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Systematic review comparing total hip and knee arthroplasty: Biomechanical principles, implant materials, surgical techniques, and functional outcomes

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Abstract
Background: Total hip arthroplasty (THA) and total knee arthroplasty (TKA) are widely performed procedures for managing advanced joint degeneration. Despite shared objectives of pain relief and function restoration, the two surgeries differ substantially in anatomical, biomechanical, and technical demands.
Objective: To perform a comparative review of THA and TKA with a focus on biomechanical characteristics, materials used, surgical techniques, and functional outcomes, based on a comprehensive analysis of current scientific literature.
Methods: This narrative review included 59 peer-reviewed studies identified through electronic databases and manual screening. Articles addressing biomechanical behavior, implant materials, surgical approaches, and clinical outcomes of THA and TKA were critically evaluated and compared.
Results: THA showed superior biomechanical restoration due to its simpler ball-and-socket configuration, resulting in faster gait normalization and higher patient satisfaction. Materials for THA favored ceramic and titanium for enhanced biocompatibility and wear resistance, while TKA relied on cobalt-chromium alloys and high-performance polyethylene to handle complex loading dynamics. Surgically, THA offered greater flexibility in approaches and earlier functional gains, whereas TKA required meticulous alignment and soft tissue balancing. Robotic-assisted technologies improved precision in both procedures, with a stronger impact observed in TKA.
Conclusion: While both THA and TKA achieve substantial clinical benefits, THA generally provides more predictable biomechanical and functional outcomes. The complexity of TKA underscores the need for technical precision and individualized rehabilitation strategies. Future innovations in biomaterials and surgical navigation may further narrow the gap in outcomes between these two cornerstone procedures in orthopedic surgery.

Keywords: Arthroplasty, replacement, hip, knee, biomechanics, joint diseases, joint instability

1. Introduction
Total joint arthroplasty (TJA) has emerged as one of the most effective interventions for relieving pain and restoring function in patients with advanced osteoarthritis and other degenerative joint disorders. The most performed procedures are total hip arthroplasty (THA) and total knee arthroplasty (TKA), which together account for millions of surgeries annually worldwide, with growing demand projected in aging and increasingly active populations [1, 2]. These procedures, though both categorized under reconstructive joint surgery, differ markedly in anatomical complexity, biomechanical behavior, surgical approach, and postoperative outcomes.

THA is primarily indicated in cases of end-stage osteoarthritis, avascular necrosis, or hip dysplasia, and typically involves the replacement of both the femoral head and the acetabulum. Due to the relatively simple ball-and-socket architecture of the hip joint, THA often provides rapid functional recovery and high satisfaction rates [3, 4]. Conversely, TKA is more technically challenging because of the knee's complex hinge joint mechanics, involvement of multiple articulating surfaces, and dependence on intact ligamentous structures for stability and motion control [5, 6]. As a result, TKA is more likely to be associated with residual pain, delayed rehabilitation, and variable patient satisfaction.

Advances in biomaterials, surgical techniques, and implant design have substantially improved the longevity and biomechanical performance of both THA and TKA prostheses. Materials such as cobalt-chromium alloys, titanium, ceramics, and highly cross-linked polyethylene have been optimized for their wear resistance, biocompatibility, and structural integrity [7-10]. Similarly, the adoption of minimally invasive techniques and the integration of robotic or computer-assisted systems have enhanced surgical precision, particularly in component alignment and soft tissue management.

Despite these advances, comparative evaluations between THA and TKA are necessary to clarify the factors that influence clinical success, complication rates, and long-term outcomes. THA and TKA each present unique challenges and opportunities in terms of patient selection, implant survivorship, and functional recovery. Therefore, understanding their differences is critical for guiding evidence-based clinical decision-making, surgical planning, and patient education.

This review aims to provide a comprehensive and comparative analysis of total hip and knee arthroplasties by examining four critical domains: (1) biomechanical characteristics, (2) material composition and properties, (3) surgical techniques, and (4) functional outcomes. Emphasis is placed on highlighting the distinctions between THA and TKA to better inform clinical practice and support improved patient-specific treatment planning.

2. Methodology

This study was conducted as a systematic review following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The objective was to compare total hip arthroplasty (THA) and total knee arthroplasty (TKA) with respect to four core domains: biomechanical characteristics, prosthetic materials, surgical techniques, and functional outcomes. The review protocol was predefined to ensure reproducibility and minimize selection bias.

2.1. Eligibility Criteria

Studies were included in this review based on specific eligibility criteria. Only peer-reviewed original research articles were considered, encompassing clinical trials, cohort studies, case-control studies, biomechanical simulations, and finite element analyses. In addition, systematic reviews and meta-analyses focusing on total hip arthroplasty (THA) or total knee arthroplasty (TKA) were included, provided they addressed at least one of the four main comparative domains: biomechanical aspects, materials used, surgical technique, or functional outcomes. Eligible studies were required to involve adult patients aged 18 years or older and to have been published between January 2000 and June 2025. Furthermore, only articles with full-text availability in English were selected to ensure consistent assessment and reproducibility of the data.

Conversely, several exclusion criteria were applied to ensure the methodological rigor and relevance of the review. Case reports, narrative reviews, opinion pieces, and editorials were excluded due to their limited generalizability and lack of robust data. Studies exclusively focused on unicompartmental knee arthroplasty or hip resurfacing were also omitted, as these procedures differ significantly from total joint replacements in scope and surgical indications. In addition, pediatric and veterinary studies were excluded to maintain a focus on human adult populations. Finally, any articles that lacked sufficient methodological detail or failed to report relevant outcome data were excluded from the analysis.

2.2. Information Sources and Search Strategy

A comprehensive literature search was conducted across four major electronic databases: PubMed (MEDLINE), Web of Science, Scopus, and ScienceDirect. The search took place in June 2025 and was designed to capture a wide spectrum of relevant studies pertaining to total hip arthroplasty (THA) and total knee arthroplasty (TKA). To ensure sensitivity and specificity, the strategy incorporated both Medical Subject Headings (MeSH) and free-text terms, with adjustments made to accommodate the unique syntax of each database. Boolean operators were employed to structure the queries effectively and optimize retrieval of pertinent studies.

For example, the search strategy used in PubMed included the following terms: ("Total Hip Arthroplasty"[MeSH] OR "THA") AND ("Total Knee Arthroplasty"[MeSH] OR "TKA") AND ("Biomechanics" OR "Implant Materials" OR "Surgical Technique" OR "Functional Outcome"). This approach enabled the inclusion of articles examining any of the four principal domains of interest across both procedures. In addition to database searches, the reference lists of all selected studies were manually reviewed to identify additional eligible publications that may not have appeared in the initial search results.

2.3. Study Selection and Data Management

Two reviewers independently screened the titles and abstracts retrieved from the search to determine potential eligibility. Full-text articles were then assessed according to the inclusion and exclusion criteria. Any disagreements were resolved through discussion or consultation with a third reviewer. The selection process was documented using a PRISMA 2020 flow diagram.

2.4. Data Extraction and Synthesis

A structured data extraction form was developed to ensure consistency and rigor in the collection of relevant study information. The form captured essential variables, including the names of the authors, year of publication, and the country where the study was conducted. Additionally, the study design and sample size were recorded to assess methodological quality and generalizability. The type of arthroplasty-total hip arthroplasty (THA), total knee arthroplasty (TKA), or both-was specified for each study, along with detailed descriptions of the prosthetic materials used, including their composition and mechanical characteristics.

Further data were extracted concerning biomechanical parameters such as joint forces, alignment, and motion patterns, which are critical for comparing the mechanical performance of the two procedures. Surgical techniques and technologies employed, including navigation systems and robotic assistance, were also noted. Functional outcomes were comprehensively documented, including patient-reported outcome measures (PROMs), gait analysis findings, and return-to-activity timelines.

Once extracted, the data was systematically categorized into four predefined analytical domains: biomechanical aspects, implant materials, surgical technique, and functional outcomes. Due to significant heterogeneity in study methodologies, outcome measures, and patient populations, quantitative synthesis through meta-analysis was not feasible. Instead, a qualitative synthesis was performed, emphasizing comparative insights and identifying key distinctions between THA and TKA across the selected domains.

2.5. Risk of Bias and Quality Assessment

The methodological quality and risk of bias of the included studies were independently assessed by two reviewers to ensure the reliability and validity of the findings. The choice of assessment tool was tailored to the specific study design. For randomized controlled trials (RCTs), the Cochrane Risk of Bias 2.0 tool was utilized, allowing for a structured evaluation of key domains such as randomization, allocation concealment, and outcome reporting. Observational studies, including cohort and case-control designs, were appraised using the Newcastle-Ottawa Scale (NOS), which considers aspects such as selection of participants, comparability of study groups, and ascertainment of outcomes.

For systematic reviews included in the analysis, the AMSTAR 2 (A MeaSurement Tool to Assess Systematic Reviews) checklist was employed, enabling a detailed appraisal of review quality, protocol registration, comprehensive literature search, and risk of bias within included studies. In the case of biomechanical simulation and finite element analysis studies, a qualitative assessment was conducted focusing on model validation, appropriateness of boundary conditions, and transparency of assumptions made during simulation.

Importantly, studies identified as having a high risk of bias or rated as low quality were not excluded from the review. Instead, their findings were interpreted with caution during the synthesis and discussion phases, ensuring that potential limitations in evidence strength were explicitly acknowledged while preserving the comprehensiveness of the comparative analysis between total hip and knee arthroplasty.

2.6. Reference Management and Documentation

All references were managed using Zotero citation software. A total of 59 studies were included in the final review after screening 96 full-text articles. The full list of included studies is presented below in Vancouver style.

3. Results and Discussion

3.1. Biomechanical Aspects

The biomechanical principles governing total hip arthroplasty (THA) and total knee arthroplasty (TKA) are inherently distinct, reflecting the structural and functional disparities between the hip and knee joints. The hip, a ball-and-socket joint, primarily facilitates multiplanar load transfer and rotary motion under axial compression. Conversely, the knee exhibits complex rolling, gliding, and rotational dynamics, demanding precise control of alignment, load sharing, and ligamentous stability. These differences not only dictate the surgical approach and implant design but also have profound implications on postoperative joint kinematics and patient functionality [1, 2].

In THA, biomechanical restoration focuses on re-establishing the anatomical femoral offset, maintaining appropriate acetabular inclination and anteversion, and equalizing leg lengths. These factors are paramount to ensure joint stability, reduce impingement risk, and optimize the function of surrounding musculature, particularly the hip abductors. Failure to restore these parameters can result in altered gait mechanics, persistent muscle weakness, or postoperative dislocation [3, 4]. The role of spinopelvic mobility has gained prominence in recent years, with evidence suggesting that stiff or fused lumbar spines modify the functional orientation of the pelvis, increasing the risk of edge-loading and instability in THA recipients [5].

The biomechanical objectives in TKA are more intricate due to the knee's dependency on both osseous congruity and soft tissue integrity. Restoration of the mechanical axis in the coronal and sagittal planes is critical to ensure uniform load distribution across the tibiofemoral and patellofemoral compartments. Additionally, successful outcomes are contingent upon achieving proper rotational alignment and meticulous balancing of the collateral ligaments throughout the range of motion. Malrotation or imbalance has been strongly associated with complications such as instability, anterior knee pain, and early polyethylene wear [6, 7].

While both procedures aim to replicate near-physiological joint function, THA consistently achieves this goal from a biomechanical standpoint. Studies utilizing gait analysis and dynamic imaging have shown that THA patients tend to recover more symmetrical and efficient walking patterns. Parameters such as stride length, hip extension, and ground reaction forces normalize at a faster rate compared to TKA, which often results in asymmetrical loading and compensatory mechanisms in adjacent joints [8, 9]. These gait abnormalities in TKA are partly attributable to residual proprioceptive deficits following disruption of the native knee ligaments and capsule during arthroplasty [10].

Furthermore, the functional outcome following TKA is heavily influenced by preoperative deformity, chronicity of joint degeneration, and neuromuscular adaptation. Patients with longstanding varus or valgus deformities often require extensive ligament releases, which may compromise postoperative stability. Conversely, patients undergoing THA typically experience rapid gains in joint mobility and strength, as the surrounding periarticular structures-particularly in minimally invasive approaches-are preserved to a greater extent [11, 12].

Recent biomechanical modeling and finite element analyses have contributed to understanding how implant design and alignment affect force transmission and stress distribution in both THA and TKA. For instance, elevated stresses at the bone-implant interface in malaligned TKAs have been correlated with early aseptic loosening, a primary mode of failure in these prostheses. In contrast, THA systems with optimized offset and head diameter have demonstrated favorable loading conditions across a wider range of motion, reducing the likelihood of impingement or edge-loading [13, 14].

Lastly, rehabilitation strategies must be adapted to reflect these biomechanical differences. THA patients benefit from early mobilization protocols aimed at gait normalization and muscle activation, particularly of the gluteal complex. In contrast, TKA rehabilitation requires a more structured progression that incorporates neuromuscular re-education, proprioceptive training, and gradual range of motion gains to accommodate the altered biomechanics of the reconstructed knee joint [15].

The biomechanical intricacies of THA and TKA necessitate tailored surgical and rehabilitative approaches. While THA generally offers a more straightforward path to biomechanical restoration, TKA presents unique challenges due to the complex interplay of joint alignment, soft tissue balance, and dynamic stability. A nuanced understanding of these principles is essential for optimizing implant performance and patient-centered outcomes.

3.2. Types of Materials Used in Total Hip and Knee Arthroplasty

Material selection is a critical determinant of clinical outcomes, long-term prosthesis survival, and complication rates in total hip arthroplasty (THA) and total knee arthroplasty (TKA). While both procedures aim to restore joint function and alleviate pain, the differing anatomical, biomechanical, and tribological demands of the hip and knee require distinct material choices and surface engineering strategies.

In THA, the femoral stem is commonly manufactured from titanium-based alloys, particularly Ti-6Al-4V, due to its favorable combination of low density, corrosion resistance, and a Young's modulus closer to that of cortical bone. These properties reduce the risk of stress shielding and promote periprosthetic bone preservation, especially important in cementless fixation strategies where biological osseointegration is desirable [16]. In contrast, cobalt-chromium (Co-Cr) alloys, although mechanically stronger and more resistant to wear, exhibit significantly higher stiffness, increasing the potential for load transfer mismatch and bone remodeling [17].

Ceramics are extensively used in THA, particularly for bearing surfaces. Alumina and zirconia-toughened alumina components are highly wear-resistant and chemically inert, offering superior tribological performance. The ceramic-on-ceramic articulation demonstrates ultra-low wear rates and minimal generation of biologically active debris, reducing the incidence of osteolysis [18]. Nevertheless, ceramics are brittle and prone to fracture under extreme stress or malalignment, particularly in older implant designs. Innovations in microstructure and manufacturing have significantly reduced fracture risk, but surgeons must still consider this vulnerability during patient selection [19].

For acetabular liners in THA, ultra-high molecular weight polyethylene (UHMWPE) remains a principal material. The development of highly cross-linked polyethylene (HXLPE) has markedly improved wear performance and oxidation resistance. The addition of antioxidants such as vitamin E has further extended the lifespan of HXLPE by mitigating free-radical-mediated degradation [20]. Compared to conventional polyethylene, HXLPE reduces volumetric wear and the generation of wear particles, thereby decreasing the risk of periprosthetic osteolysis and aseptic loosening [21].

In contrast to THA, TKA requires materials capable of withstanding multidirectional shear forces, rolling-gliding mechanics, and intermittent high loads during flexion-extension cycles. The femoral component in TKA is typically constructed from Co-Cr alloys, owing to their hardness and fatigue resistance. These properties are crucial for maintaining surface integrity in the face of repeated articulation against a polyethylene tibial insert [22]. While titanium alloys have been explored for femoral components, their inferior wear resistance limits their use in high-contact stress areas of the knee.

The tibial baseplate may be fabricated from either Co-Cr or titanium. Titanium is favored in cementless fixation due to its superior biocompatibility and osseointegration profile. Furthermore, porous titanium structures, particularly those produced by additive manufacturing, have demonstrated excellent osteoconductivity and are increasingly used in younger patients to facilitate long-term biological fixation [23].

The polyethylene insert in TKA remains one of the most scrutinized components due to its direct exposure to repetitive compressive and shear stresses. As in THA, the transition from conventional UHMWPE to HXLPE has significantly reduced wear rates in TKA. However, the biomechanical environment of the knee marked by greater conformational changes and ligament dependency still presents a higher risk of polyethylene delamination, creep, and fatigue fracture when compared to the hip [24].

One key difference in material selection between THA and TKA lies in the requirement for self-centering articulations in hips versus constrained, guided kinematics in knees. The hip relies heavily on congruent, spherical motion with minimal constraint, allowing the use of harder, low-friction bearings such as ceramics. The knee, in contrast, depends on the balancing of ligaments and precise articulation of femoral and tibial geometries. This requires material combinations that tolerate variable contact stresses while maintaining stability-often achieved with polished Co-Cr femoral components articulating against moderately cross-linked polyethylene [25].

Additionally, surface treatments and coatings play a central role in enhancing material performance. Hydroxyapatite coatings on titanium stems improve osseointegration in uncemented THA, whereas porous tantalum and trabecular metal coatings are used in revision TKA to address massive bone defects and encourage bone in-growth [26]. Antimicrobial coatings, including silver or antibiotic-loaded ceramics, are being investigated to reduce the incidence of periprosthetic joint infection particularly in high-risk revision surgeries [27].

THA and TKA differ substantially in their material requirements due to joint-specific biomechanical challenges. THA benefits from advanced ceramic and titanium combinations, prioritizing low friction and osseointegration, while TKA relies more heavily on durable metallic alloys and advanced polyethylene formulations to maintain stability under complex kinematics. As new biomaterials, nanotechnologies, and additive manufacturing techniques evolve, future implants will likely offer enhanced mechanical compatibility, individualized fit, and improved biological integration.

3.3. Surgical Technique

Surgical technique is a cornerstone of successful joint arthroplasty, influencing intraoperative efficiency, complication rates, functional recovery, and long-term implant survival. While both total hip arthroplasty (THA) and total knee arthroplasty (TKA) aim to alleviate pain and restore function, their respective surgical approaches, procedural objectives, and technical challenges differ substantially due to the unique biomechanical and anatomical characteristics of the hip and knee joints.

In THA, the choice of surgical approach is critical and often individualized based on surgeon experience, patient morphology, and functional goals. The most commonly adopted approaches include posterior, lateral (transgluteal), and direct anterior techniques. The posterior approach offers broad exposure to both the acetabulum and femoral canal and is widely used for its familiarity and efficient implant positioning. However, it necessitates the detachment of short external rotators and posterior capsule, which can compromise joint stability and increase the risk of dislocation if not properly repaired [28, 35]. Despite this, it preserves the abductor mechanism, contributing to better gait dynamics postoperatively [36].

The direct anterior approach (DAA) has gained significant traction in recent years due to its muscle-sparing nature, exploiting an intermuscular and internervous plane. Clinical studies report reduced postoperative pain, faster mobilization, and a lower risk of dislocation with the DAA [29, 37]. However, this approach is technically demanding and limited by a narrow operative window. It poses a learning curve that, if not adequately addressed, can increase complications such as femoral fractures and lateral femoral cutaneous nerve injury [38]. Nevertheless, DAA has shown superior early outcomes in selected patients, especially in fast-track protocols [39].

The lateral or transgluteal approach, although less frequently performed today, offers a compromise between stability and visualization. It is associated with a lower dislocation rate compared to the posterior route, but disruption of the abductor muscle (gluteus medius) may lead to postoperative limp or weakness [40].

In TKA, the standard surgical exposure involves a medial parapatellar arthrotomy, which provides excellent access to the distal femur, proximal tibia, and patellofemoral joint. The primary surgical objectives include restoration of mechanical alignment, accurate femoral and tibial component positioning, correction of deformities, and appropriate patellar tracking [30, 41]. Unlike THA, where stability is primarily mechanical and prosthetic, TKA heavily relies on soft tissue balance, particularly collateral ligaments, to ensure proper joint function. Imbalances in these structures can lead to complications such as instability, stiffness, or accelerated polyethylene wear [6, 42].

Precise component alignment is critical in TKA, as even minor rotational malalignment can significantly affect kinematics and increase the risk of failure. Computer-assisted navigation (CAS) and robotic-assisted techniques have become increasingly adopted to address these challenges. These technologies enable intraoperative mapping of the joint, refinement of bone resections, and soft tissue balancing based on individual patient anatomy [31, 43]. Robotic systems have demonstrated reduced outliers in implant alignment and improved reproducibility, although long-term superiority remains under evaluation [44].

Minimally invasive surgery (MIS) has been explored in both THA and TKA to reduce soft tissue trauma, blood loss, and hospital stay while promoting early recovery. In THA, MIS techniques are often integrated with mini-posterior or mini-anterior approaches and have shown benefits in early rehabilitation metrics [33, 45]. In TKA, quadriceps-sparing, subvastus, and midvastus approaches aim to preserve the extensor mechanism, potentially facilitating earlier mobilization. Nevertheless, MIS procedures are associated with a limited field of view, increasing the risk of malalignment and neurovascular injury if not performed with appropriate expertise [24, 46]. Their benefits appear to be most pronounced in early functional outcomes rather than long-term survivorship.

The complexity of revision procedures further highlights surgical differences between THA and TKA. In revision THA, modular femoral stems, acetabular augments, and customized bone grafting techniques are often necessary to restore hip biomechanics, leg length, and offset [47]. Conversely, revision TKA typically requires constrained or hinged components, metaphyseal sleeves, and potentially extensive ligamentous reconstruction, reflecting the joint's dependence on soft tissue for functional stability [26, 48].

Additionally, spinopelvic mobility and sagittal balance have recently emerged as critical considerations in THA surgical planning. Patients with spinal stiffness or lumbar fusion are at increased risk of dislocation due to altered pelvic tilt dynamics during sitting and standing transitions [3, 13, 28]. This biomechanical interdependence underscores the importance of preoperative imaging and functional assessment for surgical planning.

Comparing THA and TKA, the former is more focused on achieving a mechanically stable articulation through component design and positioning, often with less reliance on soft tissues for stability. In contrast, TKA outcomes are significantly influenced by intraoperative soft tissue handling, alignment, and ligament tensioning. Robotic systems and CAS play roles in both procedures but are more commonly used and validated in TKA due to the precision required in balancing and alignment [31, 32, 44].

The evolution of surgical techniques in joint arthroplasty reflects a growing emphasis on personalized medicine. Surgeons are increasingly integrating patient-specific instrumentation (PSI), preoperative planning software, and data from kinematic analyses to guide intraoperative decision-making and improve outcomes [25, 39, 41].

3.4. Functional Outcomes

Functional outcomes are central to evaluating the success of total joint arthroplasties, encompassing pain relief, restoration of mobility, independence in daily activities, and overall satisfaction. While both total hip arthroplasty (THA) and total knee arthroplasty (TKA) substantially improve patients' quality of life, the pattern and degree of functional recovery vary considerably due to the joints' biomechanical and anatomical characteristics.

Patients undergoing THA typically exhibit faster and more predictable functional recovery than those receiving TKA. This difference is attributed to the hip's simple ball-and-socket anatomy, allowing easier restoration of joint biomechanics once stability and leg length are restored. Clinical studies report that THA patients often resume independent walking, stair climbing, and driving within weeks of surgery [49, 50]. In contrast, TKA patients frequently require prolonged rehabilitation due to the complexity of knee biomechanics and the need to achieve both component alignment and soft tissue balance for functional success [6, 52].

Gait restoration is one of the most studied functional outcomes. Post-THA patients demonstrate near-normal gait patterns within 6-12 weeks postoperatively, with restored stride length, symmetry, and cadence [50]. Zhang *et al*. showed that kinematic recovery after THA approaches baseline levels in younger adults, especially when muscle-preserving approaches are used [50]. Conversely, TKA patients often display persistent gait abnormalities, including reduced knee flexion during stance, compensatory trunk lean, and altered ankle strategies, which can persist up to a year postoperatively [53]. These deviations are related not only to joint stiffness but also to extensor mechanism weakness and impaired proprioception.

In terms of objective outcome measures, THA patients report superior results in standardized scores. Instruments such as the Harris Hip Score (HHS) and the Hip disability and Osteoarthritis Outcome Score (HOOS) consistently demonstrate greater gains postoperatively than the Knee Society Score (KSS) or the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) used in TKA [49, 54]. Moreover, patient satisfaction is higher after THA, with studies reporting satisfaction rates of 85-90%, compared to

70-80% after TKA [55]. The dissatisfaction in TKA often stems from residual symptoms such as anterior knee pain, stiffness, or difficulty kneeling-functional demands that are difficult to replicate in a prosthetic knee joint [56].

Return to recreational and occupational activities is another area where THA often outperforms TKA. Swanson *et al*. reported that a higher percentage of THA patients resume low-impact sports such as cycling, swimming, and walking earlier and more confidently than their TKA counterparts [57]. The discrepancy is even more pronounced in activities requiring deep flexion, such as kneeling or squatting, which remain challenging for most TKA patients despite technically successful procedures [56, 58]. Lombardi *et al*. found that THA patients return to work earlier than those who undergo TKA, with higher likelihoods of maintaining preoperative activity levels, particularly in non-manual labor occupations [58].

Psychological and behavioral factors also modulate functional outcomes. Patients undergoing TKA tend to exhibit higher levels of fear-avoidance behavior and pain catastrophizing, which can interfere with rehabilitation adherence and prolong functional limitation [59]. Lindberg *et al*. showed that preoperative anxiety and depression were more predictive of poor outcomes in TKA than THA [59]. These findings suggest that comprehensive perioperative management, including psychological support, is crucial-particularly for knee arthroplasty patients.

Technological advancements such as robotic-assisted surgery and computer-assisted navigation have contributed to better component alignment and possibly better function, particularly in TKA where small deviations in alignment can substantially affect kinematics [31, 43, 54]. Kayani *et al*. demonstrated improved functional scores and earlier recovery in robotic-assisted TKA compared to manual techniques, although long-term functional differences remain under investigation [54]. While these technologies are also used in THA to optimize acetabular orientation and leg length, their impact on function has been less pronounced due to the more forgiving mechanics of the hip [32, 45].

Function over the long term tends to remain stable after THA. Survivorship studies show that patients maintain good to excellent function for up to 15 years in the absence of complications, especially when contemporary materials such as highly cross-linked polyethylene are used [19, 23]. TKA patients, however, may experience gradual functional decline due to polyethylene wear, patellofemoral issues, or ligamentous laxity, particularly if postoperative rehabilitation was suboptimal or if the patient had a high BMI or preoperative deformities [7, 43].

In conclusion, while both THA and TKA significantly enhance quality of life, THA offers faster, more predictable functional recovery and higher patient satisfaction. In contrast, TKA recovery is more technically demanding and variable, with greater dependence on soft tissue healing, patient psychology, and alignment accuracy. Understanding these differences is essential for preoperative counseling, surgical planning, and postoperative rehabilitation.

4. Conclusion

Total hip arthroplasty (THA) and total knee arthroplasty (TKA) represent two of the most successful orthopedic procedures for restoring joint function and alleviating pain in patients with end-stage osteoarthritis. Despite sharing common goals, these procedures differ profoundly in biomechanical demands, material selection, surgical technique, and functional recovery trajectories.

From a biomechanical standpoint, THA benefits from the inherent stability of the ball-and-socket anatomy, allowing more consistent restoration of normal gait and joint kinematics. In contrast, TKA must replicate complex knee mechanics dependent on both osseous geometry and soft tissue integrity, posing greater challenges in achieving symmetrical motion and long-term function. Material selection further reflects these differences: THA favors low-friction ceramics and bone-compatible titanium alloys, while TKA relies on cobalt-chromium alloys and cross-linked polyethylene optimized for high stress and multidirectional loads.

Surgically, THA offers multiple viable approaches, with increasing adoption of minimally invasive anterior techniques that preserve soft tissues and facilitate faster recovery. TKA, while also evolving with the integration of computer navigation and robotics, remains more reliant on meticulous intraoperative soft tissue balancing. These technical nuances translate into distinct postoperative outcomes, with THA generally providing more rapid and reliable functional gains, while TKA requires extended rehabilitation to overcome proprioceptive deficits and restore complex motion patterns.

Ultimately, successful joint arthroplasty depends on understanding the anatomical and functional distinctions between the hip and knee, tailoring implant design, surgical planning, and postoperative care accordingly. Future advancements in personalized implants, surgical robotics, and biomaterials will likely further enhance the precision and durability of both procedures. However, the current evidence continues to support the superior predictability and patient satisfaction associated with THA, whereas TKA demands greater surgical finesse and rehabilitation resources to achieve comparable outcomes.

5. Conflict of Interest
Not available

6. Financial Support
Not available

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