Given that the reported device migrated into the pulmonary artery, it can be assumed that it was inadvertently passed into a pelvic vein. Migration of these devices into the pelvic venous system and eventually into the pulmonary arterial system is a rare but possible complication.

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Image-Guided Injection of Bone Allograft and Autologous Bone Marrow for the Treatment of Aneurysmal Bone Cyst of the Jaw

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Editor:

Aneurysmal bone cysts (ABCs) of the jaw are usually treated by curettage or resection followed by reconstruction with autologous bone grafts (1). Long or flat bone ABCs have also been treated with bone particles and autologous bone marrow injections (2). We describe a successful treatment of an ABC of the jaw by image-guided injection of bone particles and autologous bone marrow.

None of the authors have identified a conflict of interest.

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Figures E1–E4 are available online at *www.jvir.org*.

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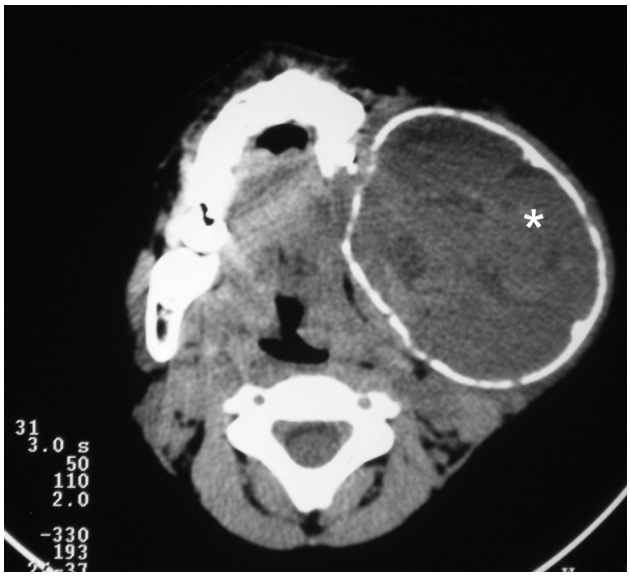

Figure 1. Axial CT image showing an ABC at the left angle of the mandible (asterisk).

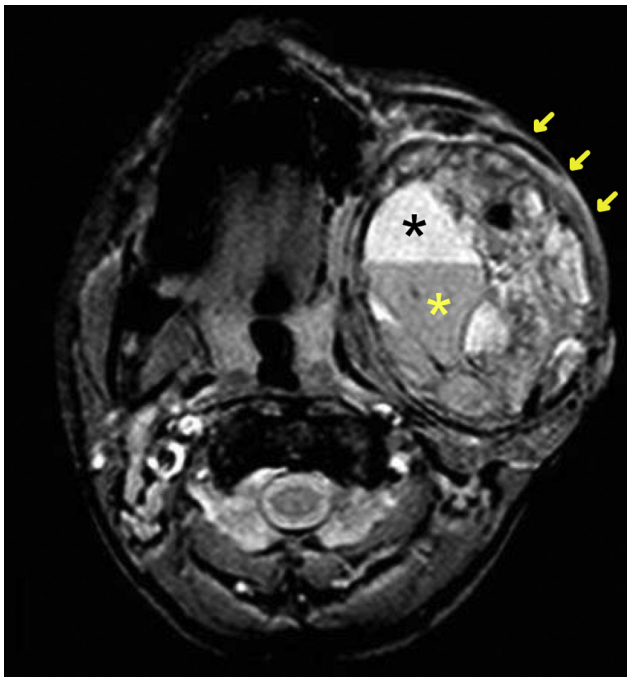

Figure 2. Axial T2-weighted magnetic resonance image showing an ABC at the left angle of the mandible (arrows) with fluid-fluid levels (asterisks).

The institutional review board approved preparation of this case report. A 6-year-old boy presented in 2009 with a 2-cm oral opening, self-limited oral bleeding, pallor (hemoglobin 9.7 g/dL), and pain (visual analog scale score = 8). Computed tomography (CT) scan (Fig 1) showed a thin-walled 7 × 6 × 6 cm diameter (volume 132 mL) expansible bone tumor at the left angle of the mandible. Magnetic resonance imaging depicted fluid-fluid levels (Fig 2).

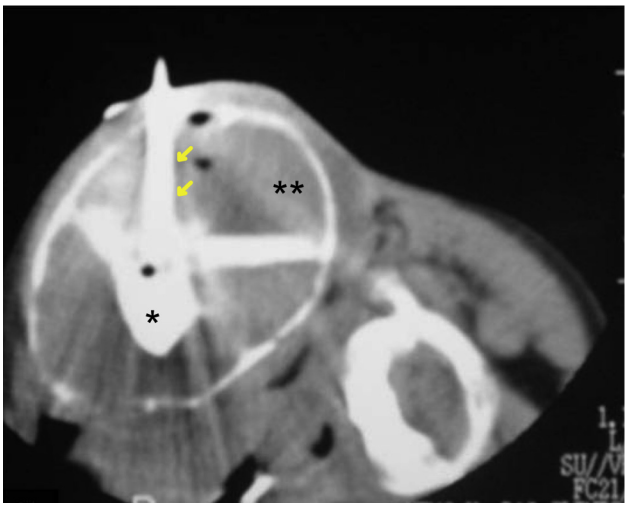

Figure 3. Axial CT image showing an 11-gauge needle (arrows) inserted into the ABC (double asterisk) and mixture of bone particles, autologous bone marrow, and nonionic contrast medium injected into the cyst (single asterisk).

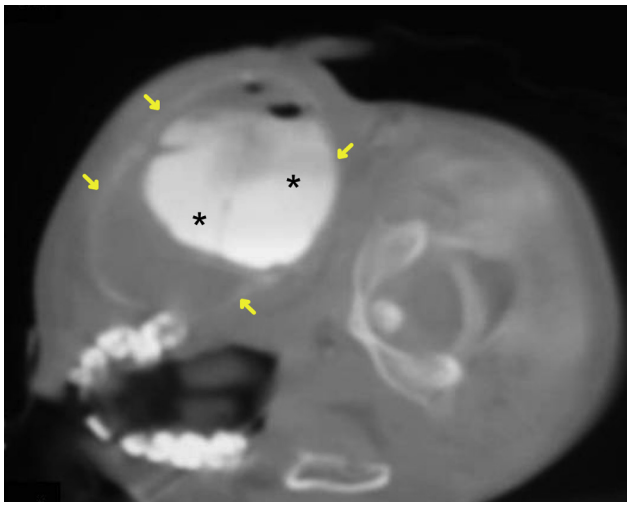

Figure 4. Axial CT image showing the ABC boundaries (arrows) and the injection of mixture of bone particles, autologous bone marrow, and nonionic contrast medium (asterisks) into the larger cyst cavities just after needle withdrawal.

Radiographs, angiography, and ultrasound completed the imaging evaluation (**Figs E1a–c, E2** [available online at *www.jvir.org*]). An open biopsy revealed a fibrous bone lesion with giant cells. An ABC, Musculoskeletal Tumor Society grade 3, was diagnosed.

After multidisciplinary discussion, a minimally invasive approach was proposed. The staff radiologist (R.M.C.d.F.), with 3 years of experience in interventional radiology, performed the procedure in the CT room (Toshiba Auklet CT scanner; Toshiba American Medical Systems, Inc, Tustin, California). Sterile freeze-dried bone allograft (40 g) obtained from a tissue bank was washed with 0.9% sodium chloride and manually crushed with an osseous press and a bone mill (**Fig E3a, b** [available online at *www.jvir.org*]). Smaller particles (30 g) were mixed with 40 mL autologous bone marrow and 10 mL nonionic iodinated contrast medium (VISIPAQUE 270; GE Healthcare, Cork, Ireland). The 30:40 ratio of bone particles to bone marrow was similar to the ratio previously described (2).

Two 20-mL syringes, one empty and the other filled with the mixture, were connected to a 3-way stopcock. The 3-way stopcock was connected to an 11-gauge needle (T-Lok; Angiotech Pharmaceuticals, Inc, Vancouver, British Columbia, Canada). With the patient under general anesthesia and using CT and fluoroscopic guidance, the needle was inserted into the larger cyst cavities (**Figs 3**, **4**). The empty syringe was used to aspirate blood from the cyst. The mixture was then immediately injected after turning the stopcock. This was repeated 4 times, moving the needle tip position into the larger cyst cavities. The total mixture (80 mL) injected was equal to the aspirated blood (approximately 60% of the lesion volume). Bleeding stopped spontaneously after injection, precluding embolization. No complications were observed.

The patient was discharged from hospital the next day with no symptoms. At a follow-up visit 15 days after treatment, he had no bleeding or pain (visual analog scale score = 0). Serum hemoglobin normalized in 3 months. Tumor shrinking and remodeling were observed over time (**Fig 5a, b**). The patient's oral opening widened to 4 cm. Pain or bleeding was not reported during 5 years of follow-up. CT scans confirmed progressive healing and ossification of the jaw (**Fig 6a–c**, **Fig E4a–c** [available online at *www.jvir.org*]).

ABCs usually are treated when the expansible tumor causes pain and swelling, with or without pathologic fracture. Standard surgical management is curettage with or without bone grafting, which has a nearly 21% recurrence rate (1). Available alternative therapies include (*a*) selective arterial embolization as a preoperative adjuvant modality to minimize intraoperative blood loss; (*b*) polymethylmethacrylate injection in benign bone lesions in children, although long-term effects may be deleterious (no growth potential, stress shielding increasing the risk of future pathologic fractures, possible nidus for infection); (*c*) percutaneous alcoholic solution of zein injection, with potential complications including local transitory inflammatory reaction, aseptic bone necrosis, and pulmonary embolism; (*d*) radiation therapy, which is associated with excellent control of ABCs but with chronic effects such as impaired function or secondary malignancies; (*e*) intralesional injections of steroids or doxycycline; and (*f*) bisphosphonate or denosumab treatments. The aforementioned therapies require further studies (1).

Injection of autologous bone marrow into benign bone tumors is mainly associated with unicameral bone cysts (3). Bone marrow in particular would have a better osteogenic capacity to promote healing than any other