Editorial
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CURRENT TECHNOLOGY IN HIP REPLACEMENT

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INTRODUCTION

Hip replacement, also known as total hip arthroplasty (THA), is widely regarded as an incredibly effective surgical procedure, often hailed as a ground-breaking achievement in medicine (1). The initial development of total hip replacement dates to 1938 when Wiles made significant progress (2). However, it wasn't until the 1960s that this procedure gained widespread recognition and popularity. Sir John Charnley's introduction of "low-friction arthroplasty" revolutionized the treatment of arthritic joints (1). Over time, significant progress has been made in THA's design, materials, and surgical techniques, significantly enhancing patient satisfaction, minimizing surgical complications, and improving clinical outcomes. Patients' expectations regarding life after total hip arthroplasty (THA) have significantly shifted. They prioritize long-term survival and the various aspects of maintaining a good quality of life. They have a strong desire to pursue their professional and personal interests, which require a high level of physical activity (3).

The initial technological advancement in hip replacement surgery was the introduction of Minimally Invasive Surgery (MIS), which reduced the surgical footprint. MIS techniques involve smaller incisions and less soft tissue disruption, reducing postoperative pain and faster recovery times. This approach contrasts with traditional open surgery, which typically requires larger incisions and more extensive muscle dissection. MIS procedures have been proven to enhance cosmetic outcomes, minimize hospital stays, and accelerate rehabilitation (4,5).

A growing focus has recently been on customizing joint replacement procedures to suit individual patients rather than relying on a generic and uniform approach. A computer-assisted surgery (CAS) and robotic-assisted surgery represent significant technological leaps in hip replacement. CAS utilizes preoperative imaging and intraoperative navigation to enhance the precision of implant placement. CAS improves the alignment of the acetabular and femoral components, thereby reducing the risk of dislocation and improving functional outcomes (6). Robotic-assisted systems, such as the MAKO robotic arm, have refined this precision. These systems allow for patient-specific surgical planning and real-time adjustments during the procedure. Studies have shown that robotic-assisted surgery results in superior implant positioning and reduced variability in component placement (6,7). The integration of these technologies into clinical practice represents a significant advancement in achieving optimal surgical outcomes.

Another enhancement in hip replacement surgery is the development of advanced biomaterials, which have been pivotal in extending the longevity of hip implants. Traditional metal-on-polyethylene bearings, while effective, are prone to wear and osteolysis over time. Recent advancements have introduced ceramic-on-ceramic and ceramic-on-polyethylene bearings, which exhibit lower wear rates and higher biocompatibility (8). Ceramic materials, being more complex and smoother than metals, significantly reduce friction and wear particles, enhancing the implant's lifespan. Highly porous metals, such as trabecular metal, have also been developed to improve osseointegration. These materials mimic the trabecular structure of natural bone, promoting biological fixation and reducing the reliance on bone cement. The benefits of trabecular metal are in providing a stable and durable implant-bone interface, which is crucial for the long-term success of hip replacements (9).

Enhanced Recovery After Surgery (ERAS) protocols represent a multidisciplinary approach to optimizing perioperative care. These protocols focus on preoperative education, optimized pain management, and early mobilization. ERAS protocols have been shown to reduce hospital stays, decrease complications, and improve overall patient outcomes in hip replacement surgery. Implementing ERAS has led to a paradigm shift in postoperative care, emphasizing patient-centered approaches and evidence-based practices (10).

Despite these advancements, challenges remain in hip replacement surgery. Implant longevity in younger, more active patients continues to be a concern. Additionally, periprosthetic joint infections (PJIs) pose a significant risk to implant success. Current research explores antibacterial coatings and systemic antibiotic regimens to address PJIs (11). Integrating artificial intelligence (AI) and machine learning (ML) into hip replacement surgery offers promising future directions. AI-driven predictive analytics can assist in preoperative planning by identifying patients at higher risk of complications and customizing treatment plans. Furthermore, ML algorithms can analyze postoperative data to monitor patient recovery and predict long-term outcomes (12)

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