

Technology

The Evolution of Medical Materials

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Materials used in the medical industry, specifically orthopedic surgery, have come a long way. As the new materials are introduced in the industry, cutting tool innovations are made. Forty years ago, limited technology meant that a surgeon fixing a shattered tibia would line up the pieces and put the leg in a cast, which then required months to heal. With today's modern materials such as titanium and advancements in technology, this same fracture would heal in a matter of weeks.

Another area where great strides have been made is the field of joint replacement surgery. In the past, because of the life expectancy of artificial joints, these procedures were typically reserved for senior citizens. A hip replacement used to last for 8 to 10 years. With today's modern materials, a hip replacement has a life expectancy of approximately 30 years. This makes it viable to replace the hip of a 50 year old patient, which should last until the patient is in their eighties.

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With numerous orthopedic implants on the market, it was important for this particular patient to select the combination that would provide longevity with the least chance of rejection. Titanium is the ideal material for the post that is inserted into the femur. It is lightweight and very strong, but it lacks abrasion resistance. Because of this, the femoral ball that goes into the hip socket is made of ceramic. Ceramic is extremely hard and provides superior abrasion resistance. It is almost impossible to machine once it is in a sintered state. The acetabular socket or hip socket must allow normal range of motion with the femoral ball for the hip joint to function properly. This provides an interesting challenge because the material on the inside of the hip socket must cause minimal friction with the femoral ball, while at the same time being able to last as long as the rest of the hip prosthesis.

The solution for this is an acetabular cup made of cobalt chrome containing a high density polyethylene (HDPE) liner. Cobalt chrome is one of the most difficult metals to machine with a machinability rating of 15% of B-1112 (160 Brinell free cutting steel). HDPE machines best with tools that are very sharp with a high positive rake. Titanium is difficult to machine because of its poor thermal conductivity. These are four very different materials each requiring a unique manufacturing method. Modern manufacturing techniques and high tech tooling have made it possible to produce an artificial joint that will last for 30 years. “Modern manufacturing techniques and high tech tooling have made it possible to produce an artificial joint that will last for 30 years.”

Joint replacement techniques continue to evolve. The same patient also had a partial knee

replacement, which used two of the same materials that they had in their hip, and meant that rejection shouldn't be an issue. A cobalt chrome "cap" is installed in the end of the tibia and the end of the femur. A HDPE insert is installed between the two metal "caps." This is far less invasive than a total knee replacement and also allows for future options to replace the plastic insert.

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Materials used in today's medical manufacturing cover the entire gamut. They include everything from the stainless steel instruments used in surgery to carbon fiber reinforced PEEK used to make targeting arms to properly locate hip implants. Each of these materials provide unique manufacturing challenges, but people who are able to live without pain are extremely grateful that these challenges are addressed and overcome with advanced cutting tool technology.

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