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TEST YOURSELF: ANSWER

Test yourself answer: supra-acetabular pelvis synthetic bone graft substitute (CERAMENT) with expected resorption of radiopaque graft material

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Answer: Supra-acetabular pelvis synthetic bone graft substitute (CERAMENT) with expected resorption of radiopaque graft material.

There are several bone graft substitutes commercially available in the USA. Radiologists interpreting imaging studies in patients who have undergone procedures utilizing a bone graft substitute should be familiar with their expected imaging appearance. CERAMENT (BONESUPPORT AB, Sweden) is a biphasic bone graft substitute which combines resorbable calcium sulfate (60%) to allow bone in-growth and hydroxyapatite (40%) to promote osteoconduction, as a scaffold for bone growth [1, 2]. Iohexol contrast material is added to CERAMENT to improve fluoroscopic visualization during graft placement. CERAMENT has been available in the USA since 2005 and has been described in a variety of orthopedic applications including the following: treatment of benign bone lesions [3], vertebral augmentation [1], osteotomies for malunion of distal radius fractures [4], acute fractures involving the tibial plateau [5], and a reversed Hill Sachs fracture [6]. Antibiotics have also been added to CERAMENT and used in joint replacement and chronic osteomyelitis [7, 8].

After placement into the bone, CERAMENT induces bone remodeling with simultaneous dissolution and bone formation starting immediately after surgery. Due to the material's microporosity, tissue fluids penetrate the implant with nutrients and growth factors which then promote osteoclasts and macrophages to enter the material and create macropores and promote osseous in-growth [5]. On immediate postoperative radiographs, CERAMENT is expected to appear hyperdense relative to native bone, filling the entire bone void cavity. As remodeling ensues, the components of the material progressively wash out and it will therefore show a progressive decrease in radiographic density until it is completely or near completely resorbed. This resorption process has been reported to occur over a variable timeframe. Iundusi et al. reported graft material resorption within 3–8 months in a series of 24 tibial plateau fractures in which CERAMENT was utilized [5]. Horstmann et al. reported near complete graft material resorption after 1 year when CERAMENT was used in the treatment of benign and borderline bone lesions [3]. Likewise Kaczmarczyk et al. reported complete graft material resorption within 12 months in 13 out of 14 benign bone tumors in which CERAMENT was utilized in management [9]. Leakage of radiographically visible CERAMENT into surrounding soft tissues is possible and has been reported to resorb within 3–6 months [3]. Bone remodeling at the graft site is not always uniform, especially in patients in whom CERAMENT with an added antibiotic agent was utilized for the management of osteomyelitis [10]. Ferguson et al. reported a mean radiographic void filling of 73.8% and a complete void filling in 24.6% of patients in a series of 138 patients with a minimum of 1 year imaging follow-up after treatment of osteomyelitis with CERAMENT G (CERAMENT augmented with gentamycin) [10].

The most common complication associated with CERAMENT is self-limited soft-tissue inflammation. Other complications include recurrence of infection and postoperative fracture. Recurrence of infection has been reported to occur in 4–4.3% of cases after CERAMENT G [8, 10]. The fracture rate after CERAMENT G ranges from 2.5–3% ranging from 0.5–13 months [8, 10]. There were no specific imaging features to suggest recurrent infection, or patients who would be at increased risk of fracture. Horstmann et al. reported an 11% (4 of 35 cases) risk of benign rumor recurrence within 16 months. However, they reported that the rate of product resorption did not influence the indication for reoperation [3].

The case presentation can be found at https://doi.org/10.1007/s00256-020-03430-y

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CERAMENT is a bone graft substitute with a variety of clinical applications. Due to its unique composition and expected bone remodeling after implantation, the postoperative radiographic appearance of this material is variable with complete or near complete resorption of the graft anticipated generally within 1 year. Radiologists who encounter this material in their imaging practice need to be aware of its physiologic properties and expected dynamic imaging appearances.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflicts of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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