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Implant Choices for Unicompartmental Knee Arthroplasty

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Introduction

Unicompartmental knee arthroplasty (UKA) design originated in the 1950s [1] and has evolved over several decades to the current options available today, including mobile- versus fixed-bearing (FB) components, metal-backed (MB) modular versus all-polyethylene (AP) tibia designs, and cemented versus cementless fixation techniques. With improvements in implant design, surgical instrumentation, and preoperative patient selection, UKA is gaining popularity with some national joint registries reporting UKA approaching 10% of primary knee replacements [2–5]. This chapter will aid the arthroplasty surgeon in selecting an implant by briefly discussing the history of UKA designs and then summarizing the available literature on different design features available in the market.

Forward-thinking surgeons such as Duncan McKeever posited several early principles of joint arthroplasty and designed the first iteration of UKA implants consisting of a cementless flat metal Vitallium baseplate that relied on a T-shaped keel for fixation [6–8]. Other surgeons of the same era inserted baseplates consisting of acrylic, Teflon, or various metals with a superior smooth, concave surface and a roughened undersurface instead of a keel; these designs relied on soft tissue constraints to maintain the position of the implant [7]. Both of these early hemiarthroplasty designs did not address the ipsilateral femoral side and ultimately failed due to loss of femoral articular cartilage [8].

After understanding the failures of earlier designs, Marmor became the first surgeon to perform a cemented UKA in the United States when he inserted a prosthesis that included a stainless steel femoral component with an AP tibia [8, 9]. The original design called for a tibial inlay cementation technique in which the AP component was cemented within the cortical rim of the tibial plateau [4, 10]. Although this design did not include standard instrumentation or cutting guides for insertion, 15-year survivorship as high as 71% has been reported for the Marmor modular UKA (Smith & Nephew, Memphis, TN) [11]. In the 1980s, an MB design was developed as a method of decreasing anteromedial strain imparted to the tibia by AP designs [10]. The MB design is thought to reduce the risk of medial tibial subsidence and has the added feature of allowing for modularity of the tibial component [10, 12].

In 1978, Goodfellow and O'Connor introduced four seminal design concepts regarding the relationships among articular constraint, range of motion tolerances, bone-implant stresses, and the stability of the surrounding soft tissues for joint

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arthroplasty [13]. The authors identified the balance needed between maximizing contact surface areas in order to reduce polyethylene wear and keeping the level of articular constraint low to reduce the risk of aseptic loosening. Based on these principles, they designed the first meniscal mobile-bearing prosthesis consisting of a flat metal-backed tibial baseplate, a metal spherical femoral component, and a fully congruent polyethylene insert, which allows for translational, rotational, and flexion-extension moments of the knee [5]. This implant, known as The Oxford mobile-bearing prosthesis (Zimmer Biomet, Warsaw, IN), was designed so that the superior surface of the polyethylene fully conformed to the spherical femoral component at all angles of flexion to simulate a mobile, congruous meniscus. The inferior surface of the polyethylene is flat against a flat tibial baseplate, which allows for translational and axial rotational movements. Although the Oxford mobile bearing has since undergone its fourth iteration in 2009, the primary features of its original design remain largely unchanged [5, 14].

In 1987, the designers introduced the Oxford Phase-II with new instrumentation that included a spherical end-mill to prepare the distal femur [5, 13]. The new instrumentation addressed the frequent complication of bearing dislocation resulting from unbalanced flexion and extension gaps [4]. Instead of making three separate femoral cuts, surgeons could now mill the distal femoral condyle in 1-millimeter increments until the extension gap matched the flexion gap [5, 13]. The Oxford Phase-III was released in 1998 with increased femoral component sizing options, tibial components with right and left laterality, and minimally invasive surgery (MIS) instrumentation that allowed for implantation without everting the patella [5, 13].

The most recent generation of the Oxford includes a cementless fixation option with the addition of a layer of porous titanium coated with hydroxyapatite on the inner surfaces of the components [15, 16]. The femoral component has two pegs for additional rotational stability; the central peg is conical in the cemented design and cylindrical in the cementless design to assist with primary fixation [15, 17]. The anterior flange of the femoral component was also extended for better implant-bone surface contact area, which confers additional stability to the anterior peg and allows for better implant-bone contact in deep flexion [15, 17–20]. To assist with more reproducible implantation of the modified femoral component, an intramedullary femoral guide with an anti-impingement guide was developed (Microplasty Instrumentation, Zimmer Biomet, Warsaw, IN) [18]. Early reports have demonstrated excellent clinical results with improved radiographic outcomes at 2 years with the newest version of the Oxford unicompartmental knee arthroplasty [17, 18].

Design Concepts

The available UKA designs can largely be classified into several categories: inlay versus onlay prostheses, mobile-bearing versus FB, MB versus AP tibia components, and cemented versus cementless designs. UKA designs utilizing a resurfacing or inlay technique rely on minimal bone removal and placement of an AP prosthesis directly on subchondral bone. Conversely, an onlay technique requires angular cutting guides and prepares a bed of cancellous bone to match the inner dimensions of the implant similar to techniques used in total-knee arthroplasty [7]. Advantages to inlay designs include conservation of bone and being amenable to minimally invasive surgical techniques because bulky jigs are not required. Onlay designs have the advantage of being more familiar to surgeons who regularly perform total-knee arthroplasty because the distal femoral cut can be made using an intramedullary jig and the tibial resection can be made using an extramedullary guide. Onlay designs do not require a burr and posterior referencing can be used with most systems to produce a consistent flexion gap [21].

Historical implants relying on the resurfacing technique include the St. Georg modular prosthesis (Waldemar Link, Hamburg, Germany), the original Marmor, and the Repicci (Zimmer Biomet, Warsaw, IN) [4, 7]. The St. Georg Sled was first introduced in 1969 and consisted of a cemented, flat AP tibial component with a biconcave metal femoral component. The curved-on-flat design of the curved femoral component articulating with a flat polyethylene concentrated stress over a small surface area. The original intent of the curved-on-flat St. Georg Sledge design was to minimize constraint and allow for increased freedom of femoral motion on the tibial component. In theory, this would allow the soft tissue tension to guide the motion of the tibiofemoral articulation and reduce stresses imparted on the implant-bone interface [8]. Despite the contact stresses imparted over a small surface area, the implant demonstrated good long-term results, with Anasari et al. reporting 87% survivorship at 10 years with 92% of patients reporting good-to-excellent results [22].

The Repicci prosthesis is a modification of the Marmor implant designed to improve femoral component fixation by the addition of a post and keel construct [8, 23]. The Repicci utilizes an AP tibial component with a unique cobalt chrome femoral design that consists of a larger central post with a sagittally oriented fin. In the coronal plane, the radius of curvature was also modified to reduce edge wear of the AP tibial component. On the tibial side, the polyethylene thickness was increased and the undersurface was striated to improve cement fixation [23]. This prosthesis is more conforming than the St. Georg Sledge in order to increase the femur-tibia surface area and reduce contact pressures. While both designs require minimal bony resections, the Repicci design is also unique in that the distal femur is milled with a motorized burr instead of performing bony cuts [8].

Historical implants that utilize an onlay technique include the porous coated anatomic knee (PCA; Stryker, Mahwah, NJ) and the Miller-Galante (Zimmer, Warsaw, IN) [4]. The PCA UKA was introduced in the 1980s with a single-peg femoral component designed to replicate the natural femoral contours and a relatively convex tibial component design, which created a small surface contact area between the two articulating components [8, 24]. The MB tibial design also called for a thinner polyethylene insert. Combined with a heat treatment that made the early generation polyethylene more fragile, the PCA UKA was prone to pitting and delamination with failure rates as high as 20% at 26 months reported [4, 7, 8, 24, 25].

The Miller-Galante UKA consists of a cobalt chrome femoral component with either a modular titanium MB tibial component or an AP tibial design [4, 8]. This implant represents the features of modern-day FB designs consisting of a flat-on-concave articulation with minimal constraint and a thicker polyethylene insert [4]. Compared to the PCA, the Miller-Galante has a flatter tibial component and has demonstrated better survival with the decreased amount of articular constraint. Argenson et al. reported their 20-year follow-up on 62 patients (70 knees) who received Miller-Galante unicompartmental prostheses between 1989 and 1997. Fourteen (20%) of patients required revision of either the femoral or tibial component and five patients required isolated polyethylene exchange resulting in a Kaplan-Meier survival rate of 74% ± 7% at 20 years [26]. Berger et al. reported a survival rate of 98% ± 2% at 10 years and 95.7% ± 4.3% at 13 years for the Miller-Galante UKA using Kaplan-Meier analysis [27].

Cemented Versus Cementless

Different fixation options available for UKA include cemented designs, cementless fixation, and hybrid fixation involving cementless fixation of the femoral component with a cemented tibial component [28]. National registry data indicate that cemented fixation is currently the most popular technique [1, 28]. Aseptic loosening at the implant-cement or cement-bone interface remains the most common mode of failure for cemented prostheses [28, 29], and the cumulative revision rate of UKA is approximately threefold that of TKA [2, 3, 5, 13, 15, 30, 31]. The increased revision rate of UKA compared with TKA is likely multifactorial. UKA patients are more frequently a younger and more demanding patient population; there is a potentially lower threshold for revision given the ease of revising a UKA to a TKA, and the more technically demanding nature of UKA is less forgiving among inexperienced surgeons [2, 13, 21, 32]. Given the increased comparative revision rate in national joint registries, there has been a growing interest in cementless fixation for UKA [1].

Published studies on cemented UKA have demonstrated excellent clinical outcomes and implant survivorship utilizing modern cemented designs, strict preoperative patient selection, and improved instrumentation [27]. Implant survivorship as high as 98% at 10 years has been reported using the Oxford medial UKA [33]. A recent systematic review identified aseptic loosening as the most common cause for early failure, and progression of OA to other compartments was the most common cause of failure in mid- and late-term follow-up in UKA [29]. Cemented fixation also has additional disadvantages of potential third-body wear from cement debris, increased prevalence of radiolucent lines on radiographs, and extended surgical times compared with cementless techniques [15, 16, 34, 35].

Historically, cementless fixation has demonstrated poor implant survivorship, but there has been increased interest recently due to design improvement and the potential for biologic fixation. Early to mid-term failure rates as high as 12–20% [2, 36, 37] for cementless UKA fixation have been reported in the literature. Recent design developments, including utilizing porous titanium surfaces that allow for osseous ingrowth and coating the prosthesis with biological active materials such as hydroxyapatite, have demonstrated improved clinical and radiographic outcomes [2, 28, 35]. A 2017 systematic review found a 94% 10-year survivorship for cementless UKA designs consisting of porous titanium coated with hydroxyapatite [28].

van der List et al. published a systematic review on 2218 cementless UKA procedures and found a revision rate of 2.9% at an average of 4.1 years [28]. Using a calculated annual revision rate (ARR) of 0.71%, the authors extrapolated 5-, 10-, and 20-year survivorships of 96.4%, 92.9%, and 89.3%, respectively, for cementless UKA fixation. The authors reported the most common modes of failure were progression of OA (32%) and bearing dislocation (25%). Unlike cemented UKAs where aseptic loosening is the most common reason for failure, aseptic loosening was only implicated in 13% of revision procedures following cementless UKA.

Several authors have suggested that cementless fixation may be more beneficial in UKA compared to TKA because restoring the normal ligamentous tension of the knee with minimal articular constraint in UKA applies compressive forces across the components with minimal shear forces [2, 15, 28]. Compressive loads transmitted across the bone-implant interfaces of the femoral and tibial components are ideal for achieving osseous ingrowth with cementless fixation [15]. Liddle et al. further suggest that soft tissue releases performed during routine total-knee arthroplasty require increased tibiofemoral constraint in the form of a cam-and-post mechanism or dished polyethylene, which increases the shear forces imparted to the implant-bone interface and predisposes the prosthesis to aseptic loosening [2].

Uncemented implants may also be associated with fewer unnecessary revisions because inexperienced surgeons often attribute “physiologic” radiolucencies seen along bone-cement interfaces as aseptic loosening [2, 15, 21]. Liddle et al. explain that physiologic radiolucencies are often misinterpreted on radiographs. The authors define these radiolucencies as narrow, nonprogressive, and representing an incomplete fibrocartilage layer that does not negatively impact implant survival [2]. The radiolucencies are often surrounded by a sclerotic margin and are less than 1 mm in width [35]. In the Oxford medial UKA, the vertical wall of the tibial component is not coated with porous titanium and therefore often has adjacent radiolucencies when evaluated on radiographs postoperatively. These can be safely ignored [2].

There are very few studies in the literature that directly compare cemented versus cementless fixation for the same implant design. Pandit et al. performed a prospective, randomized controlled trial comparing the cemented versus cementless Oxford Phase III UKA design [38]. At 5-year follow-up, 20/31 patients in the cemented subgroup demonstrated a physiologic radiolucency around the tibial component compared with 2/27 in the cementless subgroup ($p < 0.001$); none of the radiolucencies in either group were determined to be progressive. The study found no significant difference between the Oxford Knee Scores of either group but did find a statistically significant difference between the Knee Society functional scores at 5 years (92.0 ± 12.7 in the cementless subgroup versus 78.8 ± 18.4 in the cemented subgroup; $p = 0.003$). The authors concluded that cementless fixation was associated with significantly fewer periprosthetic radiolucencies postoperatively while achieving equivalent or possibly superior functional outcomes at 5 years.

Akan et al. reported on a retrospective review of 263 medial Oxford UKA (141 cemented, 122 uncemented) implanted in 235 patients between 2008 and 2011 [35]. Mean follow-up was 30 months in the uncemented group and 42 months in the cemented cohort. There were no differences in the mean postoperative Oxford knee or Knee society scores between the cemented and cementless groups. Revision rates were 7.09% in the cemented group versus 4.91% in the cementless group ($p = 0.155$). The authors found no significant differences between the two groups in terms of clinical outcomes or survivorship [35]. However, there was significantly longer surgical time for cemented UKA (45.3 minutes with cemented vs. 36.1 minutes cementless, $p < 0.001$). The authors suggest that the shorter operative time with cementless fixation may be associated with decreased infection rates and tourniquet pain, and improved operating room efficiency [35].

Schlueter-Brust et al. published a prospective study of clinical outcomes and 10-year survivorship for cemented and cementless medial Uniglide prostheses (Corin Ltd., Cirencester, United Kingdom) [39]. The authors implanted 240 Uniglide prostheses in 234 patients (152 cemented, 78 cementless, 10 hybrid fixation) between 1990 and 1999. No patients were lost to follow-up with a mean clinical follow-up of 10.7 years. The authors reported a 10-year survival rate of 95.4% for cemented, 97.4% for uncemented, and 90% for hybrid fixation [39].

In summary, both cemented and modern cementless UKA designs offer excellent functional outcomes and implant survivorship: 10-year survivorships are expected to be greater than 90% for both designs [34, 39], with the most common mode of failure being aseptic loosening in cemented UKA and progression of osteoarthritis in cementless UKA [28, 30, 34]. Based on the most recent literature, cementless designs may offer a very slight edge over cemented prostheses in terms of shorter operative times [16, 35] and long-term implant survivorship [28, 34, 39].

All Polyethylene Versus Metal-Backed Tibia

Designs of UKA systems include variations in the baseplate, the most common being an AP tibia and an MB tibial component. MB tibia were introduced to reduce the incidence of wear and tibial subsidence and allow for increased intraoperative options secondary to modularity. Benefits of the AP tibia include cheaper cost, less bony resection, decreased backside tibial wear, but with potentially diminished cement fixation. MB designs potentially have improved load transfer and cement fixation, but at a cost of more bone resection [40].

A finite element analysis model evaluating contact stresses in AP and MB tibia UKA designs found low conformity MB tibia have higher anterior and medial polyethylene contact stresses [41], with more edge loading in AP tibia, resulting in overload and subsequent medial tibial collapse [42]. Although MB tibia have a potential for improved load transfer, this comes at a cost of increased bone resection and a thinner polyethylene, with a potential for more polyethylene wear problems [43].

The 10-year survivorship of AP designs has been reported at 88–96.1% [44, 45], but results have been controversial [46–48]. In early designs, Marmor reported a 30% failure rate at 10–13-year follow-up due to high rates of aseptic loosening [48], and Mariani et al. found a 38% failure rate at 12-month follow-up secondary to loosening of the femoral component [47]. Tibial subsidence with wear has been reported in 10.4% of 140 Marmor cemented UKA knees, at 15-year follow-up [49]. In this same cohort, 10.2% of knees were revised for tibial loosening, the most common reason for revision in the series [49]. Manzotti et al. and Saenz et al. also reported that aseptic tibial loosening was the most common reason for revision [45, 50], and Manzotti *et al* found changes in mechanical axis associated with radiolucency at long-term follow-up, particularly in female patients [45]. The literature seems to show a higher early loosening failure rate with AP tibia as compared with MB tibia.

The 10-year survivorship in MB designs has been reported to be 90–98%, in the Miller-Gallante prosthesis [26, 27, 51–53], and 97% in 143 knees with the Oxford meniscal prosthesis [33]. Argenson et al. in a follow-up evaluation of Miller-Gallante prostheses reported 83% and 74% survivorship at 15 and 20 years, respectively [54], while Berger et al reported a 95.7% 15-year survivorship in 59 consecutive UKA patients [55]. Argenson et al reported late polyethylene wear that was treated with isolated polyethylene exchange in five patients at an average 12 years postoperatively [54]. MB UKA appears to have more consistent survivorship as compared with AP tibia.

Theoretically, metal-backed base plate designs would potentially require increased frequency of tibial augments during revision surgery given the increased amount of bone resection required. This is because an MB design requires either the use of a thinner PE or increased bone resection. This thought is not necessarily supported in the literature. Aleto et al. retrospectively reviewed 32 consecutive revisions from UKA to total-knee arthroplasty (TKA) [46]. The most common failure mode was medial tibial collapse (47%), and of these, 87% had an AP design. Approximately half of these failures (7 of 15) failed in 16 months or less and were associated with a more complex reconstruction [46]. On the contrary, Scott et al found the use of standard cruciate retaining TKA without augments or stems was less likely following MB designs (32%) as compared with AP (71%) [56]. MB designs were more likely to require a stem or cruciate substituting design, while the use of medial augments was no different in the two groups [56]. The authors found AP designs were associated with earlier revision secondary to unexplained pain, while MB tibia were most commonly associated with progression of arthritis as a reason for revision. AP designs required earlier revision (4.8 vs. 8.2 years) perhaps secondary to different failure modes [56]. Irrespective of indications, it is important to better understand the potential of implant design factors influencing the complexity of a subsequent revision.

There has been a wide range of reported survival rates at 10-year follow-up [27, 43]. There is, however, no consensus on superiority of outcomes between MB and AP designs, as some studies have reported high short-term failures with an AP design [46, 47, 57], while others have found no differences in failure rates or clinical outcomes [58]. An MB tibia allows for easier cement removal and may potentially decrease aseptic tibia loosening [59]. However, in 45 patients randomized to AP or MB tibia, there was no difference in tibia migration, revision rates, or clinical outcomes at 2 years with the Miller-Gallante prosthesis [58]. Hutt et al with the Accuris UKA (Smith and Nephew, London, United Kingdom) in 63 knees with mean 6.4 year follow-up, reported a 41% revision rate at mean 5.8 years in the AP group, giving a 7-year survivorship of only 56.5%, as compared with a 93.8% survivorship in the MB group [60]. Koh et al. compared 51 AP to 50 MB tibia and found no difference in clinical and radiographic outcomes [61]. However, there were 6 early failures in the AP group and none in the MB group within 2 years. Many of the benefits between the designs remain theoretical (modularity, wear at interface). MB tibia by nature of their modularity allows better intraoperative options, an option for a bearing only revision if needed, and potentially better distribution of forces on the tibia [12], but are more expensive and create another potential mode of wear [62]. Additionally, bearing only revisions are not common. AP designs are cheaper and may require less bony resection with a potential for increased bone stock in revision surgery [63]; however, clinical outcomes are more variable, and these designs may be associated with more complex reconstruction during revision.

Mobile Versus Fixed Bearing

Survivorship as high as 98% at 10 years has been reported with both mobile- and fixed-bearing designs [27, 33], and can provide benefits when compared with TKA [64, 65]. Survival rates over 90% when extended out over 15 years have also been reported [38, 49, 55], increasing popularity of these implants more recently. Mobile bearings were introduced to provide a theoretically improved benefit secondary to reduce wear to increase longevity, but this has not borne out clinically [51, 66–69]. Mobile bearings continue to be commonly used.

Longevity of FB designs, including both AP and MB designs, has a 10-year survivorship of 88–98% [27, 44, 45, 51, 52, 70, 71]. Mobile-bearing designs have a more variable survivorship of 74.7–98% at 10 years [33, 38, 51, 71–75], with 15-year survivorship of 70–93% [38, 75, 76]. Mobile-bearing designs are technically demanding and can be associated with a learning curve. They require careful attention to appropriate tissue balancing to avoid bearing spinout, which is a complication unique to this design [40]. Some concerns with this design are related to the frequency of complete tibial radiolucent lines that have been reported, particularly in the Oxford knee design [76]. While there is not a clearly defined criteria for when this constitutes failure secondary to aseptic loosening, if similar results were seen in TKA implants, these would be categorized as loose.

When looking at factors for revision, time to revision for FB implants has been found to trend longer (41.5 months) as compared with mobile bearings (24.1 months), although this was not statistically different [77]. Peersman et al., based on a systematic review of mobile versus fixed bearings, suggested that the shorter time to failure in the mobile-bearing group is related to the technical factors and susceptibility for surgical error in these designs [78]. Emerson et al. reported a 99% survival for mobile bearing and 93% survival for FB at 11 years, and found FB bearing failed more often secondary to tibial component failure and mobile bearings trended to fail more commonly with arthritis progression [79]. Bloom et al. also reported that mobile-bearing designs much more frequently required tibial augments (46.7%) than did FB implants (11.1%) [77]. While Neufeld et al. found similar timing and etiology for revisions between these two groups, the 1/3 of revisions that required stems or tibial augments were all of mobile-bearing design [71].

Many studies evaluating the clinical difference between these designs have been performed and do not demonstrate a clear reason to recommend one of these designs over the other [51, 66–68, 79, 80]. A recent systematic review with meta-analysis showed no difference in designs as measured by survivorship or functional outcomes [78]. The only significant difference between the designs was seen in short-term follow-up of young patients; in this patient cohort, a high revision rate secondary to loosening was seen with the mobile bearing [78]. Neufeld et al. retrospectively reviewed 38 Phase 3 Oxford mobile-bearing UKA and 68 fixed-bearing UKA, either Miller-Gallante or Zimmer Unicompartmental High Flex Knee System (Zimmer, Warsaw, IN) [71]. The authors reported a 10-year survivorship of 82.9% and 90.9% for mobile and FB, respectively, with similar patient outcomes. Gleeson et al. compared complications and short-term follow-up between 47 Oxford mobile-bearing UKR and 57 St. George Sled, a fixed-bearing UKR [80]. The authors reported higher revision rates in the Oxford and better pain relief in the St George Sled, with similar functional outcome scores. Fixed-bearing designs are either MB or AP, with variability of results attributable to the AP designs [44, 45]. Mobile bearings are all of MB designs, and while outcomes have been no different as compared with FB designs, similar to the AP designs, these mobile-bearing designs have shown more variability in survivorship. The tenants for successful longevity of these implants remain the same, regardless of the design chosen, including appropriate preoperative patient selection, meticulous surgical technique, and surgical experience that is associated with a learning curve [40].

Burton et al., in an in vitro study comparing wear rates of mobile and FB designs, found reduced wear with FB UKA [81]. In both designs, the lateral side had an increased amount of wear, suggesting that increased motion on the lateral side seems to play a larger role in wear generation than increased weight bearing, as is seen medially [81]. Kwon et al., in a finite element analysis model, found lower contact pressure and stress in the opposite compartment in mobile bearings as compared with FB, and they concluded this imparts a theoretically increased risk of OA progression in FB knees [82].

Overall, comparative studies evaluating fixed- and mobile-bearing designs have found no differences in terms of survivorship or clinical and functional outcomes [51, 66–68, 79, 80]. Some suggest that mobile designs are associated with better kinematics [68], but they also have a unique failure mode – bearing dislocations [80]. Mobile-bearing designs can be more technically challenging, with a more pronounced learning curve, which can lead to the variability in the results seen in the literature, particularly in studies including heterogenous high and low volume centers. With experienced or high-volume surgeons, the outcomes of either the mobile- or fixed-bearing designs may be great. Given more variability with the mobile-bearing designs, as these are more technically challenging, Bonutti et al. recommended that for lower volume surgeons, an FB design could potentially provide more predicable high rates of survival [40].

Conclusion

Current UKA designs include mobile versus FB, MB modular versus AP tibia, and cemented versus cementless fixation. Cementless designs may be associated with shorter operative times and slightly improved long-term implant survivorship. MB tibia allow for more intraoperative options, an option for a bearing only revision, and potentially better distribution of forces on the tibia, but are more expensive and create another potential mode of wear. AP designs are cheaper and may require less bony resection, but clinical outcomes are more variable, and these designs may be associated with more complex reconstruction during revision. With experienced or high-volume surgeons, the outcomes of either the mobile or FB designs can be high. Mobile-bearing designs have more variability in survivorship, as these are more technically challenging. For lower volume surgeons, an FB design could potentially provide more predicable high rates of survival.

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