

CASE REPORT

Learning from biology: the management of bone healing in an osteoclastic environment

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- › Osseous regeneration of an aneurysmal bone cyst (ABC)
- › Initial synthetic bone graft was revised after 15 months
- › Revision surgery included the use of Orthoss® and BMAC
- › Complete healing of the ABC 12 weeks after revision surgery

In contrast to unicameral (solitary, simple) bone cysts which heal spontaneously in most cases, aneurysmal bone cysts show an aggressive behaviour with expansive growth and local destruction of the surrounding bone. As a typical tumor-like lesion, aneurysmal bone cysts (ABC) are characterized by a local osseous destruction leading to relevant osteolysis of the affected area. Based on progressive cortical thinning ABC may lead to pathologic fractures. The treatment of choice is the surgical resection including extensive curettage of the lesion. However, even after surgical treatment ABCs are associated with a high local osteoclastic activity resulting in recurrence rates between 10–59% [1–3] and even greater in children younger than 10 years. Therefore even after extensive curettage and surgical removal of pathologic tissue the healing of an ABC remains challenging for the orthopaedic surgeon.

This case describes the initial treatment of an ABC using a synthetic bone graft substitute. After progressive resorption of the synthetic bone graft and recurrence of the bone cyst, a revision procedure became necessary. During the revision procedure, cancellous bone was augmented utilising Orthoss® (Geistlich Pharma AG, Wolhusen, Switzerland) as natural hydroxyapatite (HA) in combination with concentrated bone marrow aspirate (BMAC). Orthoss® as a cell scaffold material for autologous cells has a comparatively long resorption period and therefore a volume maintaining effect. The favourable characteristics promote bone formation and stimulate revitalisation through angiogenesis of blood vessels.

A 7-year old female patient was presented with progressive pain of the left knee joint. X-rays showed an osteolytic lesion



FIGURE 1
X-rays of the left knee joint showing significant osteolysis and destruction of a fibula head corresponding to a aneurysmal bone cyst of a 7-year old female patient.

of the fibula head. For further differential diagnosis MRI scan with and without radiopaque solution showed a 2.0 x 2.5 x 5.0 cm multicameral osteolytic lesion of the fibula head affecting both, epiphysis and metaphysis. The patient underwent biopsy in 11-2007 and the histopathological diagnosis showed an aneurysmal bone cyst without any signs for malignant transformation (FIGURE 1).

Surgical treatment included an extensive curettage of the bone cysts followed by filling of the local bone defect with bone substitute. Here, porous beta tricalcium phosphate (TCP) granules (ChronOS™, Fa. Synthes) were incubated with autologous bone marrow aspiration concentrate (BMAC, Harvest Technologies™) as described previously [4,5]. Bone marrow aspiration concentrate (BMAC) was isolated in closed system by density centrifugation of 60 ml vacuum aspirated bone marrow from the iliac crest. After an incubation period of 15 minutes the HA-BMAC composite was implanted into the local bone defect. The size of the TCP granules

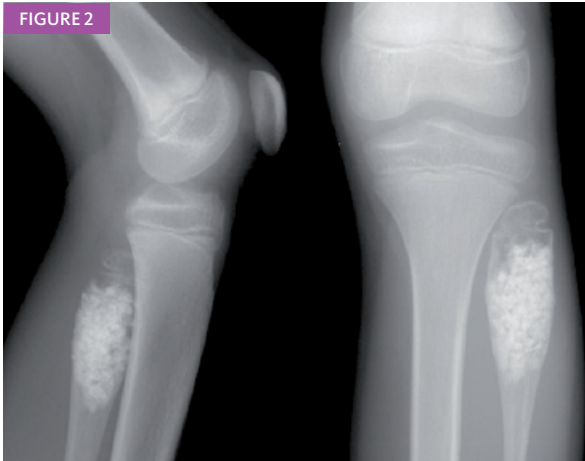


FIGURE 2
X-ray follow-up three months after surgery. At the epiphysis local osteolysis was noted due to early resorption of the TCP indicating a recurrence or persistence of the ABC.

was 1.4–2.8, the porosity 60% and the pore width varied from 100 to 500 μm . The wound healing and further postoperative follow-up was uneventful. The patient received physiotherapy and used crutches with a limited weight bearing for 6 weeks. Three months after surgery new but moderate pain was reported. The radiographs taken three months after surgery showed a regular dense biomaterial within the bone cysts. However, at the tip of the epiphysis the first signs of a questionable recurrence or persistence of the bone cyst was noted (FIGURE 2).

However, due to the strong osteolytic nature of aneurysmal bone cysts and its surrounding tissue, further radiographic follow-ups showed a progressive resorption of the TCP biomaterial indicating a recurrence of the bone cyst. Based on a relevant fracture risk with cortical thinning of the fibula but also on progressive pain during the following months, which occurred especially during night, revision surgery was performed (FIGURE 3). The diagnosis was confirmed by preoperative MRI scans showing an epiphyseal but also a metaphyseal active ABC perforating the central part of the growth plate.

Therefore 15 months after the initial surgery a second curettage was performed and the defect was treated by autolo-

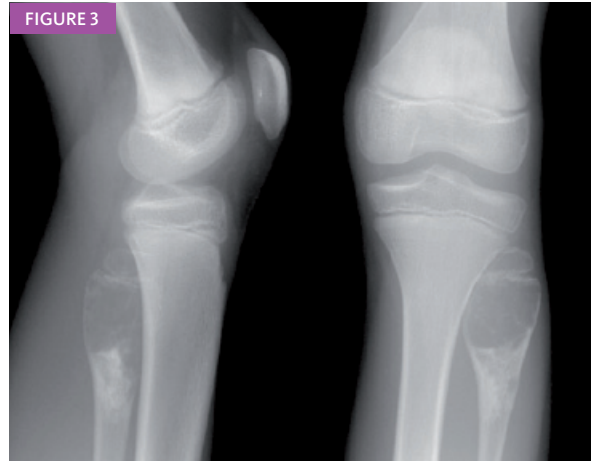


FIGURE 3
A recurrence of a ABC 14 months after curettage and implantation of a TCP-BMAC composite leading to progressive cortical thinning and osteolysis of the fibula head.

gous bone grafting using cancellous bone from the iliac crest. The graft was augmented by a hydroxyapatite (HA)-BMAC composite (each 50 Vol%) using the same procedure and incubation time as described above. The bone filler was a highly porous bovine hydroxyapatite (Orthoss®, Geistlich Pharma AG, Wolhusen, Switzerland). The HA granules have an inner surface area of 80.3 m^2/g , a total porosity of 77%, a crystal size of 15x15x34 nm, and a Ca/P ratio of 1.54–1.60. Postoperative follow-up was uneventful and no complications were observed. The pain disappeared a few weeks after surgery and the ABC healed completely within the next 12 months post-operatively as documented by x-ray follow-up. At latest follow-up the patients has returned to sport activities and is free from any complaints (FIGURE 4 AND 5).

This case report indicates that bone substitutes with a high in vivo resorption or degradation rate may have disadvantages in an aggressive and osteoclastic environment such in ABC, giant cell tumor or enchondroma. In addition, local bone defects in biomechanical relevant regions of the skeleton have to compensate relevant forces, e.g. during weight bearing. To our opinion affected patients with one of the mentioned lesion may benefit from bone fillers which show a slow resorption rate and a high biomechanical stability to-



FIGURE 4 Two months after revision surgery the osteolytic defect is completely covered with autologous bone combined with a HA-BMAC composite.

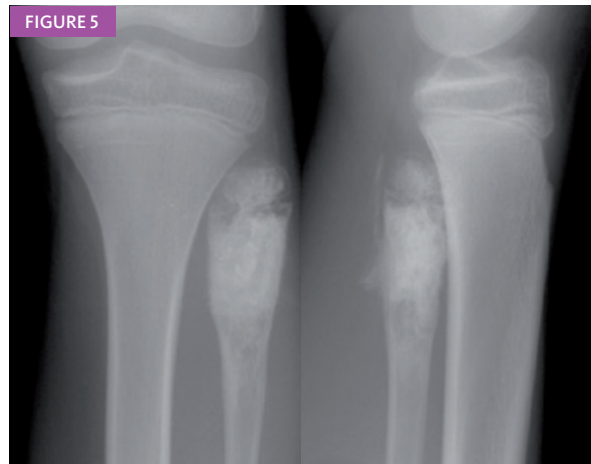


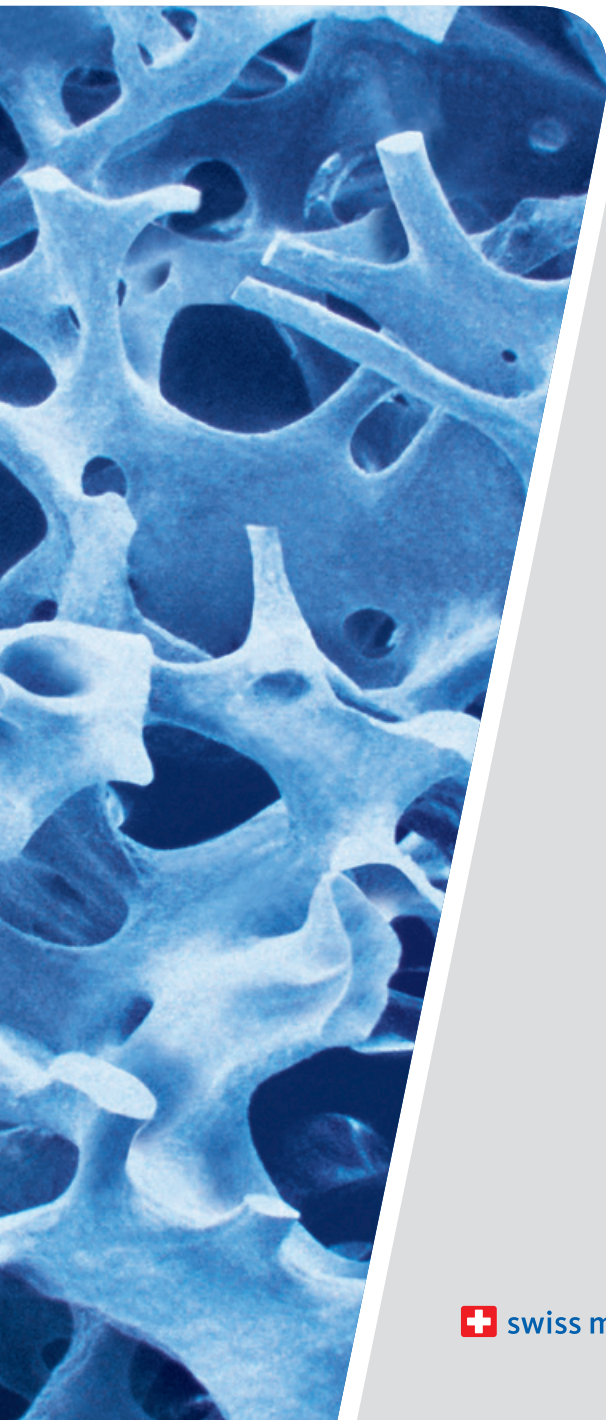
FIGURE 5 Complete healing of the ABC 12 weeks after revision surgery using a HA bone substitute combined with autologous cell therapy (BMAC). Cortical bone remodeling has led to relevant thickening.

wards pressure and torque forces. Here HA, with a large surface area promoting binding of extracellular matrix proteins but also the attachment and adherence of local cells, is a useful option compared to other biomaterials. Although 50 Vol% of the local bone defect was treated by autologous bone grafting, a combination with the HA carrier described above and a BMAC, has led to complete healing

of the ABC. It is evident that bone marrow cells have been applied successfully since many years in other bone healing disturbances such as osteonecrosis or pseudarthrosis [6-8]. Further clinical studies with statistical relevant cohorts have to show the efficiency of cell therapy in bone regeneration.

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