The number of people per year needing bone replacement surgeries due to degenerative bone diseases or natural bone degeneration due to aging and trauma continues to increase. The current treatment procedure is to take bone from a different location in the patient and transplant it to the affected site. This is known as an autograft. An alternative to this is the allograft, in which bone is taken from a cadaver and implanted into the patient. Both of these procedures have significant limitations that have compelled researchers to develop synthetic alternatives to bone using the technology of tissue engineering and regenerative medicine.

The goal of the synthetic bone is not only to act as a replacement to the degenerated bone, but also to induce new bone growth. Using the biodegradable polymer poly (lactide-co-glycolide) (PLAGA), a series of 3-dimensional porous structures fabricated with polymer microspheres has been developed. In combination with bone morphogenetic proteins and stem cells, these matrices may serve as scaffolds for bone regeneration. Once implanted, the presence of growth factors and stem cells, induced to differentiate into osteoblasts, will initiate bone regeneration throughout the 3-D pore network. As regeneration continues, the matrix is slowly resorbed by the body, leaving no residual polymer upon complete degradation, thus negating the need for the implant to be surgically removed.

There have been significant advances in biotechnology to allow for such innovations in regenerative medicine. But these advancements do not come without ethical concerns. Stem cells are being used in this research to more effectively regenerate new bone. Although adult stems cells are being used, the research on adult stem cells compliments what could be done with embryonic stem cells. As more is discovered about the promises and shortcomings for adult stem cells, more knowledge will be revealed about the possibilities that embryonic stem cells may provide. In addition to the issues that stem cells raise, much of regenerative medicine relies on gene therapy as the most effective means of delivering the necessary growth factors to the stem cells in order for them to differentiate down the desired cell lineage. As these technologies are perfected, the realm of possible uses for gene therapy will expand, forcing policy decisions to be made on the application of gene therapy rather than its theoretical use.