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The Spine Journal 6 (2006) 600–602

THE SPINE JOURNAL

FACES OF SPINE CARE

From Imaging…

Bone void filler in posterior iliac crest reconstruction and to supplement intertransverse process fusion

The synthetic cancellous bone void filler Beta Tricalcium Phosphate (B-TCP; Vitoss, Orthovita, Malverne, PA) provides an osteoconductive scaffold. Its unique wicking capability also renders it osteoinductive and osteogenic when it is combined with autogenous bone marrow aspirate. The efficacy of B-TCP as a non–weight-bearing bone void filler was evaluated in two clinical settings: posterior iliac crest reconstruction (10 patients), and intertransverse process fusion when accompanied in a 50:50 mix with autogenous laminectomy bone (3 patients).

After posterior iliac crest bone harvesting, 10 patients had posterior iliac reconstruction performed using granules of B-TCP (Vitoss). Cervical laminectomies with instrumented fusions were performed in five patients, while another five undergoing multilevel anterior corpectomy/fusion and plating warranted simultaneous posterior arthrodesis. Patients were followed a minimum of 9 postoperative months.

Accompanying 1–2 level instrumented lumbar fusions, three patients had intertransverse process fusions performed. Autogenous laminectomy bone was supplemented with B-TCP in a 50:50 mix. The extent of fusion was evaluated on two-dimensional computed tomographic studies performed 3 and 6 months postoperatively (Figs. 1–4). Patients were followed a minimum of 8 postoperative months.

Computed tomographic studies of the posterior iliac crest showed 80% incorporation by the third postoperative month and full incorporation by the sixth postoperative month. Of note, the one patient who developed a postoperative hematoma demonstrated moderate myositis ossificans. As this patient was the third in the study, all

Fig. 1. This coronal two-dimensional computed tomographic study obtained 6 months postoperatively revealed near continuous incorporation of the posterolateral fusion mass placed at the time of laminectomy and instrumented fusion from L4–S1. The graft included a 50:50 mix of autogenous laminectomy bone and B-TCP (Vitoss).

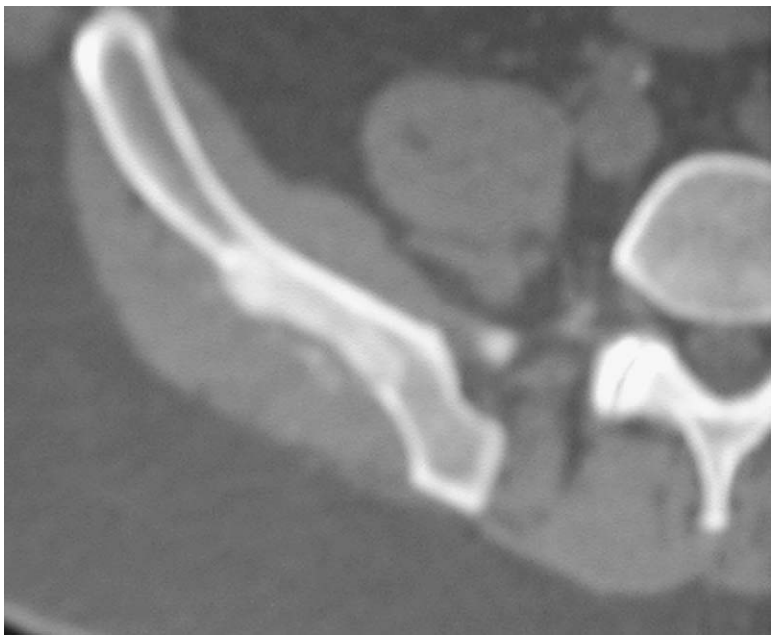

Fig. 2. Posterior iliac crest reconstruction with B-TCP (Vitoss) was performed in a patient undergoing a cervical laminectomy with instrumented fusion requiring autogenous bone graft. On this bone-window axial two-dimensional computed tomographic bone-window study performed 3 months postoperatively, rapid incorporation of B-TCP granules placed within the donor site defect may be seen.

subsequent patients had drains placed intraoperatively, and no subsequent hematomas were encountered.

Of the three patients undergoing intertransverse process fusion with autogenous laminectomy bone and B-TCP (50:50), all patients showed partial incorporation (70%) by the third postoperative month, and full incorporation by the sixth postoperative month (Fig. 1). No additional complications were encountered.

Synthetic bone void fillers avoid the morbidity of autograft harvesting and the potential infectious complications of allograft [1]. B-TCP (Vitoss) offers osteoconduction, osteoinduction, and osteogenicity when combined with bone marrow aspirate. B-TCP contains 39% calcium and 20% phosphorus (molar ratio 1.5) [chemical formula is B-$Ca_3(Po4)_2$]. Scanning electron microscopy shows the mean size of the B-TCP crystallites is 102 nm, while interconnecting pores result in a 90% void space. Larger pores (diameters of 100 microns to 1 mm) potentiate bony ingrowth and vascularization, while smaller pores foster fluid transport, wicking capacity, hemostasis and the retention of nutrients [1]. B-TCP (Vitoss) is Food and Drug Administration–approved as a bone void filler and a biocompatible implant.

In animal models, B-TCP compares favorably with other synthetic, autograft, or allograft alternatives to bone supplementation. When three bioactive bone cements were compared—apatite and wollastonite containing glass-ceramic (AW-GC), B-TCP, and hydroxyapatite—AW-GC particles were more fully incorporated into bone, reflecting a higher bioactivity than B-TCP or hydroxyapatite [2]. Filling tibial metaphyseal defects in mature rabbits, four different variants of calcium phosphate synthetic products were comparably effective as bone void fillers [3]. B-TCP proved superior to B-TCP combined with 3.5% hyaluronate [4]. In an evaluation of three bone void fillers used to reconstruct the mandibular alveolar ridge of dogs, autograft proved

Fig. 3. This coronal bone window two-dimensional computed tomographic study obtained 3 months postoperatively documented incorporation of B-TCP (Vitoss) granules into the posterior iliac crest donor site.

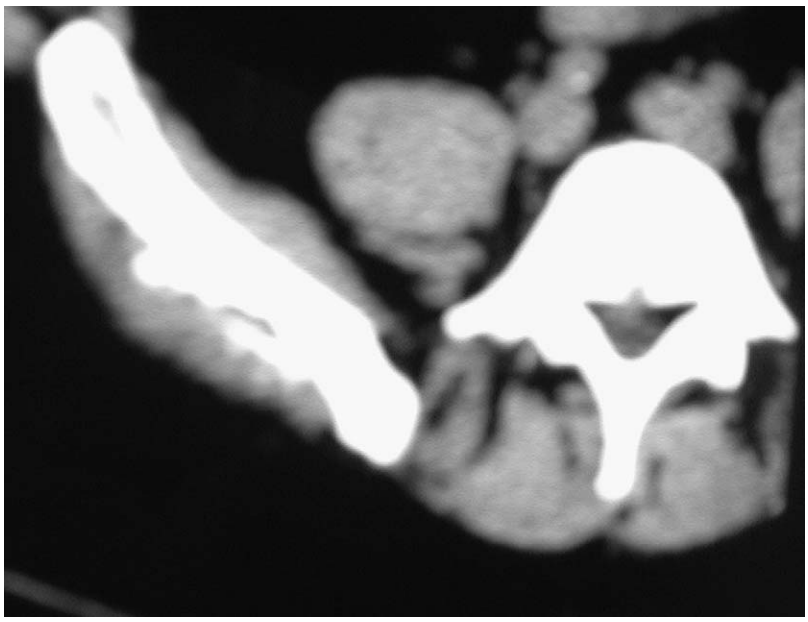

Fig. 4. Six months postoperatively, the axial two-dimensional computed tomographic soft-tissue image demonstrated near complete incorporation of the B-TCP granules into the posterior iliac crest donor site.

superior to B-TCP and freeze-dried allograft [5]. Fusion constructs were studied using bright-field polarized light microscopy and scanning electron microscopy [6].

B-TCP has also been shown to be an effective bone void filler in human clinical trials. When fractures of the calcaneus were filled with granules of B-TCP, radiographs 2 months later demonstrated bone filling the gap [2]. In a prospective randomized double-blind study involving patients undergoing noninstrumented and instrumented spinal fusion, the adequacy of intertransverse process fusions using autogenous iliac crest graft on one side and B-TCP with autogenous laminectomy bone graft (1:1 ratio) on the other side was compared [7]. Both fusion masses proved equally effective. Meadows also performed multilevel laminectomies with noninstrumented and instrumented fusions but specifically used B-TCP (Vitoss) to supplement iliac crest autograft [8]. Thirty-two patients were evaluated 5–7 months after surgery All demonstrated fusion on plain X-rays. In the two series presented, B-TCP (Vitoss) demonstrated adequate incorporation within 6 postoperative months. Incorporation occurred whether B-TCP with bone marrow aspirate was applied in granular form over the posterior iliac crest or when it was applied in blocks over lumbar transverse processes in conjunction with autogenous laminectomy bone.

Acknowledgments

I would acknowledge the Joseph A. Epstein Neurosurgical Education Foundation for supporting this research. The editorial expertise of Dr. Joseph Epstein and Ms. Sherry Grimm, Administrator of Long Island Neurosurgical Associates is also appreciated.

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doi: 10.1016/j.spinee.2005.12.031