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Review Article

# How Innovation Fueled Outpatient Shoulder Arthroplasty (SA)

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In 1893, Dr. Jules Emile Péan used a shoulder prosthesis made of vulcanite and platinum to replace a French server's abscessed shoulder joint. And so began the age of shoulder arthroplasty (SA)—and the exciting study of joint replacement as a whole. While this event is often heralded as the very first joint replacement, it is worth noting that Péan referenced the work of Dr. Themistocles Gluck—a German physician credited with performing the first wrist arthroplasty in 1890 using an ivory prosthesis—as the inspiration for it.

Over the years, SA innovation has mainly centered around the development of new prosthetic devices. By the 1930s and 40s, several surgeons were using acrylic shoulder prostheses. A decade later, Dr. Charles S Neer II developed a prosthesis made of Vitallium, a cast cobalt-chrome alloy. It had a 44-mm radius of curvature and a single stem size.

Today, with prostheses available in a variety of sizes and materials which provides the ability to match the patient's anatomy, attention is shifting to other forms of SA innovation: advances in anesthesia and pain control, expanded eligibility criteria, improved perioperative measures, and superior surgical techniques, all of which have supported this procedure's expansion beyond an inpatient setting. So, let's see how these innovations have made outpatient SA a reality.

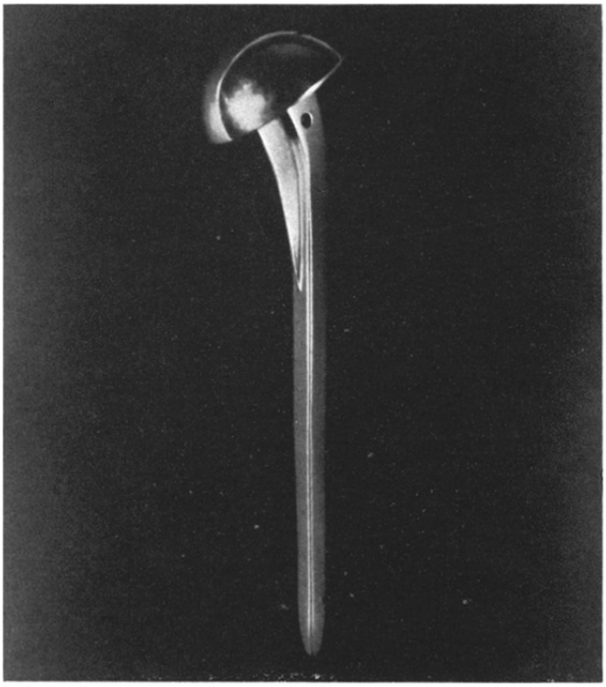

**Figure 1. The first published photograph of Neer's prosthesis appeared in an article in the American Journal of Surgery in 1953**

a Anthony Romeo, M.D., is one of the nation's leading shoulder, elbow, and sports medicine surgeons with more than 27 years of clinical experience. Having spent his career in the pursuit of excellence for his patients, Dr. Romeo has pioneered new approaches to shoulder replacement surgery and developed advanced orthopaedic implants and surgical procedures that are supported by cutting-edge research and patient-focused outcomes. Dr. Romeo is also the Chief Medical Editor of Orthopaedics Today and the Executive Vice President of DuPage Medical Group's state-of-the-art Musculoskeletal Institute.

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## ADVANCES IN PAIN CONTROL AND ANESTHESIA

One of the most critical innovations to outpatient surgery is better perioperative pain control. In the past, pain control was achieved primarily by using narcotics adjusted to the patient's pain complaints. Narcotic medications were provided in strong dosages and volumes, leading to side effects such as drowsiness, depressed respiration, nausea and vomiting, constipation, and adverse reactions to other medications commonly used by patients. Nowadays, regional nerve blocks, consistently effective when performed with ultrasound guidance, can completely eliminate perioperative pain for a predictable time frame. Minimizing or eliminating the sensation of pain during surgery allows for less anesthetic agents which have their own side effects, thereby reducing anesthesia-related complications and increasing the number of patients eligible for outpatient SA.

It is even possible to perform SA cases in which the patient receives a regional block, as well as local anesthetic injection, combined with sedation instead of general anesthesia. The patient breathes on their own throughout the case. For example, we recently did an awake TSA on a 78-year-old woman who had previous problems with anesthesia. Admittedly, the sound of the bone saw or other noises may be unpleasant to a patient's ear, but some actually prefer it to the possible complications of anesthesia due to existing health conditions or prior experience. Overall, the possibility of minimizing general anesthesia will further open up new possibilities for outpatient surgery due to decreased concerns regarding the modification of a patient's respiratory or circulatory system.

## EXPANDED ELIGIBILITY CRITERIA

Another notable change in joint replacement outpatient surgery is how we identify eligible patients. In the past, eligibility criteria was quite stringent and many patients did not qualify. But now, through evidence-based research, we can better identify which patients are most suitable to sail through outpatient surgery without major complications—and this group is growing all the time. As we expand the eligible patient population, our focus remains on patient safety and enhancement of the patient's overall experience when compared to the traditional hospital environment.

The pandemic is acting as a further accelerant. An increasing number of patients want surgery outside of the hospital due to the fact that patients that are severely affected with a Covid-19 infection will be treated at the hospital, leading to the perception of it being a high-transmission environment. Patients are actively requesting care options outside of the hospital, leading to a surge in public interest in outpatient surgery. As lawmakers and administrators look to accommodate their needs, combined with the incentive of significantly reduced overall costs, eligibility for surgery at an ASC is steadily increasing. For example, age limits have been increased or removed entirely. And comorbidities which would have previously excluded a patient from outpatient surgery—such as hypertension and type 2 diabetes—are now permitted in many facilities. What's more, evidence shows that outpatient surgery presents a low stress to physiology and is safe for a wider roster of patients than previously thought.

**Figure 2. An Eclipse stemless shoulder prosthesis**

## ROBUST PERIOPERATIVE MEASURES

Evidence-based perioperative measures are also fueling the success of outpatient surgery. For example, the Enhanced Recovery After Surgery (ERAS) protocols—which I use regularly—is instrumental in mitigating anesthesia's effect. ERAS protocols are multimodal perioperative care pathways designed to accelerate surgical recovery by maintaining perioperative organ function and reducing post-surgical stress response. Key elements include preoperative counselling, nutrition optimization (we offer a perioperative nutrition program to our patients), standardized analgesic and anesthetic regimens that are initiated before the surgery begins, and early mobilization.

I find ERAS's approach to fasting especially interesting. As we know, when patients are NPO (nothing by mouth), their electrolytes and blood sugar (glucose) can become imbalanced, affecting both their response to medication and pain tolerance. The ERAS program requires patients to consume an electrolyte drink three to four hours prior to surgery to stabilize electrolytes prior to the administration of anesthesia. This approach to surgery sets up patients to tolerate anesthesia better and is part of the process that helps reduce the need for postoperative pain medicine.

I'd be remiss if I didn't mention the advent of more precise surgical techniques and their impact on SA advancement. Shoulder entry approaches are now more precise, thereby reducing incision and surrounding soft tissue damage of healthy muscles, tendons, and ligaments. Additionally, powerful yet smaller implants have been developed (Figure 2), allowing for more precise surgeries, shorter op-

erating times, less bone removal, and more strength at the site of surgical repairs. We are also able to preoperatively enter the patient's specific bone anatomy into a computer program that allows us to plan out a customized surgery for each patient, further reducing the number of surgical steps and shortening time under anesthesia. Preoperative computer assisted planning ensures that everyone in the operating room has the same "game plan" even before the surgery begins.

Importantly, advances in surgical technique lead to less bleeding. Ten to 20 years ago, blood loss of 300 cc's or more during TSAs was a foregone conclusion due to cutting bone and tissues. But more scrupulous surgical techniques have led to better blood loss control, which makes outpatient surgery more feasible. In fact, a patient having a SA can expect to lose less than one-third of what they might donate at the Red Cross during a typical blood draw (1 pint, which is equal to 470cc's). Additionally, a well known synthetic derivative of the common amino acid lysine, known as tranexamic acid (TXA), can help reduce the breakdown of normal blood clots which improves the ability to slow down and stop bleeding. Remarkably, when used during joint replacement surgery, multiple studies have demonstrated the safety of TXA in large populations of patients, including no additional risk of excessive blood clotting. This inexpensive medication that works primarily during the time of the surgical procedure can be given orally or by IV and has become a lynchpin in reduced blood loss. When we tested the difference between SA patients treated without TXA, which was previously the standard, versus patients who received IV TXA before the incision was made, the average blood loss was decreased by 100cc's.

An increasing number of over 170,000 shoulder replacements performed each year in the U.S. are done in an outpatient setting. Current estimates are that less than 10% of the shoulder replacements in the United States are done in the ASC (even less worldwide), while more than 50% are likely to be eligible for the ASC environment, which is already our current practice when treating patients with shoulder arthritis. As we continue to explore this new frontier of shoulder surgery, we will no doubt continue to find ways to make it more effective, efficient, and safe. In fact, I would not be surprised if at some point in the not-so-distant future, the lion's share or more than 70% of SAs are done on an outpatient basis in an ASC environment. The combination of advances in anesthesia such as multimodal analgesia and ERAS, combined with precise surgical technique, smaller yet more anatomic implants, shorter OR times, and less blood loss is leading to the safe transformation of shoulder replacements from a hospital-based procedure to an outpatient procedure in an ambulatory surgery center. Patient-related outcome measures, including patient satisfaction scores and asking patients directly if they would want to have their procedure in the hospital or ASC has convinced us that our practice already reflects what will be the future of shoulder replacements as we continue to focus on enhancing the patient safety and experience when treating their shoulder arthritis.

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