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Bone Morphogenetic Protein (BMP)

The widespread use of fusion procedures in the management of spinal disorders has led investigators to explore the use of growth and differentiation factors in such procedures. For years scientists have been searching for ways to stimulate the human body to generate and repair bone more reliably and quicker. Traditionally, spinal fusion requires the transplant of bone chips from a patient's pelvis to the spinal vertebrae to help fuse the two together. This procedure can be very effective for the treatment of certain spinal disorders, the bone transplantation (bone grafting) can extend the surgery, increase blood loss, increase hospital stay, increase recovery time, and increase recovery pain. One must keep in mind that bone transplantation is not always successful due to inadequate bone growth.

Bone Morphogenetic Protein (BMP) may be the most exciting development in spine surgery in the past decade. It seems that BMP may be a better way to achieve spinal fusion with more success and few complications. Studies are showing BMP to be very effective and may forever change the way fusion surgery is performed.

Let's start our road towards BMP by explaining what the purpose of Spinal Fusion is. Spinal fusion surgery is used to treat injuries to the spinal vertebrae; degeneration; abnormal curvatures (such as scoliosis or kyphosis) and a weak or unstable spine caused by infections or tumors. My colleagues, as well as myself, are very conservative and will only consider this treatment after therapies to reduce pain have failed. Spinal fusion is a "welding" process by which two or more of the small bones (vertebrae) that make up the spinal column are fused together with bone grafts and internal devices such as metal rods to heal into a single solid bone. The surgery eliminates motion between vertebrae segments, which may be desirable when motion is the cause of significant pain. Bone is the most commonly used material to help promote fusion. Generally, small pieces of bone are placed into the space between the vertebrae to be fused. Sometimes larger solid pieces of bone are used to provide immediate structural support. Bone may come from the patient (autogenous bone) or a bank of bone harvested from other individuals (allograft bone).

And finally, BMP……. Through years of research to find a better way to promote bone growth and to alleviate the need for grafting, BMP was "discovered" in the 1960's by Dr. Marshall Urist. Bone is made up of about 65-70% mineral and 30-35% organic matrix. Dr. Urist discovered that by demineralizing bone and placing only the organic matrix part of the bone into the muscle of rats, he could promote new bone formation. This discovery led to the extended research that proved that a series of proteins found in bone matrix, collectively known as BMPs, are responsible for the bone formation observed by Dr. Urist. This ability to promote bone growth at an ectopic (non-bony) site in an adult animal has become the definitive test to determine if a material is classified as osteoinductive (induces bone growth).

The different members of the BMP family have slightly different amino acid structures. The structure of BMP-2 has been shown to be (the same) across a range of species. BMP has been studied on some level for decades. The science behind BMP has focused on whether a single protein of recombinant human BMP can promote bone regeneration. New bone formation is required to achieve a successful spinal fusion. Without bone growth, a patient will not obtain a solid fusion and the pain, that was the main reason behind having the surgery in the first place, will not be relieved. Naturally occurring BMP found in bone is only available in trace amounts. It has been estimated that nanogram levels of BMP are found in each gram of dry bone. To provide clinically useful amounts of isolated, human BMP, hundreds of kilograms of bone would be needed. Therefore, human donor bone supply limitations prevent clinically useful BMP extracted from human bone from being a viable option for routine medical use.

To solve the problems of limited amounts of available human and animal extracted BMP, and to ensure the uniformity of the vital components, the preferred method for obtaining BMP is to manufacture a recombinant version of a naturally occurring BMP using well established molecular biology techniques. This method of production ensures a uniform and consistent supply of a single pure BMP, with no limitations to the amount of protein that can be produced. In addition, recombinant production means extremely controlled manufacturing processes which guarantees consistency of the protein structure and promotion of bone growth in the final product.

One of the most talked about areas of interest in the spine community including patients, doctors and scientists, is the development of successful bone graft. A huge amount of resources are currently being devoted to developing a BMP alternative to patient harvested bone as part of spinal fusion surgery.

Then in the 1980's the proteins were individually identified and reproduced. Scientists felt very confident that this bone-growing material could be the answer they were looking for. After years of research, in 1997 BMP was used for the first time in a clinical trial of patients undergoing spinal fusion. In this initial clinical trial, all 11 patients who had been implanted with BMP achieved successful fusion within 6 months from the time of surgery. In fact, 10 of these 11 patients had achieved their fusions within 3 months of surgery. Because these patients did not require bone grafting from the pelvis, their hospital stays were shorter and their post-surgical pain was less than typically seen with traditional bone grafting techniques. Studies have proven that BMP not only successfully creates fusion, but it seems to do so more quickly and reliably than autograft.

There is minimal doubt that BMP will eventually help all surgical specialists' treat a variety of common, as well as complex spinal disorders. These factors will enable surgeons to modify their techniques to minimize the invasiveness of their operations. Ultimately, the goal will be to reduce the pain associated with surgery and recovery, improve the effectiveness of the surgical treatments, and hasten the return of patients to productive healthy lifestyles.

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