SIGNAFUSE™ Case Report

# ADULT SCOLIOSIS REVISION

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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 scoliosis and back pain with bilateral rod failure

**Procedure**
Revision fusion from T9-S2 with instrumented posterolateral fusion

**Outcome**
X-ray after 13 months confirms fusion

## Patient

A 46-year-old female presented to the clinic with scoliosis and back pain with bilateral rod failure above L5 **(Figure 1)**. Further, there appeared to be a break in the bone fusion mass at the site of rod failure. Previously, the patient was diagnosed with progressive scoliosis and underwent thoracolumbar fusion to the pelvis. She resumed normal function and activity levels following this initial surgical intervention. Two years after this initial procedure, she started developing significant pain in her back, especially with activity. The patient began seeking physical therapy and pain management. Follow-up with the patient revealed breakage of both rods in her construct, and additional surgical intervention was indicated.

## Procedure

The objective of the surgery was to perform a revision fusion from T9 to S2. Previous posterior bone fusion above L5 was ultimately preserved, but the lack of bone fusion in the lower lumbar area near the bilateral rod failure (L5) was revised with a posterolateral fusion procedure using 30 grams of SIGNAFUSE (15 grams per side) mixed with local autograft. Pedicle screws and rods were used for fixation. No complications were reported.

## Outcome

Radiographic assessment at 13-months post-operation showed intact pedicle screws and rods in satisfactory and unchanged position with evidence of a posterolateral fusion mass **(Figures 2 and 3)**. X-rays demonstrated new bone formation posterior and lateral to the rods in the lower lumbar region, and no loosening of the instrumentation. Previous posterior bone fusion was present in the pre-operative anterior/posterior thoracolumbar spine X-ray **(Figure 4)**. The new bone fusion mass is clearly evident surrounding the new instrumentation in the posterolateral lower lumbar region in the 13-month post-operative anterior/posterior thoracolumbar spine X-ray after SIGNAFUSE was applied **(Figure 4)**. Patient was symptom free and returned to all previous activities with no limitations.

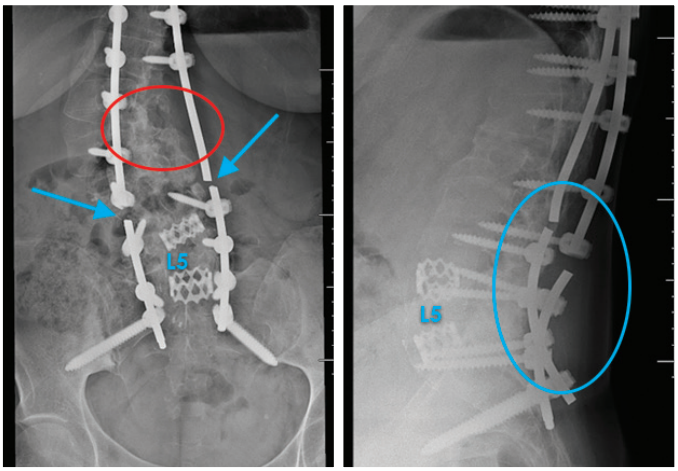
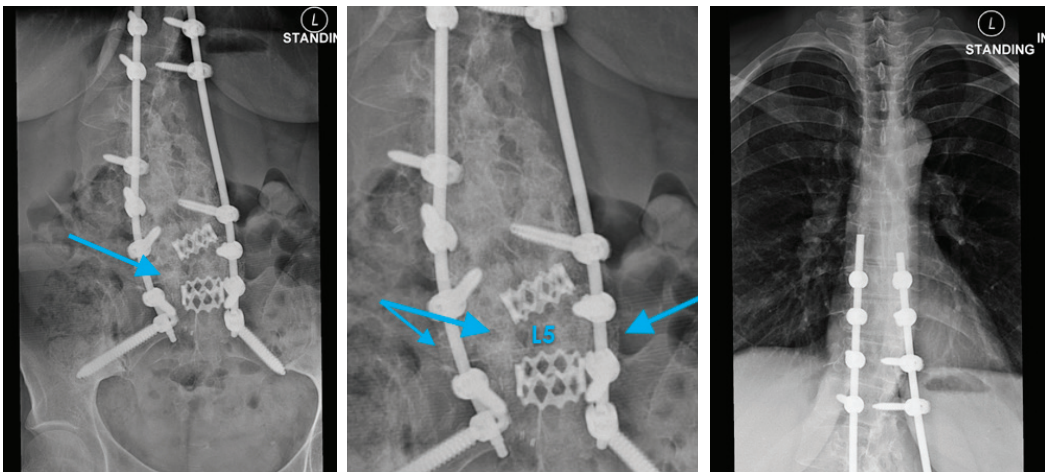



**Figure 1.**
Pre-operative anterior/posterior (left) and lateral (right) thoracolumbar spine X-rays of the patient. Blue arrows indicate bilateral broken rods above L5. Red circle indicates there is bone fusion mass from previous surgery along the posterior midline (left), but there is a lack of posterolateral bone fusion mass in the lumbar region indicated by the blue circle (right).

## Post-operative

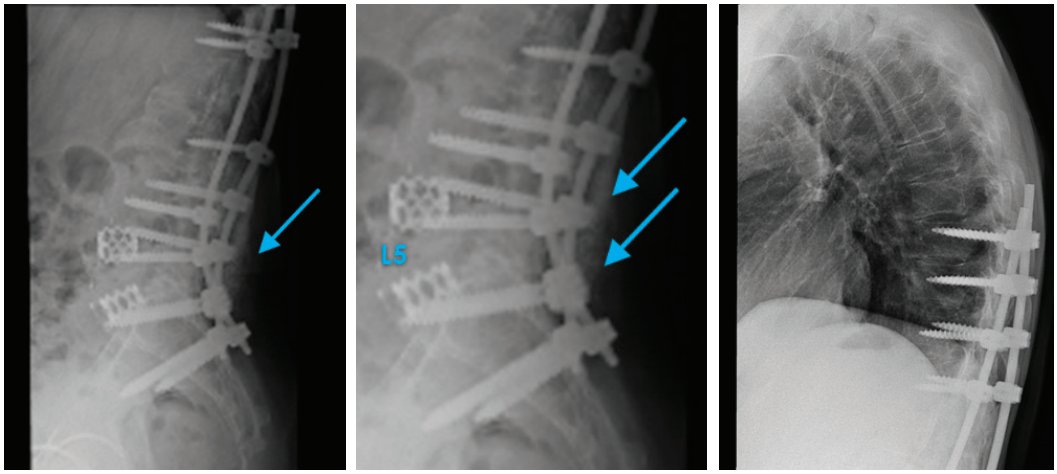
### Figure 2.

13-month post-operative anterior/posterior standing thoracolumbar spine X-rays of the patient (middle image is a magnification of image on the left). Hardware instrumentation appears to be in satisfactory and unchanged position in thoracic and lumbar regions (all three images). Arrows indicate the presence of the new fusion mass from the revision surgery with SIGNAFUSE posterior and laterally in the lower lumbar region.



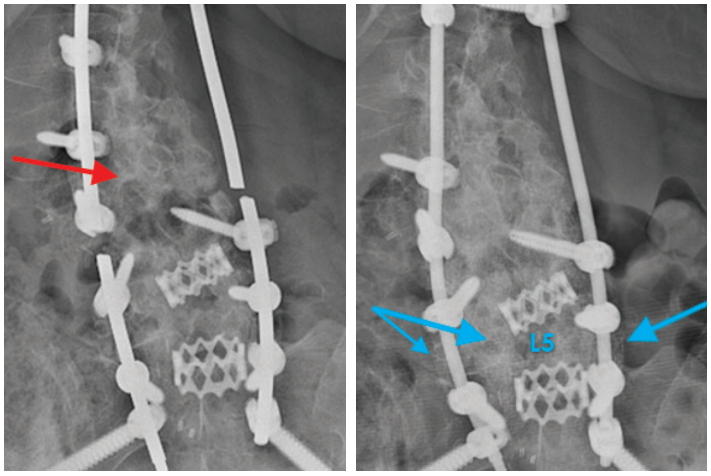

### Figure 3.

13-month post-operative lateral standing thoracolumbar spine X-rays of the patient (middle image is a magnification of image on the left). Hardware instrumentation appears to be in satisfactory and unchanged position in thoracic and lumbar regions (all three images). Arrows indicate the presence of new bone fusion mass from the revision surgery with SIGNAFUSE posterolaterally in the lower lumbar region.




### Figure 4.

Comparison of pre-operative (left) and 13-month post-operative (right) anterior/posterior thoracolumbar spine X-rays of the patient. Red arrows indicate previous posterior bone fusion (left). Blue arrows indicate new bone fusion from the revision surgery with SIGNAFUSE in the posterolateral lower lumbar region (right).



## 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 5)**. 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 6)**. 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 7)**. 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 8)**. 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.

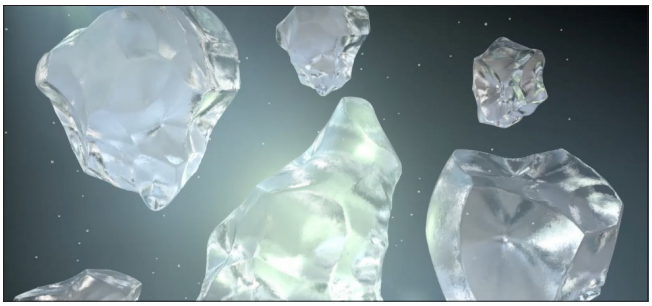


**Figure 5.**

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

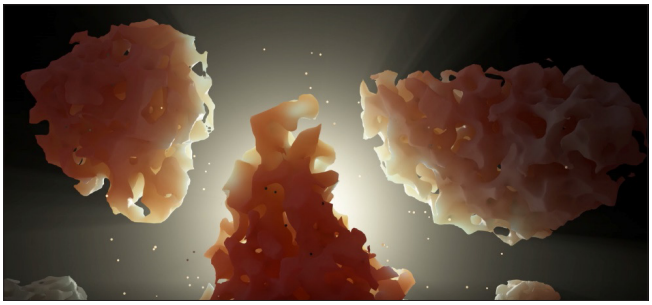


**Figure 6.**

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

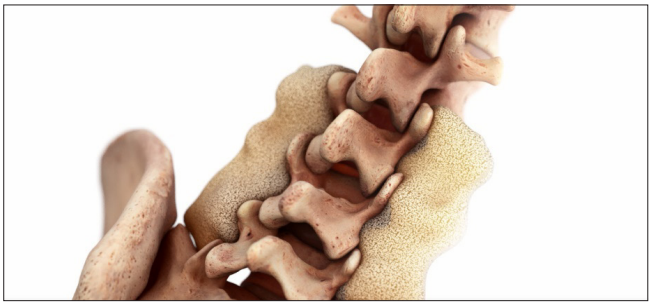


**Figure 7.**

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

**Figure 8.**

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.

**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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