Summary. Demineralized bone powder (DBP) was prepared from human cortical bone using methods to preserve its osteoinductive properties. The DBP was then used in 100 consecutive patients in whom autologous grafts would normally be used. Thirty-eight of these patients had bone tumors and underwent 40 grafting procedures. There were 15 sarcomas and 23 benign conditions. Various procedures were applied to these groups of patients: massive allografts (16 cases), porous-coated custom prostheses (three), curettage and bone graft (21). Patients were followed long enough to establish whether or not radiographic union had been achieved. In the allograft group the average time to union was 8.5 weeks (range 4–19 weeks). There were two nonunions in the same patient. There were also two infections in this group, which necessitated allograft removal. In the prosthesis group, the average time to radiographic union between the host and the prosthesis was 4 weeks. The curettage group had radiographic evidence of incorporation at an average of 4.1 weeks (range 2–6 weeks). There were no complications in this group. DBP showed efficacy in the treatment of space-occupying lesions of bone when curettage was used as the treatment modality. Furthermore, DBP shows promise in the induction of bony union between host bone and porous-coated prostheses. While DBP appeared effective in promoting union between the host and large allografts (union rate 86%), a higher union rate would be desirable.

Key words: Demineralized bone powder—Bone tumor—Allograft

Introduction

Autograft bone has been used in the treatment of bone neoplasms for many years; however, in very large space-occupying lesions or tumors which require massive cortical grafts there is rarely enough autograft available. Allograft bone has been used alone or to augment autograft successfully [1]. These techniques involve osteoconduction, but little if any osteogenesis or osteoinduction [1, 2]. Demineralized bone matrix used as particulate powder has been effective in a clinical setting as an inductive agent [2]. This prospective study was undertaken to investigate the effect of the exclusive use of allogenic bone materials in bone tumor surgery with augmentation with an osteoinductive material, demineralized bone powder (DBP).
Materials and Methods

Preparation of DBP

Demineralized bone powder was prepared according to the methods developed by other investigators [3, 4]. DBP is prepared from cortical diaphyseal specimens removed from appropriate human donors (age 15–50 years). The marrow and soft tissue are removed from the bone and the bone is sectioned and placed in a mechanical crusher, which produces 3- to 5-mm chips. These chips are then placed in a water-cooled bone mill to reduce their size further, resulting in a powder, which is then placed through a sieve, allowing particles 250–500 μm to pass through (average size 400 nm). This material is then demineralized in 0.6 M hydrochloric acid at 4° C for 12 h. The powder is washed with a phosphate buffer (pH 7.4) and distilled water. The powder is further treated in ethanol, then ether. The powder is placed in glass containers and undergoes lyophilization and ethylene oxide sterilization. The glass containers are vacuum-sealed at the end of this procedure and then stored at room temperature until utilized.

Patient Selection

One hundred consecutive patients who would have ordinarily needed autologous bone grafts comprised the original study group. All procedures were performed by the author. Of these 100 patients, 38 had tumorous conditions requiring 40 grafting procedure. The patients were followed clinically with physical and X-ray examination at regular intervals. When both clinical the X-ray examinations confirmed bony bridging and graft incorporation, union was judged present. The patients were followed at least 6 months after union to assess further progression of healing.

Results

There were 38 patients who had various benign or malignant primary processes involving bone. There were 15 sarcomas and 23 benign conditions. The majority of patients were in the third or fourth decade of life. The patients were grouped according to the type of surgical procedure performed: massive allografts (16 cases), porous coated custom prosthesis (three), curettage and bone graft (21).

Massive allograft procedures were defined as those requiring fresh frozen sterile cortical grafts greater than 5 cm in their largest dimension. Both intercalary and osteochondral grafts were included. Once the lesion was resected and rigid internal fixation of the replacement graft was obtained, DBP was meticulously inserted in and about the graft—host junctions. Additional powder was placed upon the surface of the cortical bone several millimeters in thickness. Whenever possible, local muscle was wrapped about the graft area. In two cases, a free fibular transfer was performed to augment the reconstruction. Four of the massive graft patients had chemotherapy preoperatively and at least 6 months postoperatively for either Ewing’s sarcoma (one case) or osteosarcoma (three cases). In the massive allograft group, the average time to union was 8.5 weeks (range