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Video content accompanies this article at http://www.orthopedic.theclinics.com.

Hip, spine, and pelvis function as a unified kinetic chain. Any spinal pathology, results in compensatory changes in the other components to accommodate for the reduced spinopelvic motion. The complex relationship between spinopelvic mobility and component positioning in total hip arthroplasty presents a challenge in achieving functional implant positioning. Patients with spinal pathology, especially those with stiff spines and little change in sacral slope, are at high instability risk. In this challenging subgroup, robotic-arm assistance enables the execution of a patient specific plan, avoiding impingement and maximizing range of motion; especially utilizing virtual range of motion to dynamically assess impingement.

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Ittai Shichman, Vinaya Rajahraman, James Chow, David W. Fabi, Mark E. Gittins, Joseph E. Burkhardt, Bertrand P. Kaper, and Ran Schwarzkopf

One of the primary aims of total knee arthroplasty (TKA) is restoration of the mechanical axis of the lower limb. Maintenance of the mechanical axis within 3° of neutral has been shown to result in improved clinical results and implant longevity. Handheld image-free robotic-assisted total knee arthroplasty (HI-TKA) is a novel way of performing TKA in the era of modern robotic-assisted TKA. The aim of this study is to assess the accuracy of achieving targeted alignment, component placement, clinical outcomes, as well as patient satisfaction after HI-TKA.

Robotic-Assisted Total Knee Arthroplasty is Safe in the Ambulatory Surgery Center Setting 153
Travis Eason, William Mihalko, and Patrick C. Toy

Background: Robotic-assisted total knee arthroplasty (RA-TKA) has become more popular in the United States. With the significant trend towards performing TKA in outpatient and ambulatory surgery center (ASC) settings, this study was implemented to determine the safety and efficacy of RA-TKA in an ASC. Method: A retrospective review identified 172 outpatient TKAs (86 RA-TKAs and 86 TKAs) performed between January 2020 and January 2021. All surgeries were performed by the same surgeon at the same free-standing ASC. Patients were followed for at least 90 days after surgery; complications, reoperations, readmissions, operative time, and patient-reported outcomes were recorded. Results: In both groups, all patients were successfully discharged home from the ASC on the day of surgery. No differences were noted in overall complications, reoperations, hospital admissions, or delays in discharge. RA-TKA had slightly longer operative times (79 vs 75 min [$p = 0.017$]) and total length of stay at the ASC (468 vs 412 min [$p < 0.0001$]) than conventional TKA. No significant differences were noted in outcome scores at 2-, 6-, or 12-week follow-ups. Conclusions: Our results showed that RA-TKA can be successfully implemented in an ASC, with similar outcomes compared with TKA using conventional instrumentation. Initial surgical times were increased secondary to the learning curve of implementing RA-TKA. Long-term follow-up is necessary to determine implant longevity and long-term outcomes.

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Maxwell Weinberg, Jonathan R. Danoff, and Giles R. Scuderi

This review article presents the current state of remote patient monitoring (RPM) in total joint arthroplasty. RPM refers to the use of telecommunication with wearable and implantable technology to assess and treat patients. Several forms of RPM are discussed including telemedicine, patient engagement platforms, wearable devices, and implantable devices. The benefits to patients and physicians are discussed in the context of postoperative monitoring. Insurance coverage and reimbursement of these technologies are reviewed.

Predicting Corrosion Damage in the Human Body Using Artificial Intelligence: In Vitro Progress and Future Applications 169
Michael A. Kurtz, Ruoyu Yang, Mohan S.R. Elapolu, Audrey C. Wessinger, William Nelson, Kazzandra Alaniz, Rahul Rai, and Jeremy L. Gilbert

Artificial intelligence (AI) is used in the clinic to improve patient care. While the successes illustrate AI's impact, few studies have led to improved clinical outcomes. In this review, we focus on how AI models implemented in nonorthopedic fields of corrosion science may apply to the study of orthopedic alloys. We first define and introduce fundamental AI concepts and models, as well as physiologically relevant corrosion damage modes. We then systematically review the corrosion/AI literature. Finally, we identify several AI models that may be implemented to study fretting, crevice, and pitting corrosion of titanium and cobalt chrome alloys.

Short-to Mid-Term Survivorship of a Patient-specific Unicompartmental Knee Arthroplasty Implant Cast from a Three-Dimensional Printed Mold 193
Alexandre Barbieri Mestriner, Brielle Antonelli, Pierre-Emmanuel Schwab, Antonia F. Chen, Todd Jones, Jakob Ackermann, Gergo Bela Merkely, and Jeffrey K. Lange

The purpose of this study was to determine early survivorship and complication rates associated with the implantation of a new patient-specific unicompartmental knee implant cast from a three-dimensional (3D) printed mold, introduced in 2012. We retrospectively reviewed 92 consecutive patients who underwent unicompartmental knee arthroplasty (UKA) with a patient-specific implant cast from a 3D printed mold between September 2012 and October 2015. The early results of a patient-specific UKA implant were favorable in our cohort, with survivorship free from reoperation of 97% at an average 4.5 years follow-up. Future studies are necessary to investigate the long-term performance of this implant. Survivorship of a patient-specific unicompartmental knee arthroplasty implant cast from a 3D printed mold.

Pediatrics

Intraoperative Navigation and Robotics in Pediatric Spinal Deformity 201
Zachary R. Diltz and Benjamin J. Sheffer

Current technologies for image guidance navigation and robotic assistance with spinal surgery are improving rapidly with several systems commercially available. Newer machine vision technology has several potential advantages. Limited studies have shown similar outcomes to traditional navigation platforms with decreased intraoperative radiation and time required for registration. However, there are no active robotic arms that can be coupled with machine vision navigation. Further research is necessary to justify the cost, potential increased operative time, and workflow issues but the use of navigation and robotics will only continue to expand given the growing body of evidence supporting their use.

Shoulder and Elbow

Emerging Technologies in Shoulder Arthroplasty: Navigation, Mixed Reality, and Preoperative Planning 209
Brenton R. Jennewine and Tyler J. Brolin

Shoulder arthroplasty is a rapidly improving and utilized management for end-stage arthritis that is associated with improved functional outcomes, pain relief, and long-term implant survival. Accurate placement of the glenoid and humeral components is critical for improved outcomes. Traditionally, preoperative planning was limited to radiographs and 2-dimensional computed tomography (CT); however, 3-dimensional CT is becoming more commonly utilized and necessary to understand complex glenoid and humeral deformities. To further increase accurate component placement, intraoperative assistive devices–patient-specific instrumentation, navigation, and mixed reality–minimize malpositioning, increase surgeon accuracy, and maximize fixation. These intraoperative technologies likely represent the future of shoulder arthroplasty.

Foot and Ankle

Advances in Cartilage Repair 227
Mohammad T. Azam, James J. Butler, Matthew L. Duenes, Thomas W. McAllister, Raymond C. Walls, Arianna L. Gianakos, and John G. Kennedy

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Osteochondral lesions of the ankle joint are typically associated with a traumatic etiology and present with ankle pain and swelling. Conservative management yields unsatisfactory results because of the poor healing capacity of the articular cartilage. Smaller lesions (<100 mm^2 or <10 mm) can be treated with less invasive procedures such as arthroscopic debridement, anterograde drilling, scaffold-based therapies, and augmentation with biological adjuvants. For patients with large lesions (>100 mm^2 or >10 mm), cystic lesions, uncontained lesions, or patients who have failed prior bone marrow stimulation, management with autologous osteochondral transplantation is indicated.

Spine

Technological Advances in Spine Surgery: Navigation, Robotics, and Augmented Reality 237

Tarek Yamout, Lindsay D. Orosz, Christopher R. Good, Ehsan Jazini, Brandon Allen, and Jeffrey L. Gum

Accurate screw placement is critical to avoid vascular or neurologic complications during spine surgery and to maximize fixation for fusion and deformity correction. Computer-assisted navigation, robotic-guided spine surgery, and augmented reality surgical navigation are currently available technologies that have been developed to improve screw placement accuracy. The advent of multiple generations of new technologies within the past 3 decades has presented surgeons with a diverse array of choices when it comes to pedicle screw placement. Considerations for patient safety and optimal outcomes must be paramount when selecting a technology.