine relationship does appear real and some surgeons have developed strategies in their practices to routinely assess and act on the data developed. Some surgeons suggest altering the position of the acetabular component to anticipate the functional changes that are driven by particular combinations of hip-spine problems. Typically those component position changes are then intended to be enacted with the aid of some-type of enabling technology that allows precise adjustment of acetabular component position. An alternative technique is to harness the power of dual-mobility implants by taking advantage of larger effective head-diameters and the second articulation as a mechanism to achieve better effective hip range of motion prior to impingement (and thus decrease the risk of dislocation).

The early impact of dual-mobility in decreasing the risk of dislocation after revision THA has been demonstrated fairly conclusively in both retrospective cases-series and in meta-analyses in recent years. The impact of dual-mobility in primary THA is somewhat more challenging to demonstrate conclusively. That is because the absolute risk of dislocation is lower in primary THA, making it more difficult to demonstrate a difference, and because in the smaller acetabular cup sizes used in primary THA the effective head sizes of a modular dual-mobility implant may not be substantially larger than the corresponding largest fixed femoral head. For those surgeons who embrace a non-modular dual mobility socket then they are in-fact able to take of advantage of larger effective femoral head diameters with dual mobility and may see a greater advantage.

Dual-Mobility implants in primary and revision THA: A systematic review and meta-analysis. J Clin Orthop Trauma 2024

The efficacy of **dual**-**mobility** cup in preventing dislocation after total hip arthroplasty: a systematic review and **meta**-analysis of comparative studies.

Romagnoli M, Grassi A, Costa GG, Lazaro LE, Lo Presti M, Zaffagnini S.Int Orthop. 2019

Modern **Dual**-**Mobility** Cups in Revision Total Hip Arthroplasty: A Systematic Review and **Meta**-Analysis.

Levin JM, Sultan AA, O'Donnell JA, Sodhi N, Khlopas A, Piuzzi NS, Mont MA.J Arthroplasty. 2018

Symposium – Trends in Total Joint Arthroplasty: Are they supported by evidence?

Handout – Large Ceramic Heads for all THA's

Charles L. Nelson, MD, Penn Medicine

Total hip arthroplasty is among the most successful surgical procedures in medicine. However, despite the high success of THA, the procedure has been associated with failures during several generations of implant design related to implant, surgical and patient factors. Implant related failures have included metal implant fractures, particle related osteolysis, aseptic loosening with failure of long-term fixation in both cemented and cementless designs, ceramic bearing fractures, stripped wear and squeaking, adverse reactions to metal debris (ARMD) including metal-on-metal wear and taper mechanically assisted crevice corrosion (commonly referred to as taper corrosion).

With advances in implant design, bearing wear, osteolysis, and loosening have become less common, and the most common etiologies for THA failures are currently infection, instability and periprosthetic fracture [4]. Less common, but still important etiologies related to modern implant failures include adverse reactions to metal debris, currently predominantly related to mechanically assisted crevice corrosion [2,3], and intra-prosthetic dislocation of dual-mobility bearings.

Large head ceramic heads on cross-linked polyethylene have become the most common bearing used in the United States [1], and address many of the current and past failure mechanisms. Large femoral heads have been associated with lower dislocation rates compared with smaller femoral heads. Use of large femoral heads to decrease dislocation is particularly important given that dislocation is either the first or second leading cause of re-operation after total hip replacement [4]. In addition, large ceramic femoral heads have lower fracture rates than smaller ceramic femoral heads. The risk of ceramic fracture for Biolox Delta femoral heads is less than 1/100,000, and has not been reported with Biolox Delta Heads 36mm in diameter or greater [5].

Advantages of using large diameter ceramic femoral heads versus large diameter cobalt chrome femoral heads include the following:

1) Large ceramic femoral heads have been shown to be associated with less frictional torque compared with large diameter femoral heads [6]. While mechanically assisted crevice corrosion is seen with both small and large diameter metal femoral heads [2,3], the increase in frictional torque as well as increased bending moments with larger diameter metal femoral heads may explain the increased rate of mechanically assisted crevice corrosion seen with larger diameter femoral heads in some studies [3]. ARMD has not been reported with ceramic on polyethylene bearings for femoral stems that do not have a modular neck.
2) Large diameter ceramic femoral heads are harder and more scratch resistant compared with large diameter cobalt chrome femoral heads. When paired with contemporary cross-linked polyethylene, both large diameter ceramic and chrome cobalt femoral heads have extremely low wear rates, but in studies where there is a difference, large

diameter ceramic femoral heads have lower wear rates. In addition, when there is concern for 3rd body wear, particularly in the setting of prior ceramic fracture, large diameter ceramic femoral heads are less prone to damage and are preferred.

The current trend of increased use of large ceramic heads versus cross-linked polyethylene bearings is supported by evidence. Hip instability is among the leading etiologies of failure among contemporary THA, and large femoral heads have been shown to lower dislocation rates after THA. Cumulative revision rates for ARMD with metal femoral heads is estimated at 0.1%[3], substantially higher than the rate of contemporary large head Biolox Delta ceramic head fractures (less than 1 in 100,000)[5].

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2) Cooper, HJ, Della Valle, CJ, Berger, RA, Tetreault, M, Paprosky, WG, Sporer, SM, Jacobs, JJ. Corrosion at the head-neck taper as a cause for adverse local tissue reactions of total hip arthroplasty. J Bone Joint Surg Am, 94: 1655-61, 2012.
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4) Hannon, CP, Salmons, HI, Trousdale, RT, Lewallen, DG, Berry, DJ, Abdel, MP. Why are contemporary primary ceramic-on-highly cross-linked polyethylene total hip arthroplasties failing? An analysis of over 5500 cases. J Arthrop, Online ahead of print, 2024.
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Knee Kinematics and Primary TKA
PS and CR TKA Have Stood the Test of Time

Giles R. Scuderi, MD, FAAOS
Northwell Health

Over the decades there have been significant implant design changes in total knee arthroplasty (TKA). Initial designs focused on either retaining, sacrificing or substituting the posterior cruciate ligament (PCL). Recently more conforming PCL sacrificing designs, such as the ultracongruent (UC), medial congruent (MC) and medial pivot implants, have been introduced as an alternative to posterior substituting designs. This wide selection of implants has influenced the trends in surgeons' selection of implants. The 2023 AJRR Annual Report revealed that more than half of all primary total knee arthroplasty procedures utilized posterior stabilized implants until 2019 when that rate dropped below 50%. Cruciate retaining designs increased annually since 2017 to reach 56.1% in 2022. The use of ultracongruent components doubled from 2012-2020 but has slightly decreased in the last two years (1).

The AJRR Annual Report also reported on the revision rates of the different implant designs. After adjusting for age, sex, and Charlson comorbidity index in patients ≥65 years of age, ultracongruent and cruciate retaining designs showed a significantly reduced cumulative percent revision compared to posterior stabilized designs. This analysis does not account for numerous potential confounders and the reasons for revision may be unrelated to the implant type (1). Posterior stabilized knee designs facilitate ligament balance with more significant deformity and complex cases, which may impact the ultimate outcome. Further investigation is needed to determine the long-term durability of newer designs, clinical outcome and implant survivorship.

Despite the newer designs and shift in the choice of implants, the literature has failed to identify an overall clinical superiority between implant designs, as well as the clinical consequence of sacrificing the PCL in more conforming designs (3). Management of the PCL and choice of the tibial insert in TKA will continue to be a surgeon's decision. Further study should evaluate if surgeon choice is based upon clinical outcomes, regional training, individual preference or manufacturer influence (2). Ultimately it is experience with a specific implant design and meticulous surgical techniques that are fundamental to assuring the best outcomes for patients.

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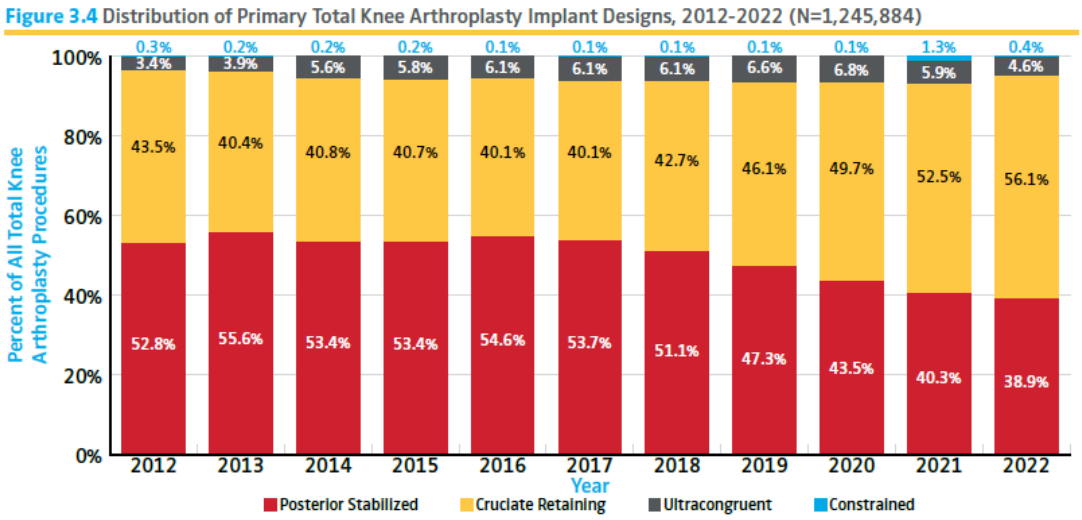
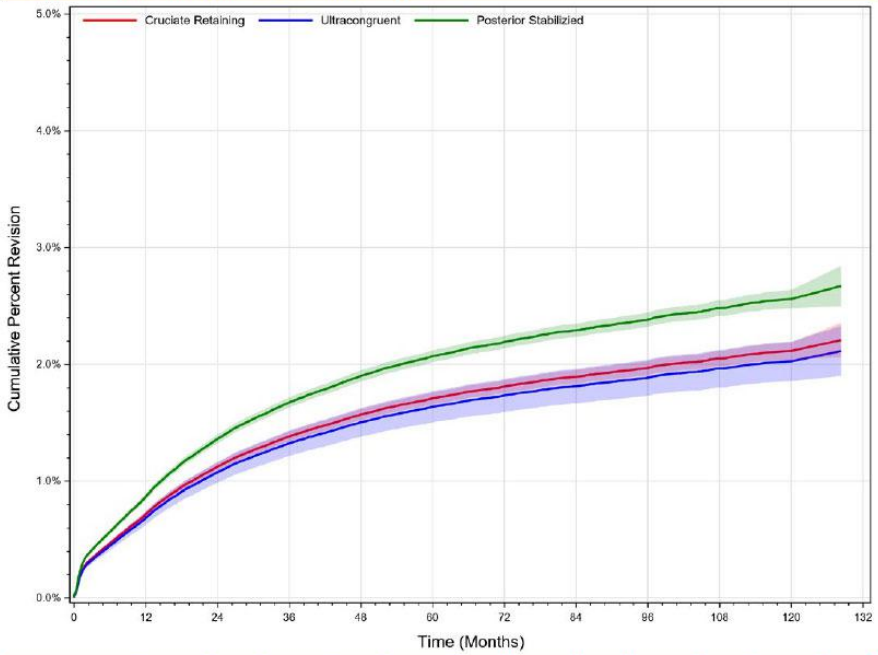


Figure 3.5 Cumulative Percent Revision for Primary Total Knee Arthroplasty Implant Designs in Medicare Patients 65 Years of Age and older with Primary Osteoarthritis, 2012-2022



Number at Risk (Months)	0	12	24	36	48	60	72	84	96	108	120	132
Cruciate Retaining	296,510	262,554	227,876	196,959	160,467	124,299	86,536	54,266	30,635	14,340	4,561	4
Posterior Stabilizied	331,098	303,431	275,340	246,563	208,284	165,077	114,311	69,399	38,317	17,301	4,612	1
Ultracongruent	39,755	36,220	31,914	27,574	22,125	16,938	11,046	6,661	3,488	1,227	328	1
Total	667,363	602,205	535,130	471,096	390,876	306,314	211,893	130,326	72,440	32,868	9,501	6

Age/Sex/CCI adjusted HR (95%CI), p-value
Cruciate Retaining vs. Posterior Stabilizied: 0.824 (0.79,0.86), p<0.0001
Ultracongruent vs. Posterior Stabilizied: 0.789 (0.718,0.867), p<0.0001

Cobalt Chrome heads are cost effective and have stood the test of time.

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Whilst we have seen a huge push towards the use of ceramic heads in hip arthroplasty, there is still a role for Cobalt Chrome heads. This is both for cost and expediency reasons. Not all healthcare systems can afford ceramic heads for everybody.

The increased success rates of the successful introduction and evolution of highly crosslinked polyethylene has meant that the acetabular side of the equation has largely been resolved. There are still some staunch advocates of ceramic on ceramic who favour that bearing, particularly in young patients, but the evidence for highly crosslinked polyethylenes is strong. The key issue now is which counter face to use with it.

There is no doubt that ceramic on highly crosslinked polyethylene has become the standard, partly for theoretical wear reasons but mostly because of fear of corrosion at the taper. The 3 available alternatives are the use of ceramic heads, oxidised zirconium heads or cobalt chrome heads. The other issue is the increasing push to large head sizes in order to decrease the risk of instability. This has theoretically further pushed the surgical community towards ceramic heads as there has been a suggestion that large metal heads are more likely to lead to corrosion.

Cobalt-chrome on polyethylene is a long-standing bearing couple that has the advantage of modularity and avoids the risk of fracture seen with ceramic articulations. However, both simulator and clinical studies demonstrate the potential for oxidative wear and damage, resulting in a roughened surface and accelerated polyethylene wear. Oxidized zirconium is a metallic alloy centre with an oxidized zirconium surface 5–10 μm thick that offers reduced wear rates on a polyethylene bearing surface. It was introduced to improve scratch resistance over traditional cobalt-chromium heads and to lower the risk of femoral head fracture reported with ceramic implants. Tribiological testing has shown that oxidized zirconium has better wettability and less surface adhesion on polyethylene than cobalt-chrome.

The goals of any bearing surface are to optimise stability, improve range of motion and minimise wear. Wear no longer seems to be the key issue with highly cross polyethylenes with all counterfaces showing low wear rates into the long term. The main concern over metal on polyethylene components is the possibility of corrosion. Corrosion at the head/neck junction (taper) with release of metal ions may still occur leading to an adverse reaction to debris. This was particularly seen in metal-on-metal arthroplasty but is of course possible with a metal head on a metal taper. We increasingly monitor metal ion levels when concerned about pain in an arthroplasty that doesn't otherwise have an alternative concerning diagnosis.

Implant factors such as the length since implantation, the design of the taper, size of femoral head and the mixing of different alloys are all associated with taper corrosion related failure. In theory heads above 36mm could lead to increased corrosion due to greater stress at the head/neck junction.

Work from both the National Joint Registry for England and Wales and the Australian National Joint Registry suggested there is an increased rate of revisions related to adverse metal reaction with head sizes above 36. Clinical and retrieval studies however have not confirmed this. Retrospective studies are really not powerful enough to answer this question as the causes of taper corrosion are multifactorial, as of course are the causes of revision in registries. There are, however, randomised controlled trials now out to 5 years suggesting that there is no association between cobalt chrome femoral head size and release of metal ions out to at least 5 years. This RCT is important as it has shown that at 5 years there is no difference in metal ion levels between patients with 32mm femoral head and those with a femoral head between 36 and 44. Moreover, these increased metal ion levels did not impact function and the patients with raised metal ion levels were as active as those with normal levels of metal ions.

Ultimately each system must consider cost effectiveness. There is a surplus cost to using ceramic but there are also excess costs to investigating and revising metal heads with corrosion. Ceramic femoral heads are premium implants, certainly more expensive at initial point of care. The ceramic surplus varies with practice setting, from $500 to $1500. Lower costs were discovered in high-volume practice settings, indicating that a shift to increased use of ceramic femoral heads would likely decrease ceramic surplus for most institutions.

Further study on the epidemiology of trunnionosis, corrosion, and metal toxicity in metal-on-polyethylene THA is needed to evaluate the economic validity of its continued use. Complications are rare but important and are impossible to predict. Ceramic usage will continue to rise although it is still reasonable to use metal femoral heads.

The size of the femoral head does not influence metal ion levels after metal-on-polyethylene total hip arthroplasty: a five-year report from a randomized controlled trial.
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Title: Trends In Total Joint Arthroplasty - Are They Supported by the Evidence?

Outline:

William J Maloney, MD, FAAOS Trends In Total Joint Arthroplasty From The AJRR - 5 minutes

Fixation in Primary TKA

Robert Barrack, MD, FAAOS Cementless TKA: Its Time Has Come

Steven MacDonald, MD, FAAOS Not So Fast: Cement Fixation Remains the Gold Standard

Stability in THA

Mark Pagnano, MD, FAAOS Dual Mobility For All High Risk Patients

Craig DellaValle, MD, FAAOS Large Femoral Heads Are Equivalent in Outcome and Less Expensive

Robotics in Primary Total Joint Arthroplasty

David Mayman, MD, FAAOS Robotics: An Advantage in THA

Seth Jerabek, MD, FAAOS Robotics: A Big Advantage in TKA

Robert Barrack ~~Antonia Chen, MD, FAAOS~~ Robotics: A Must Have for UKA

Daniel Berry, MD, FAAOS Robotics in Total Joint Arthroplasty: Let's Put Things In Perspective

Knee Kinematics and Primary TKA

C Lowry Barnes, MD, FAAOS Medial Stabilized Inserts For All Primary TKA's

Giles Scuderi, MD, FAAOS PS and CR Have Stood the Test of Time

Bearing Surfaces in THA

Charles Nelson, MD, FAAOS Large Ceramic Heads For All THA's

Fares Haddad, MD Metal Heads Have Stood the Test of Time and are Cost Effective

Trends in Total Joint Arthroplasty -Are they Supported by the Evidence

AAOS Symposium 2025

William J. Maloney, MD FAAOS

Trends in Total Joint Arthroplasty From the AJRR

The American Joint Replacement Registry accurately tracks trends in hip and knee arthroplasty in the US. The most recent report from the AJRR was released in November, 2024 and highlights important trends over the last decade.

Highlights

The site of service in definitely changing. More total hip and knee replacements are being done in the outpatient setting. In 2012 only on ASC submitted data to the AJRR. In 2023, 312 ASCs submitted data. Only 10% of the procedures submitted come from academic medical centers.

Knee

The mean number of TKAs done per surgeon has continued to increase and is now at 65 TKAs per year

Average length of stay is now down to 1.1 days.

The use of medial stabilized total knee replacements continues to grow. In 2023, 34.6% of the primary total knees were characterized as medial pivot or medial stabilized knees. At the most recent AAHKS meeting (2024), 41 % of surgeon report using a medial stabilized knee as there go to primary knee replacement.

Patellar resurfacing remains the predominant strategy for patellar management, but though this has gradually decreased from 95.9% in 2012 to 87% in 2023. In patients 65 and older, there was no difference in revision surgery based on patellar resurfacing.

The use of cementless fixation is rapidly increasing in primary TKA and represents 22% of the cases submitted in 2023. This is up from about 2% in 2013 and we can expect this to continue to grow. Cementless fixation was associated with a lower fixation rate in men regardless of age. In contrast, cementless fixation had a significantly higher revision rate in woman over the age of 65.

Robotic technology continues to grow in primary TKA. In 2017, 1.8% of primary TKAs were done with robots, compared to 15.9% in 2023. This probably underrepresents robotic usage due to inconsistent use of the appropriate codes. In contrast, the use of navigation has been relatively stable over the past decade (4-5% of the cases).

Partial knee replacement (medial and lateral unicompartmental knee arthroplasty) has been relatively stable over the past six years ranging from 3.7 to 4.6% of all knee arthroplasties

submitted to the AJRR. Uni's are revised at a higher rate than totals. The used of robotic technology in unicompartmental knee replacement was not reported.

Hip

Similar to the knee, the mean number of total hips surgeon continues to increase in in 2023, the mean was 44 THRs.

In terms of femoral head size, 36 mm heads predominate and now represent more than 60 % of femoral heads used in primary THA. Dual mobility sockets peaked at 10.7% in 2019 and have gradually declined over the past four year to 7.5% in 2023. In contrast, 40 mm heads have grown to 9.9%.

A higher revision rate is reported for primary THAs that use a dual mobility socket, but that may represent a selection bias with dual mobility sockets being used in patients who are at a higher risk for dislocation.

Ceramic femoral heads represent the vast majority of heads used regardless of head size – now reported in 81.9% of the cases if you exclude dual mobility sockets. Cobalt chrome femoral heads are now being used in only 8% of cases with ceramicized femoral heads in 10%. Metallic femoral heads are more commonly used in older patients.

In primary THA, cementless fixation is performed in about 95% of all cases, with cement fixation growing slowing especially in older patients. Cemented fixation had a significantly lower rate of revision in patients older than 65 as a result of lower rate of periprothetic fractures.

Unlike the knee, robotics is growing slowly in THA representing only 6.6 percent of cases submitted while at navigation has decreased from 5.1% to 2.8% from 2022 to 2023.

In this symposium, we will examine some of these trends and try to ask the question – Does the Evidence Support the Trends?

Trends in Total Joint Arthroplasty: Are They Supported by the Evidence?
Talk Title: Cementless TKA: Its Time Has Come

Faculty: Robert L. Barrack, MD

TAKE HOME KEY POINTS:

- Long-term fixation remains an issue with cemented TKA with revision rates significantly higher in the young and the obese which is particularly a problem since the young and the obese are the largest growing portion of the total knee population. AND studies comparing cementless versus cemented TKA showed that cementless outperforms cemented TKA in the obese.
- RSA studies show that cementless knees are more stable at 5-10 years while cemented TKA has a disturbing percentage of late tibial migration.
- Issues with PMMA include variability in cement properties, cement techniques, and the interaction between tibial component design and cement technique.
- Cement is a problem with the patella components with recent MRI studies showing concerning rates loosening, avascular necrosis, and fragmentation. MRI also shows a more stable fixation surface in cementless vs cemented femur and tibia also.
- New technology that has enhanced cementless TKA includes highly porous surfaces with 3-D printed Ti and optimized component designs that minimize micromotion.
- A level 1 RCT showed cementless TKA to have equivalent EBL and clinical outcomes at 4-6 weeks, 2-4 yrs and 5-10 yrs with 13 min less OR time.
- Recent AJRR data reveals that cementless TKA outperformed cemented in the highest risk group, young males.
- When the cost of cement and accessories are considered cementless procedures actually are less in total than their cemented counterpart.
- This constellation of factors has resulted in exponential increase in the use of cementless TKA in the last 5 years and indicates that like THA, most (but not all) TKA's will be performed cementless, in the near future.

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Trends in Total Joint Arthroplasty
Symposium CC
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Cemented Total Knee Arthroplasty Remains the Gold Standard

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- **Introduction**
    - Cement fixation has been the gold standard when performing a total knee arthroplasty (TKA) since the 1970's
    - Cemented TKAs have produced survivorship of well over 90% at 10 years and greater follow-up in multiple published series and national registries
    - Cementless TKAs had a period of increased popularity in the late 1980's and early 1990's, however were plagued with less predictable outcomes and survivorship with those early generation implants
    - Cementless TKAs today are enjoying a resurgence of enthusiasm which is being driven by improvements in biomaterials with the hopes for better survivorship than historically seen, coupled with a proposed increased efficiency by decreasing OR time
    - The true long-term survivorship of these current generation cementless TKAs remain to be seen
    - The important factors to consider when comparing Cemented and Cementless TKAs include:

- **II <u>Survivorship</u>**
    - While there is no long-term registry data on current generation Cementless TKAs, to date cemented TKAs have generally had the lowest revision rates when compared with cementless TKAs
    - In the most recent <u>Australian Joint registry</u>:
    - The 15-year cumulative revision rate of cruciate-retaining TKAs is:
        - 5.4% for Cemented TKAs
        - 5.5% for Hybrid TKAs
        - 6.8% for Cementless TKAs
    - The 15-year cumulative revision rate of cruciate-sacrificing TKAs is:
        - 7.1% for Cemented TKAs
        - 7.7% for Cementless TKAs
        - 7.8% for Hybrid TKAs
    - In the most recent <u>UK National Joint registry:</u>
    - The 15-year cumulative revision rate of cruciate-retaining TKAs is:
        - 4.11% for Hybrid TKAs
        - 4.41% for Cemented TKAs
        - 5.89% for Cementless TKAs
    - The 15-year cumulative revision rate of cruciate-sacrificing TKAs is:
        - 5.46% for Cemented TKAs
        - 6.57% for Hybrid TKAs

        - 8.84% for Cementless TKAs

- **III. <u>Generalizability</u>**

    - Patient selection becomes a relevant issue when performing Cementless TKAs
    - Issues such as bone quality, patient age, weight and demands are important considerations
    - Older patients and those with poor quality bone will have more reproducible fixation with a Cemented TKA
    - Additionally, obese patients may be better served with Cemented TKAs with small tibial stems
    - A Cemented TKA can be equally applied to all patients requiring a TKA, making it a more generalizable technique
    - The majority of TKAs currently performed globally are Cemented TKAs. There will inevitably be a learning curve for surgeons who switch to Cementless TKAs

- **IV. <u>Costs</u>**

    - The issues around costs and cost efficiency are complex and many factors need to be considered:
        - Cementless implants have a higher implant cost than Cemented
        - Ideally the revision burden costs should be calculated into any cost equation
        - Cementless implants on average are 10 mins quicker in terms of operative time than a Cemented TKA
        - Cemented TKAs have the additional costs of cement mixers and the cement itself (which can be increased if antibiotic-impregnated cement is chosen)

References

2024 Australian National Joint registry at www.aoa.org.au/docs

2020 UK National Joint Registry at www.njrcentre.org.uk

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Bone Joint J, 2019 vol.101B, pp. 61-63

Trends in Total Joint Arthroplasty:
Are they supported by Evidence

Large Femoral Heads are Equivalent in Outcome and Less Expensive

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Dislocation continues to be amongst the most common, if not the most common, reason for revision of a total hip replacement in North America. There are several strategies to potentially reduce the risk of dislocation including alternative surgical approaches, larger diameter femoral heads and dual mobility bearings.

Dual mobility bearings are attractive as they maximize femoral head size which increases jump distance and thereby reduce the risk of instability. The advent of crosslinked polyethylene, however, has also allowed for the routine use of larger diameter standard bearings, which also leads to an increased jump distance and a lower risk of dislocation. Hence it is unclear whether the increased cost of a dual mobility bearing is justified to further reduce the risk of dislocation over the use of a standard large diameter femoral head.

While there have been several retrospective analysis that have suggested a potential benefit to dual mobility bearings in primary THA, there have been no RCTs to suggest the same. Hence in November of 2017 we began a multi-center RCT (Rush, Rothman Institute and NYU) to compare the use of large diameter femoral heads and dual mobility bearings. Inclusion criteria for the study included a primary THA done via a posterior approach and a history of a lumbar spinal fusion, a neuromuscular disorder, age > 75 years old, dementia or cognitive impairment, inflammatory arthritis, high preoperative hip range of motion (combined preoperative flexion+adduction+Internal rotation > 115 degrees) or a history of substance abuse or >10 alcoholic beverages per week. Our power analysis suggested we needed 206 patients per group to show a reduction in the dislocation rate from 8% to 2%. At this point we have randomized 263 patients with 3 dislocations in each group. Hence, we have not as of yet been able to show an advantage of dual mobility over a large femoral head in patients at high risk for dislocation but we are still enrolling in the trial.

I will add, however, that I do think the major downside of a dual mobility bearing is cost, and I have little concern regarding the risk of corrosion at the modular junction between the modular dual mobility liner and the acetabular component. We recently completed an RCT which showed no difference in serum metal levels between two cohorts of patients where the same stem, same cup, a ceramic head and a polyethylene as compared to a dual mobility bearing were utilized.

The only other potential downside of a dual mobility bearing is the risk of intra-prosthetic dislocation. While in the past these events were related to wear at the introitus of the mobile polyethylene bearing, with contemporary designs these have only been associated with closed reductions of a dislocated dual mobility bearing. Hence, if a dual mobility bearing does dislocate, it is strongly recommended that the closed reduction be done in an operating room, with full muscular relaxation (paralysis) and fluoroscopy to ensure a gentle closed reduction. It is imperative that post reduction X-Rays be scrutinized to ensure a concentric reduction without intra-prosthetic dislocation.

***Dr. Della Valle has a conflict of interest with this topic as receives royalties from the design of a dual mobilty bearing*