Use of freeze-dried bone allograft with platelet-derived growth factor for revision of a glenoid component

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Glenoid replacement is technically challenging. Removal of a cemented glenoid component often results in a large osseous defect which makes the immediate introduction of a revision prosthesis almost impossible. We describe a two-stage revision procedure using a reversed shoulder prosthesis. Freeze-dried allograft with platelet-derived growth factor was used to fill the glenoid defect. Radiological incorporation of the allograft was seen and its consistency allowed the placement of a screwed glenoid component. There were no signs of new mature bone formation on histological examination.

The addition of platelet-derived growth factor to the allograft seems to contribute to an increase in incorporation and hardness, but does not promote the growth of new bone.

The main reasons for revision of the glenoid component following a total shoulder replacement include loosening and failure of the implant. Removal of a cemented glenoid component often results in a large osseous defect which precludes the placement of a new component and makes revision surgery challenging. Grafting of the defect without introducing a new component can yield satisfactory results and may allow for successful re-implantation of a glenoid prosthesis in the future, if pain persists. Cancellous bone allograft is commonly used in order to avoid morbidity from an iliac crest graft, despite the high rate of delayed incorporation into the host site and the possibility of late resorption. However, if the insertion of a new glenoid component is required it must be delayed until there is complete incorporation of the graft.

The use of platelet-derived growth factor has been introduced recently to increase the availability of growth factors at the site of bone healing. It has been used successfully in lumbar intertransverse fusions and in periodontal regeneration to repair defects of alveolar bone. We describe the use of freeze-dried bone allograft mixed with platelet-derived growth factor for the revision of a glenoid component.

Case report

A 78-year-old man was seen in the emergency department complaining of sudden pain and functional impairment in his right shoulder following minor trauma. Radiographs showed failure of the glenoid implant of a total shoulder replacement, which had been performed at our institution 11 years previously for osteoarthritis (Fig. 1). The diagnosis was confirmed by CT.
At operation all the cement and fragments of the glenoid component were removed, resulting in a defect measuring 3 cm x 2 cm (Fig. 2). This was filled with morsellised freeze-dried allograft obtained from our bone bank and mixed with platelet-derived growth factor to increase its osteogenic activity. The platelet-derived growth factor was prepared from 120 ml of blood three days prior to surgery. The blood sample was sent to the haematology service, where the platelets were separated from 100 ml of the blood and the remaining 20 ml were used to evaluate in vitro platelet output and serological studies. The platelets and cryoprecipitate obtained were stored at -80°C. Platelet-derived growth factor gel was mixed with 20 ml of cancellous freeze-dried bone allograft and the mixture impacted into the osseous defect. Radiographs taken four months later showed full incorporation of the graft (Fig. 3). However, the patient continued to have pain and a limited range of movement, suggesting that a new glenoid component was required. A tear of supraspinatus was diagnosed on arthrography, and a reverse total shoulder replacement was seen as an appropriate solution to both problems. This procedure was undertaken a year after the bone grafting. When the holes for screws of the glenoid component were drilled, hard bone was encountered. Histological examination of the bone obtained by drilling showed well-differentiated trabeculae with no osteoblasts. This necrotic bone was surrounded by fibrotic tissue and no osteoblastic activity or osteoid formation was seen (Fig. 4). Immediate relief of pain was obtained following surgery, with a progressive increase in the range of movement. Two years later, the patient continues to have a painless shoulder, active forward elevation of 100°, internal rotation up to the gluteus and no external rotation. There is no radiological evidence of allograft resorption or loosening of the glenoid component (Fig. 5).

Discussion
The indications for a reverse total shoulder prosthesis remain controversial, although the early results in arthritic
shoulders with deficiency of the rotator cuff have been encouraging. However, no long-term results are available and the frequent formation of a notch at the inferior pole of the neck of the scapula is a possible source of mechanical failure, restricting its indication to patients older than 70 years. Nevertheless, there is little information available on the management of patients with persistent pain following removal of the glenoid component and bone grafting. There is also no current consensus on the relative efficacy of allograft versus autograft in revision shoulder arthroplasty. A few reports mention the use of morsellised cancellous allograft used for glenoid component revision with good results, but its late resorption remains a concern. The addition of platelet-derived growth factor has been shown to stimulate osteoblastic activity and promote early bony fusion. This has led to platelet-derived growth factor being used to stimulate osteogenic activity in vivo, either alone or in combination with hydroxyapatite, autogenous bone graft and freeze-dried cancellous allograft bone chips.

In our patient, we had the unique opportunity to obtain a histological specimen to analyse the effect of platelet-derived growth factor added to morsellised freeze-dried allograft. Histological examination showed that there was no ingrowth of new bone and the platelet-derived growth factor perhaps had acted only as a type of adhesive, increasing the hardness of the allograft, dispelling the fear that its addition might lead to an increase in osteoarthritic activity. As illustrated by this case, the concept that cancellous freeze-dried allograft bone chips combined with platelet-derived growth factor may serve only as a scaffold for early new bone ingrowth, as has been suggested, should be revised.

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References


Fig. 5a
Two years after surgery an osteophytic formation at the inferior edge of the glenoid was observed. No allograft resorption was noted. a) Anteroposterior view and (b) axial view.


