Current Orthobiologics for Elective Arthrodesis and Nonunions of the Foot and Ankle

George F. Wallace, DPM, MBA

KEYWORDS

• Value analysis • Nonunions • Orthobiologics • Osteoinduction • Osteoconduction

KEY POINTS

- Surgical principles encompassing every facet of an intended procedure need to be followed to increase the probability of fusion.
- Orthobiologics are expensive. Are they absolutely necessary to facilitate an initial fusion or should they be reserved for the nonunion?
- Over the course of time, more and possibly improved orthobiologics will be brought to market in hopes of lessening the nonunion rates of arthrodesis of the foot and ankle. Therefore, foot and ankle surgeons have to be kept informed about these new products.

INTRODUCTION

As in any discussion germane to medicine, there are certain key words and concepts to be initially addressed.

For the broad category of orthobiologics, the important words and definitions used throughout this article and in clinical situations when discussing this topic are defined.

Orthobiologics/Osteobiologics

Orthobiologics/osteobiologics are materials derived to promote formation of bone in arthrodeses, osteotomies, and fractures. They are biologically derived. These terms are for the general heading of a plethora of materials to aid in bone healing.[1] No discussion on the topic is complete without mentioning the seminal work of Urist and colleagues[2,3] in the early 1960s, with the discovery of bone morphogenic protein (BMP) and its function in bone regeneration.

Osteoinduction

In osteoinduction, stem cells are recruited and can be differentiated into osteocytes to aid healing.

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Podiatry Service, Ambulatory Care Services, University Hospital, 150 Bergen Street G-142, Newark, NJ 07103, USA
E-mail address: wallacgf@uhnj.org

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Osteoconduction

Orthobiologics are inserted as a porous scaffold so bone can proliferate. Additionally they are used as a filler with some use in delayed or nonunions.

Nonunion

Nonunion is the absence of bone healing over 9 months without radiographic evidence of healing over 3 consecutive months. Nonunions never heal on their own. The healing potential has been lost. Delayed unions maintain that potential. Types of nonunions are hypertrophic and atrophic. A general percentage often cited for ankle and rearfoot procedures leading to nonunion is approximately 10%.[4]

Osteogenesis

Osteogenesis provides osteoconductive and osteoinductive properties along with actual fabrication of new bone. Osteoblasts are present within the graft. Only human autograft is osteogenic.

Table 1 lists the types of orthobiologics and provides examples for each.

There are a multitude of products available offering 1 or more of the properties described previously. Their selection depends on whether the application will be during an initial surgery or during a second or even third surgery. Orthobiologics are devised to achieve higher rates of fusion.[1]

SURGICAL PREPARATION

Does the surgeon want to mitigate chances of a nonunion? Then select patients wisely, guarantee compliance, and/or practice sound surgical principles during every case. Even if all of these tenets are followed, however, nonunions can occur. The incidence rate of this complication will never be zero, as would be desired.

Select Patients Wisely

Selecting patients wisely is just about an impossibility. Many patients today have comorbidities and are taking many medicines. A patient who would have been not cleared for surgery years ago is now cleared. Therefore, a thorough medical history is required preoperatively. This alerts the foot and ankle surgeon and begins a discussion of whether an orthobiologic should be used. Some salient findings that may hamper healing are as follows:

- Diabetes especially with neuropathy
- Smoking
- Peripheral artery disease
- Obesity

Table 1
Orthobiologic properties and examples

Osteoinduction	Osteoconduction	Osteogenesis
BMP	Autografts	Autografts
DBM	Allografts	
Allograft chips	DBM	
PRP	Ceramics	
rh-PDGF	Carbon	

Note: Above products will have various trade names.