Despite extensive experience with prosthetic replacement for the reconstruction of limbs following juxta-articular resection of tumours, there are few reports of prosthetic replacement of the distal radius. We present two cases of massive bone defects of the distal radius in which alumina ceramic prosthetic replacements were used. We evaluated the patients more than ten years after the procedure. Both patients had degenerative changes to the wrist. This, however, was not associated with pain or decreased function, and both had returned to their previous occupation after surgery.

When a patient has a massive defect of the distal radius, reconstruction using a ceramic prosthesis is a reasonable alternative to using autograft. This method of treatment results in little pain, a moderate range of movement and satisfactory function.

Reconstruction of the wrist joint following excision of the distal radius is challenging because of the functional demands of the hand. Various procedures have been described including arthrodesis using bulk autograft,\(^1\)\(^2\) ulnar translocation,\(^3\) use of a non-vascularised or vascularised fibular graft with or without arthrodesis,\(^4\)\(^-\)\(^10\) osteoarticular allograft\(^11\)\(^,\)\(^12\) and prosthetic replacement.\(^13\)\(^-\)\(^15\) There are few descriptions of prosthetic replacement for defects of the distal radius,\(^13\)\(^-\)\(^15\) and no information regarding the long-term outcome of this procedure have been published.

We present two cases where massive bone defects of the distal radius were treated by a ceramic prosthesis. We evaluated the functional outcome of prosthetic replacement after a follow-up of ten years.

**Case 1**
A 52-year-old right-handed man was referred for the treatment of a recurrent giant cell tumour of the distal aspect of the right radius. He had undergone a previous curettage and grafting with autologous iliac bone nine years earlier. Radiographs revealed an osteolytic lesion of the distal radius (Fig. 1a). Possible options for reconstruction were discussed with the patient. He was reluctant to agree to the use of the proximal fibula since he was anxious about possible morbidity at the donor site including difficulty in walking, paraesthesia, muscle weakness and instability of the knee. He chose prosthetic replacement (Kyocera Corporation, Kyoto, Japan; Fig. 1b), and wide resection of the tumour was performed through a dorsal approach. The affected part of the distal radius was excised en bloc. The lesion did not penetrate the articular cartilage allowing preservation of the carpal bones. The prosthesis was inserted into the proximal radius using cement.

Maintaining the length of the radius is paramount for balance of the ligaments and tendons. The palmar ligaments and the fibrocartilage complex were sutured to the prosthesis. The limb was immobilised in an above-elbow cast for three weeks, after which a protective volar splint was used for one month. The pathological diagnosis was a recurrent giant cell tumour.

Repeated radiographs showed a gradual loss of the radiocarpal joint space resulting in ulnocarpal abutment which caused a mild radial deviation of the hand (Fig. 2a). The extent of migration was evaluated by measuring the distance between the proximal end of the capitate and the distal end of the stem of the prosthesis\(^1\) on anteroposterior radiographs (Fig. 2a). This distance decreased by 5 mm during the first three years after surgery but there was no further decrease. Radiographs also showed a radiolucent line at the bone-cement interface ten years after surgery (Fig. 2b), but there were no associated symptoms.

At 14 years after surgery, the patient has no pain and engages in normal activity. There is no evidence of local recurrence. There is 45° of
supination, 30° of pronation, 30° of extension and 15° of flexion in the wrist. The grip force is 22 kg on the right and 31 kg on the left. He can lift a 20 kg weight with his hands. The functional score using the scale of Enneking et al,16 is 83%.

Case 2
A 55-year-old right-handed man presented with a painful swelling of the right wrist. Radiographs revealed an osteolytic lesion of the radius. He was treated by curettage and an iliac bone graft. Histological examination revealed a benign fibrohistiocytic tumour. Eight months later he returned with recurrent symptoms. Radiographs demonstrated an osteolytic lesion in the distal radius (Fig. 3), and possible options for reconstruction were discussed. Because of previous myocardial infarction and bypass surgery, prosthetic replacement was selected as the treatment of choice because of shorter operating time, using the same technique as in case 1.

Migration of the proximal carpal bones also occurred leading to ulnocarpal abutment with radial deviation of the hand. The distance between the capitate and the implant decreased by 3 mm during the first two years after surgery but did not change further.

A radiolucent line was apparent at the bone-cement interface in the upper limb prostheses is usually non-progressive and the presence of such a line does not itself signal component loosening.17,18 It is probable that the absence of weight-bearing prevents loosening of the prosthesis despite the occurrence of radiolucent lines.

Various bone grafts have been used during radiocarpal fusion for the reconstruction of the distal radius following
resection of skeletal tumours. Most grafts eventually result in solid union giving stability, but movement of the wrist and forearm is sacrificed. Reconstruction using an allograft segment of the distal radius has yielded encouraging results. Advantages of this procedure include no donor-site morbidity, shorter operating time and greater congruency of the radiocarpal joint. Complications include nonunion, fracture, and the possibility of transmitting infectious diseases. In several countries it is difficult to obtain suitable allografts.

Replacement using the vascularised or non-vascularised head of the fibula has been the method of choice because of the anatomical similarities between the distal articulation of the radius and the proximal aspect of the fibula. However, the articular surfaces of the fibular head, the scaphoid and the lunate are quite different. Proximal fibular epiphysial transfer, a procedure for reconstruction of the wrist in children, can cause articular remodelling, which results in a more appearance similar to that of the radial epiphysis, thus preventing deformity of the wrist. However, in adults degenerative change between the proximal carpal bones and the head of the fibula can gradually accelerate because of the lack of articular remodelling. The average range of movement of the wrist after reconstruction using the head of fibula has been noted to be 15° to 21° of flexion, 22° to 40° of extension, 30° to 72° of pronation, and 27° to 58° of supination. Despite osteoarthritic changes and a decreased range of movement, these patients demonstrated little limitation in daily activities or light work. Our findings with prosthetic replacement are comparable to those of reconstruction involving the head of the fibula. Restriction of movement and degenerative changes following prosthetic reconstruction did not cause severe functional problems.

Reconstruction with a ceramic prosthesis has several advantages, including preservation of function, restoration of the anatomy, and the ability to repair large defects while avoiding delayed union and donor-site morbidity which can be associated with the use of an autograft. Suzuki, Ukai and Iwabu described a 38-year-old woman who had undergone reconstruction with this prosthesis after an open comminuted fracture of the distal radius. She had no pain and displayed no difficulty performing daily activities or light work 112 months after replacement.

Degenerative changes to the wrist joint following reconstruction with a ceramic prosthesis appear to be inevitable, but the functional results at ten years suggest that this method may be an acceptable alternative for salvage of the joint in adults. It is reasonable to presume that cases characterised by more extensive soft-tissue involvement would have a higher incidence of distal subluxation and dislocation. Arthrodesis employing autografts may be the procedure of choice in patients with an extensive soft-tissue mass.

Reconstruction with a ceramic prosthesis for massive bone defects of the distal radius prevents delayed union and donor-site morbidity.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References
