Bone Graft Vs Bone Substitutes in Treatment of Cavitary Benign Bone Tumors

A Systematic Review

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List of Abbreviations

Abb.	Full term
ABCs	*Aneurysmal Bone Cysts*
BMP	*Bone Morphogenetic Protein*
CPCs	*Calcium Phosphate Cements*
CT	*Computed Tomography*
DBM	*Demineralized Bone Matrix*
DFDBA	*Demineralized Freeze Dried Bone Allograft*
FD	*Fibrous Dysplasia*
FDA	*Food and Drug Administration*
FGF	*Fibroblast Growth Factor*
GCT	*Giant-Cell Tumor of Bone*
HA	*Hydroxyapatite*
HIV	*Human Immunodeficiency Virus*
HS	*Highly Significant*
IGF	*Insulin Growth Factor*
MRI	*Magnetic Resonance Imaging*
NS	*Non Significant*
PCL	*Poly(ε-Caprolactone)*
PDGF	*Platelet Derived Growth Factors*
PLA	*Polylactic Acid*
PMMA	*Polymethylmethacrylate*
PRP	*Platelet-Rich Plasma*
rhBMP	*Recombinant Human BMP*
S	*Significant*
SBCs	*Simple (unicameral) Bone Cysts*
TCP	*Tri-calcium Phosphate*

List of Abbreviations (Cont...)

Abb.	Full term

TGF .....*Transforming Growth Factor*

TGF-β .....*Transforming Growth Factor β*

VEGF .....*Vascular Endothelial Growth Factor*

β-TCP .....*β -Tri-Calcium Phosphate*

ABSTRACT

Background and Introduction: Extended curettage is the commonest mode of treatment of cavitary benign bone tumors. If a tumor is very large and threatening to involve the joint, complete excision with joint reconstruction may be necessary. Cure rates of 90‑95% have been achieved using curettage as the sole mode of treatment in benign bony lesions. However this treatment is not devoid of controversy and many authors recommend that bone defect after curettage of benign bone tumors should be filled with bone grafts or bone substitutes.

Aim of the Work: To compare clinical and radiological outcomes, when possible after using of synthetic bone substitutes and bone grafts in surgical treatment of cavitary benign bone tumors.

Materials and Methods: This systematic literature review has included 22 studies and consisting of 4 steps which are a systematic search of the literature (PubMed, SCOPUS, Cochrane Library), selection of studies , recording of study characteristics and extraction of data based on clinical outcomes and their comparisons between different surgical groups.

Results: This systematic review has included 1071 patients of which 742 were treated using different types of bone substitutes, while the remaining 329 were treated using bone grafts (allografts or autografts). Comparing between both groups we have found that the difference in the graft incorporation time between both groups was statistically insignificant which was 6.65 months in group A and 7.01 months in group B with P value = 0.355(NS). The difference in the postoperative fracture rate as well was statistically insignificant; 1.9% in group A and 3.9% in group B with P value = 0.294(NS). However, there was a significant difference in the postoperative infection rate between group A (2.1%) and group B (12.8%) with P value = 0.01(S) and in the recurrence rate as well, which was 10% for group A and 4.3% for group B with P value = 0.002(HS).

Conclusion: Synthetic bone graft substitutes have evolved in response to the downsides of autograft and allograft. No level I studies regarding their use in the treatment of bone tumors have been performed. This study indicates that all of the bone substitutes are safe and may be as effective as other bone graft options and with no limitation in their source for filling the large defects. Prospective randomized clinical trials in the treatment of bone tumors comparing bone graft substitutes versus other grafts (autograft and allograft) are necessary to properly delineate the real indications for bone grafting and to demonstrate the graft's efficacy in this regard.

Keywords: *Bone Graft - Bone Substitutes - Cavitary Benign Bone Tumors*

Introduction

Benign bone tumors with true growth potential are frequently treated operatively with *intralesional curettage*. Such benign bone tumors include nonossifying fibroma, aneurysmal bone cyst, eosinophilic granuloma (histiocytosis), and chondroblastoma. [1,2]

Treatment options depend on establishing a diagnosis and involve eradication of the tumor by intralesional resection followed by skeletal reconstruction. The reconstructive approach to the resulting contained bone defects is controversial, and clinical practice is varied. Skeletal reconstruction usually entails bone grafting (an autogenous graft or allograft) with or without internal fixation with a metallic implant, maintaining structural integrity and functional stability of the bone and adjacent joint. [3]

Synthetic bone substitutes may provide early mechanical support while minimizing the risks of disease transmission, nonunion, infection, and donor-site morbidity. [4] Many surgeons now prefer to avoid the morbidity of iliac bone graft harvesting by using the variety of bone graft substitutes now available on the market. However, to date, no reliable, controlled, documented published series have compared bone graft substitutes with natural bone grafts in humans. [4]

The size of the eradicated tumor cavity and the pathology differ so greatly from patient to patient that uniformity in treatment is hard to achieve. Nonetheless, it appears that calcium sulfate result in successful bone healing at pathologic fracture sites after curettage in the range of 50%. This success rate encourages surgeons to try these measures before proceeding with the separate incision necessary for iliac crest bone graft harvesting. [4,6]

Aim of the work

The aim of the study is to compare clinical and radiological outcomes, when possible after using of synthetic bone substitutes and natural bone grafts in surgical treatment of cavitary benign bone tumors.

Review of literature

Introduction:

Cavitary benign bone tumors represent a diverse group of pathological and clinical entities. They vary greatly in aggressiveness and clinical behavior. Thus requiring a broad spectrum of treatment. Many of these lesions can be observed without any form of intervention, while others require complete en bloc excision followed by complex reconstruction. It is important for the treating physician to understand these wide variations of behavior in order to manage patients properly [(1)].

Classification of cavitary benign bone tumors: [(2)]

Cavitary benign bone tumors are generally classified based on their histologic characteristics. These include among others:

- Bone-forming tumors such as osteoblastoma[(3,4,5)].
- Cartilage-forming tumors such as chondroblastoma[(6,8)], chondromyxoid fibroma and enchondroma[(7,10)].
- Giant cell tumor.
- In addition to these tumors that are classified by the world health organization, there are several tumor like lesions of bone that closely resemble benign bone tumors and are included in this discussion. These lesions include solitary

bone cyst, aneurysmal bone cyst, metaphyseal fibrous defect (non-ossifying fibroma), eosinophilic granuloma, fibrous and osteofibrous dysplasia[1,2].

Diagnosis of benign bone tumors & staging:

Patients with benign bone tumors typically present to their primary care physician with either pain, or an incidental finding on radiographs taken for another reason. Initial evaluation of these patients requires a thorough discussion of the nature and duration of the symptoms as well as any history of trauma. More commonly, the clinical history is less specific. [11]

The next step in the diagnostic evaluation is orthogonal radiographs. Often a benign or malignant diagnosis can be made based on these plain films findings. The first characteristic of the radiographs to consider is the location of the lesion. Anatomic location can usually shorten the list of possible diagnoses.

- Epiphyseal or subchondral lesions are commonly chondroblastoma or giant cell tumor.
- Metaphyseal lesions are the most common location of any benign bone lesion and include enchondroma, chondromyxoid fibroma, non-ossifying fibroma, aneurysmal bone cysts (ABCs), and simple (unicameral) bone cysts (SBCs), among others.
- Diaphyseal lesions include fibrous dysplasia (FD) or eosinophilic granuloma. [11]