

JUVENILE IDIOPATHIC SCOLIOSIS

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SIGNAFUSE IS A PATENTED, MOLDABLE BONE GRAFT COMPRISED OF BIOACTIVE GLASS AND BIPHASIC HA/ β -TCP GRANULES COMBINED IN A RESORBABLE POLYMER CARRIER TO DELIVER OPTIMAL HANDLING CHARACTERISTICS.



Patient

Presented with juvenile idiopathic scoliosis and kyphoscoliosis



Procedure

Fusion from T3-L2 with instrumented posterior fusion



Outcome

X-ray after 12 months confirms fusion

Patient

A 14-year-old female presented to the clinic with juvenile idiopathic scoliosis and kyphoscoliosis (**Figure 1**).[†] The scoliosis curvature in the thoracic spine had been progressing for over a year. She was initially diagnosed and followed by an outside surgeon. She had no pain and no family history of scoliosis. Due to the progression of the curvature (close to 80 degrees), surgery was recommended. Based on the complexity of her condition and the associated surgical risks, she was referred by her outside surgeon to MedStar Georgetown University Hospital. Her family had religious beliefs which precluded the use of blood products as well as any cadaveric allograft tissue.

Procedure

The objective of the surgery was to perform a posterior midline fusion from T3 to L2. The procedure was augmented with 75 grams of SIGNAFUSE – five 15-gram packages of SIGNAFUSE – and mixed with approximately 20% autograft along the posterior midline. Pedicle screws and rods were used for fixation. No complications were reported.

Outcome

Radiographic assessment at 12-months post-operation showed intact pedicle screws and rods in satisfactory and unchanged position with evidence of a posterolateral fusion mass (**Figures 1-3**). X-rays demonstrated new bone formation posterior along the midline within the rods, and no loosening of the instrumentation. Patient had no apparent distress with normal gait, stance, and ambulation. The incision had healed well. Patient reported no pain at the 12-month post-operation examination, and returned to all previous normal activities with no limitations.

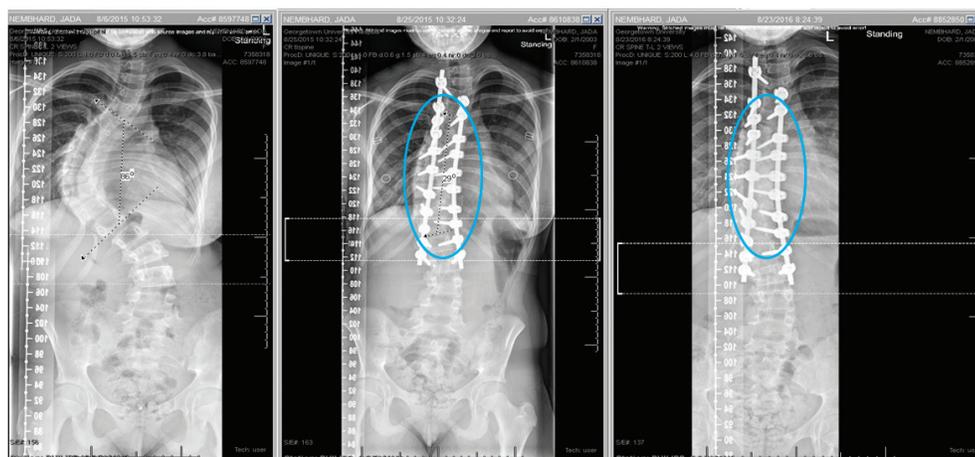


Figure 1.

Pre-operative (left), 3-week post-operative (middle), and 12-month post-operative (right) anterior/posterior standing thoracolumbar spine X-rays of the patient. Blue circles indicate placement of SIGNAFUSE in the posterior midline position at multiple levels.

Post-operative

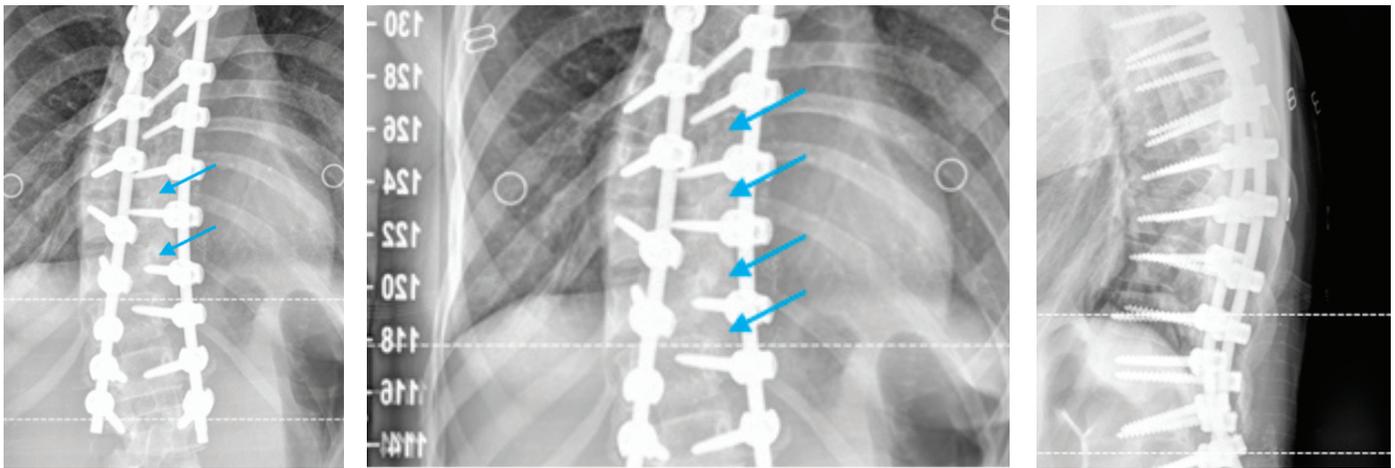


Figure 2.

3-week post-operative anterior/posterior (left, middle image is a magnification of image on the left) and lateral (right) standing thoracolumbar spine X-rays of the patient. Hardware instrumentation appears to be in satisfactory and unchanged position in thoracic and lumbar regions (all three images). Blue arrows indicate placement of SIGNAFUSE in the posterior midline position.

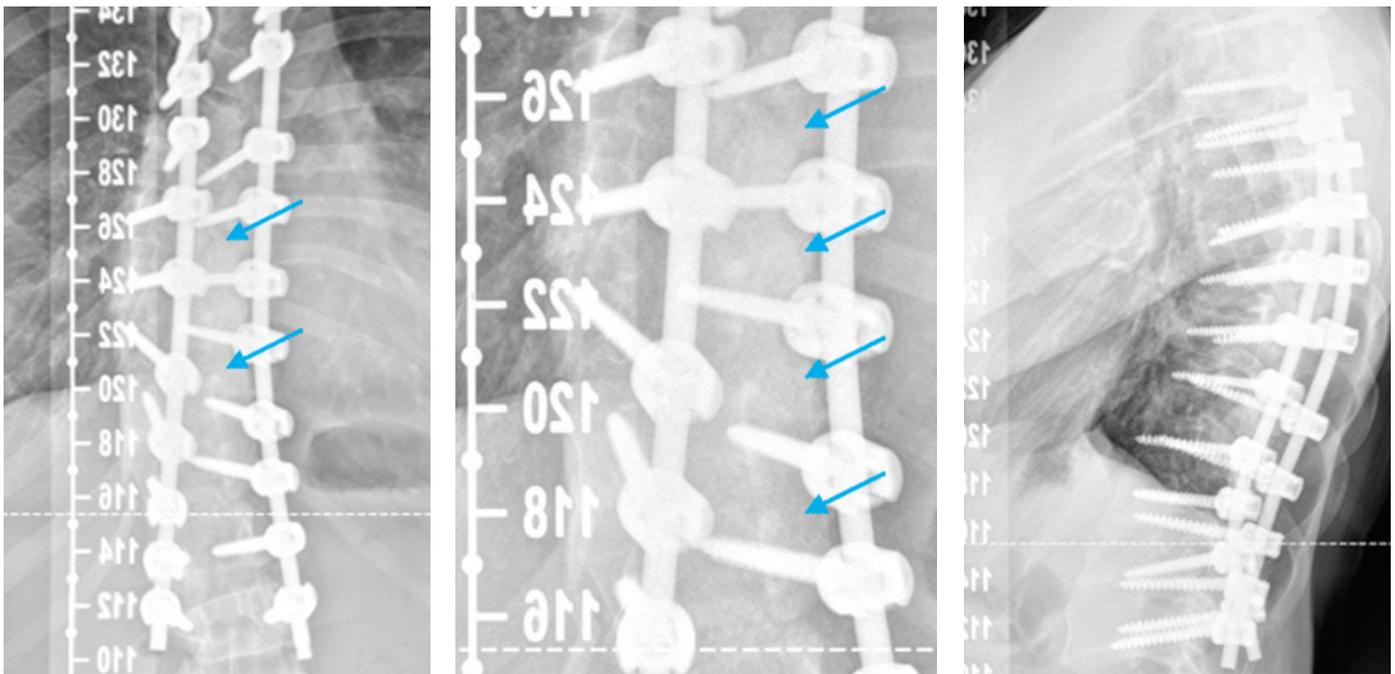


Figure 3.

12-month post-operative anterior/posterior (left, middle image is a magnification of image on the left) and lateral (right) standing thoracolumbar spine X-rays of the patient. Hardware instrumentation appears to be in satisfactory and unchanged position in thoracic and lumbar regions (all three images). Blue arrows indicate presence of new bone fusion mass in the posterior midline position.



About SIGNAFUSE

SIGNAFUSE, a patented bioactive bone graft putty, has been designed with a proprietary blend of bioactive glass (212-420 μm) and biphasic mineral granulate (1-2 mm) suspended in a resorbable polymer carrier, to provide a moldable putty with an unprecedented combination of bone graft technologies optimal for bone remodeling.¹

The bioactive glass component (45S5 Bioglass) of SIGNAFUSE undergoes a unique surface modification within the physiological environment that allows for direct bonding with surrounding local bone (**Figure 4**). Following implantation, an exchange of biologically active ions produces a bioactive hydroxyl carbonate apatite layer to which bone can readily bond.² These surface reactions also induce proliferation and differentiation of bone-related cells on the apatite matrix as part of the normal healing process.²⁻³ Further, the patented size range of the bioactive glass in SIGNAFUSE, 212-420 μm , has demonstrated advantages over the more common and broader 90-710 μm range, including higher rates of new bone formation and material remodeling at the defect site.⁴

The biphasic mineral component of SIGNAFUSE consists of hydroxyapatite (HA) and beta-tricalcium phosphate (β -TCP) (**Figure 5**). HA is similar in composition to bone; however, HA is relatively insoluble and bone bonding to HA is limited to its surface. β -TCP is similar in composition to amorphous bone precursors and readily undergoes surface remodeling, whereas the fast resorption (relative to new bone formation) of β -TCP may limit the efficacy of the mineral. By combining the relative solubility of HA with the resorption characteristics of β -TCP, SIGNAFUSE is designed to circumvent the limitations of the individual minerals and create an osteoconductive material with a gradual resorption profile optimal for bone defect remodeling.

The polymer carrier component of SIGNAFUSE is designed for aggressive intraoperative handling and rapid, biologically inert resorption from the implant site (**Figure 6**). The patented polymer carrier is comprised of a blend of low and high molecular weight alkylene oxide polymers, which produces a carrier viscosity that is optimal for use with bone graft materials. This moldable, highly biocompatible carrier allows for accurate graft placement and containment at the defect site, followed by rapid dissolution and resorption into the surrounding tissues. This rapid dissolution allows immediate access to the bioactive glass and granular components of SIGNAFUSE to initiate the healing process.

SIGNAFUSE Mechanism of Action

Immediately following implantation, the polymer carrier resorbs into surrounding tissues as the bioactive glass particles elicit a homogeneous, osteostimulative response within the matrix of biphasic granules. This response promotes the adhesion, proliferation, and differentiation of bone healing cells on the newly formed apatite surface layer, and facilitates a uniform progression of these processes to the biphasic granulate matrix (**Figure 7**). The biphasic HA/ β -TCP matrix resorbs in tandem with the host healing process to facilitate structural development and remodeling of the fusion site. The various dissolution effects and healing performance of SIGNAFUSE have been verified using established laboratory tests and in a preclinical spine fusion rabbit model.⁵

**In vivo* performance is not predictive of performance in humans.



Figure 4.

The patented size range of 45S5 Bioglass within SIGNAFUSE undergoes a unique surface modification that allows for direct bonding with surrounding local bone.

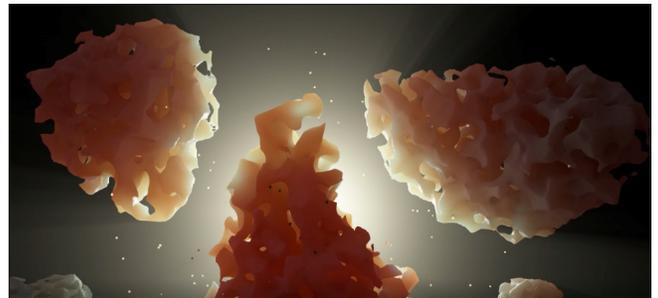


Figure 5.

Relatively insoluble HA and fast resorbing β -TCP granules of SIGNAFUSE combine to make an osteoconductive environment.



Figure 6.

The patented polymer carrier component of SIGNAFUSE is moldable and allows for accurate graft placement and containment at the defect site.



Figure 7.

The response elicited by the 45S5 Bioglass promotes the adhesion, proliferation, and differentiation of bone healing cells on the newly formed apatite layer on the biphasic granules.

The power of design

The ideal environment for bone healing from beginning to end



Fred Mo is a paid consultant of Bioventus LLC and received compensation from Bioventus LLC related to this article.

† see IFU for full list of indications, contraindications, and warnings.

References:

1. Brunelle JB, Cook RL, Antone DS, inventors; Bioventus, LLC, assignee. Moldable bone graft compositions. US patent 9,566,368 B2. February 14, 2017.
2. Hench LL. The story of Bioglass. *J Mater Sci Mater Med.* 2006;17(11):967-78.
3. Gerhardt LC, Boccaccini AR. Bioactive glass and glass-ceramic scaffolds for bone tissue engineering. *Materials.* 2010;3(7):3867-910.
4. Yang SS, inventor; Unicare Biomed, Inc., assignee. Compositions and methods to repair osseous defects. US Patent 6,228,386 B1. May 8, 2001.
5. Fredericks D, Peterson EB, Watson N, Grosland N, Gibson-Corley K, Smucker J. Comparison of two synthetic bone graft products in a rabbit posterolateral fusion model. *Iowa Orthop J.* 2016;36:167-73.

Indications for Use

SIGNAFUSE is a bone void filler device intended for use in bony voids or gaps that are not intrinsic to the stability of the bony structure. These defects may be surgically created osseous defects or osseous defects created from traumatic injury to the bone. SIGNAFUSE is indicated to be packed gently into bony voids or gaps of the skeletal system (ie, extremities, pelvis and posterolateral spine fusion procedures). SIGNAFUSE can also be used with autograft as a bone graft extender in posterolateral spine. The device provides a bone void filler that is resorbed and replaced with host bone during the healing process.

Contraindications

SIGNAFUSE is not designed or sold for any use except as indicated. Do not use SIGNAFUSE in the presence of any contraindication. SIGNAFUSE is contraindicated where the device is intended as structural support in the skeletal system. Other conditions representing contraindications include:

- Severe vascular or neurological disease
- Uncontrolled diabetes
- Severe degenerative bone disease
- Uncooperative patients who cannot or will not follow post-operative instruction, including individuals who abuse drugs and/or alcohol
- Hypercalcemia, abnormal calcium metabolism
- Necrosis at the recipient site
- Inflammatory bone disease such as osteomyelitis
- Malignant tumors
- Severely impaired renal function
- Intra-articular implantations

Warnings

SIGNAFUSE is not intended for load-bearing uses. It is important to ensure that the area where SIGNAFUSE has been implanted be properly secured mechanically with rigid fixation to strengthen the surroundings. Attempts should not be made to modify the size of the granules or to change their shape. It is important to maximize contact between existing bone and the implant to ensure proper bone regeneration. The safety and effectiveness of SIGNAFUSE on patients with the following conditions is unknown:

- Documented renal disease
- Metabolic bone disease
- Pregnant women
- Pediatric patients
- Radiation bone therapy
- Long-term infection
- Cardiovascular disease precluding elective surgery

Please see instructions for use for a complete list of contraindications, warnings, and precautions on the product label, at www.bioventussurgical.com, or by calling 1-800-637-4391.

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