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Trends in Total Knee Arthroplasty Implant Utilization

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ABSTRACT

The incidence of total knee arthroplasty (TKA) has increased alongside our knowledge of knee physiology, kinematics, and technology resulting in an evolution of TKA implants. This study examines the trends in TKA implant utilization. Data was extracted from The Orthopedic Research Network to evaluate trends in level of constraint, fixed vs. mobile bearing, fixation, and type of polyethylene in primary TKAs. In 2012, 88% used cemented femoral and tibial implants, and 96% involved patellar resurfacing. 38% of implants were cruciate retaining, 53% posterior stabilized or condylar stabilized, 3% constrained. 91% were fixed-bearing, 7% mobile-bearing. 52% of tibial inserts were HXLPE. TKA implant trends demonstrate a preference for cemented femoral and tibial components, patellar resurfacing, fixed-bearing constructs, metal-backed tibial components, patellar resurfacing, and increased usage of HXLPE liners.

Total knee arthroplasty (TKA) has been widely established as a highly successful and cost-effective treatment for advanced degenerative joint disease of the knee in terms of pain relief, increased function, and improvement in quality-of-life dimensions [1–4]. First introduced into clinical practice in the 1970s, TKA has now become one of the most common inpatient surgical procedures performed in the United States [5]. Recent studies on the projected future demand purport that TKA use is expected to exponentially rise in the next 10 years, driven by the aging baby boomer generation, obesity epidemic in the United States, public expectations, and investment in health-care interventions [1]. According to data from the Millennium Research Group [6], the number of TKA procedures in the US grew 2.9% in 2012 to 734,100 procedures. 80% of these procedures were primary TKA, 8% were unicondylar replacements, 10% were revision TKA, and 2% were patello-femoral replacements.

Over the past 40 years, the number of implants available on the market has grown considerably and usage has evolved as experience has been gained with different implant materials and designs. However, much of the published outcomes associated with different implants are from small single-surgeon or single-center case series performed by design surgeons. The increased demand for TKA as well as the potential biases of previously published reports requires a better understanding of the implants that are currently utilized during TKA procedures and how they behave *in vivo* so steps can be taken to improve outcomes. The purpose of this study was to analyze trends in implant utilization for TKA in the United States between 2001 and 2012 to ultimately inform clinical decision making.

Materials and Methods

Data used in this study were obtained from the Orthopedic Research Network (ORN) database, which is collected from hospitals participating in www.implantdata.com [7]. In 2012, the database included 165 hospitals, representing approximately a 3% sample of mainly community hospitals and some academic centers within the United States. The participating hospitals are located in 20 different states widely distributed among different regions of the nation. Though the data used in this study were provided by a group of self-selected hospitals—and thus may not be nationally representative—informal surveys have indicated that the collected data are depictive of national trends [8].

Data are submitted from participating hospitals on a continuous basis and are made available to registered users every three months. The ORN publishes reports on the data received on knee implant utilization annually. For this study, data were collected from the ORN on a quarterly basis after the data were anonymized and cleaned by excluding cases found to be invalid, TKA constructs were calculated, and products were classified using GIC code, material, sizes, and product lines. Data from a total of 273,285 TKA procedures collected from 2001 to 2012 were analyzed to evaluate trends in procedure type, level of constraint (posterior cruciate ligament-substituting, posterior cruciate ligament-retaining systems), fixed vs. mobile bearing, fixation type (cemented versus cementless), type of polyethylene (highly-crosslinked polyethylene, polyethylene, vitamin E infused polyethylene), and patellar resurfacing. The average selling price of these different implants was also obtained. The data

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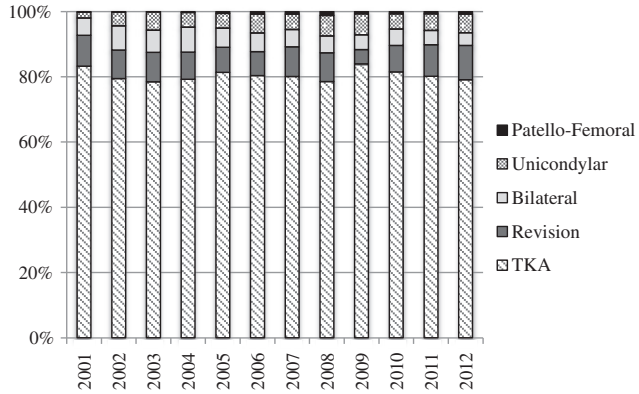

Fig. 1. Trends in types of knee arthroplasty from 2001 to 2012 (TKA: total knee arthroplasty).

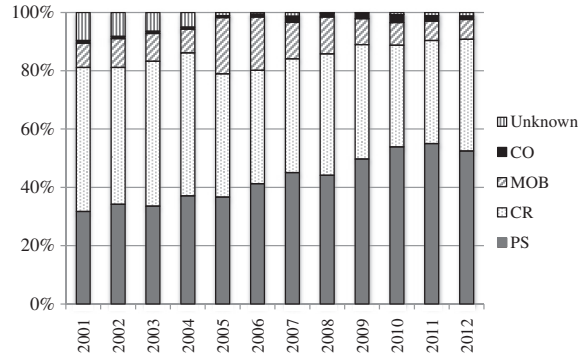

Fig. 3. Trends in types of tibial implants from 2001 to 2012 (CR: cruciate retaining, PS: posterior stabilized, MOB: mobile bearing, CO: constrained).

presented here were obtained from available data in the ORN as of May of 2013.

Results

The vast majority of primary knee arthroplasty procedures in 2012 were unilateral total knee arthroplasties accounting for 88% of procedures, slightly down from 92% in 2001 (Fig. 1). 4% of primary knee arthroplasty procedures were bilateral, 7% were unicondylar (medial or lateral), and 1% were patello-femoral arthroplasties. In 2012, 96% of all TKA procedures used a patellar implant, which is slightly increased from 93% in 2001. Of the different types of constructs used for TKA, 88% of the procedures in 2012 used cemented femoral and tibial components, increased from 81% in 2001. Hybrid constructs—those with a cementless femur and cemented tibia—accounted for 4% of TKA constructs in 2012, which is down from 14% in 2001. The percentage of cementless femoral and tibial component constructs has remained relatively constant for the past decade, accounting for 5% of primary TKA procedures in 2001 and 4% in 2012 (Fig. 2).

Among primary TKA procedures, 38% used a cruciate retaining construct in 2012, down from 50% in 2003 (Fig. 3). 53% used a posterior stabilized or condylar stabilized construct in 2012, up from 31% in 2001. 3% of primary TKA procedures used a constrained construct in 2012, down from 4% in 2011. 91% of primary TKA procedures used a fixed bearing in 2012, up from 81% in 2005, while 7% used a mobile bearing, down from 19% in 2005. 1% of primary TKA procedures used an all-polyethylene tibial implant, down from 2% in 2011.

Highly-crosslinked polyethylene (HXLPE) tibial inserts were used in 52% of TKA procedures in 2012, up from 24% in 2001 (Fig. 4). Use of conventional polyethylene tibial inserts declined from 76% in 2001 to 32% in 2012. Vitamin E infused polyethylene accounted for 4% of tibial inserts in 2012, up from 1% in 2009.

A recent trend has been the use of custom cutting guides for knee replacement procedures. A CT-scan or an MRI of the knee joint is performed, and this is sent to the manufacturer to create cutting guides that are then delivered to the hospital prior to the patient's surgery. The use of these cutting guides has increased from 1.3% in 2009 to 6% in 2012.

The overall average selling price (ASP) for primary TKA implants was $5104 in 2012, a 4% decrease from 2011 (Fig. 5). This was the second consecutive decline in ASP compared to a previous increase of 1.2% between 2009 and 2010. The sharpest increase in ASP occurred between 2000 and 2005 when the average cost of a TKA implant increased from approximately $3000 to $5200, an increase of 73%. Since that time, the price of TKA implants has stabilized and recently has begun to decrease, albeit minimally. The costs reported include the implants themselves as well as bone cement and accessories, bone graft and substitutes, freight and loaner fees, and charges for instruments and cutting guides. These ancillary supplies make up approximately 6% of the total implant costs reported.

There is a significant difference in price for the different types of constructs utilized for TKA. Currently, the most expensive is the hybrid construct, consisting of a cementless femoral and cemented tibial implant, which had an ASP of $6764, a 15% decrease from 2011. Surprisingly, the cementless femoral and tibial construct is less expensive than the hybrid construct, with an ASP of $5908, a 1% decrease from 2011. The unicondylar construct had an ASP of $5017, a 2% decrease from 2011. The least expensive construct is the cemented femoral and tibia combination with an ASP of $5005, a 6% decrease from 2011.

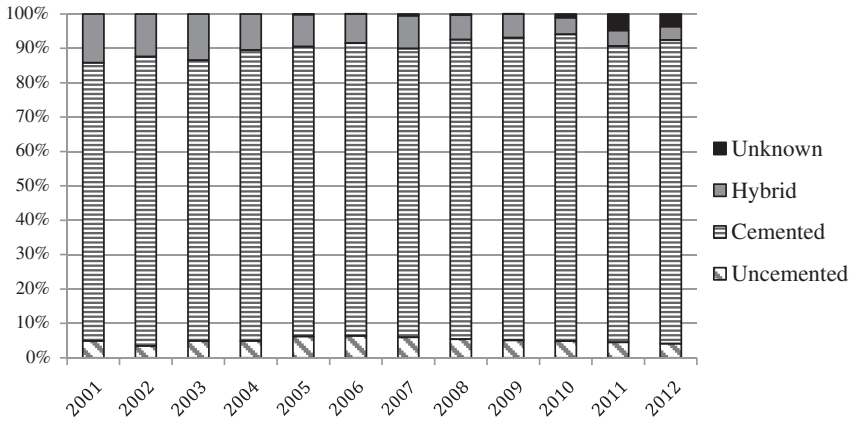

Fig. 2. Trends in fixation from 2001 to 2012.