A Posttraumatic Distal Radius Allograft: 10 Years Follow-Up

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Abstract

Background Wrist osteoarthritis is a common disease often resulting from malunited fractures of the distal radius. The primary treatment purpose is to provide pain relief, while maintaining strength and mobility whenever possible. In a patient presenting a posttraumatic degeneration of the wrist, deciding which surgical technique, which joints to sacrifice and which to preserve is crucial to optimizing the outcome.

Case Description We describe a 10-year follow-up of an osteoarticular allograft of the distal radius proposed to treat an isolated distal radius posttraumatic degeneration. The patient was young and active. No or slight articular degeneration of the carpal rows was present. The surgical technique was based on a periarticular step-cut that allowed the preservation of the dorsal capsule and the maximum contact between the bone and the allograft.

Literature Review In the literature, the allograft of the radius is described as a solution to an oncologic problem. Considering a posttraumatic scenario other techniques are usually performed. However, compared with artificial interbody fusion devices and prosthetic implants, structural bone allograft retains an advantage in biologic performance. It has osteoconductive properties and is similar to native tissues providing a progressive incorporation by the host.

Clinical Relevance This surgical technique provide a metaphyseal step-cut able to ensure a secure stabilization and a wide contact surface between the allograft and the native bone. Integration of the allograft with good functional and radiological outcome seen after 10 years supports this technique.

Keywords

- ▶ distal radius allograft
- ▶ wrist arthritis
- ▶ distal radius degeneration
- ▶ distal radius fracture
- ▶ radioscapulohumeral

Wrist osteoarthritis often results from malunited fractures of the distal radius. The primary treatment purpose is to provide pain relief, while maintaining strength and mobility when possible. The most common procedures are total or partial wrist arthrodesis, total wrist arthroplasty (TWA), and wrist denervation. In a systematic review, TWA and total wrist fusion both resulted in high patient satisfaction, although the complication and revision rates are higher in TWA.¹

In cases of distal radius articular incongruity with no or slight chondral wear of the carpus, hemiarthroplasty has been proposed.² Although the outcomes are still short-term, distal radius hemiarthroplasty may serve as an intermediate arthroplasty option for those patients with diffuse arthritis but with high activity levels. Complete denervation of the wrist can result in significant pain relief in 75 to 80% of the patients with few postoperative complications while maintaining wrist mobility.³

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Fig. 1 (A, B) Preoperative and (C, D) postoperative X-ray of the injured wrist.

Articular degeneration of the distal radius, without the involvement of the proximal carpal row, can be treated with an osteoarticular allograft. It preserves bone stock and the articular surface of the carpus and can be progressively incorporated into the host.⁴ We describe a 10-year follow-up of an osteoarticular allograft of the distal radius for the treatment of an isolated posttraumatic degeneration of the distal radius.

Case Report

A 39-year-old man presented with posttraumatic incongruity of the distal radius as the result of an open fracture (►Fig. 1). There was a notable articular step of greater than 5 mm in the lunate and scaphoid fossa and an increased radial tilt and inclination. There was no posttraumatic degeneration of the carpal bones (►Fig. 2) or instability on the distal radioulnar joint (DRUJ). Clinically, the wrist was tender with an active arc of motion of 20 degrees in flexion–extension and 30 degrees in pronation–supination. The patient underwent replacement of the entire osteoarticular surface of the distal radius 11 months after the injury. The surgical approach to the wrist was volar. The volar capsule with its ligaments was marked with stitches (►Fig. 3A). A transverse osteotomy was performed with a sharp osteotome from volar to dorsal. This short osteotomy (►Fig. 3B) preserved the dorsal capsule with its ligaments attached to the native dorsal surface of the radius. A small saw was then used to continue the bone cut parallel to the long axis of the bone taking out the volar piece of bone. This resulted in a wide metaphyseal surface, which the allograft could be locked. The osteoarticular allograft was cut using the resected portion of the native radius as a template and was stabilized with a volar plate (►Fig. 3C, D). The volar capsule was sutured to the

Fig. 2 Postoperative computed tomography scan at 6 months.

Fig. 3 (A) The volar capsule is detached and tagged with stitches. (B) Resected margin of the distal radius. A short osteotomy preserves the dorsal capsular and ligamentous attachment to the native dorsal surface of the radius. (C) The allograft is internally fixed to the radius with a volar plate. (D, E) Intraoperative and postoperative X-rays.

capsule of the allograft, while the native dorsal capsule remained attached on the native radial dorsal surface. The DRUJ remained stable despite not suturing the triangular fibrocartilage complex.

The patient was assessed clinically and radiographically. No postoperative complications were observed. After 10 years, the wrist was pain-free with an active range of motion of 40 degrees of extension, 30 degrees of flexion, 30 degrees of ulnar deviation, and 10 degrees of radial inclination, 40 degrees of supination, and 80 degrees of pronation (→Fig. 4). The radiocarpal and DRUJs were stable. The magnetic resonance imaging intensity signal of the distal radius cancellous bone was comparable to that of the carpal bones and the distal ulna, confirming successful graft incorporation with the host bone (→Fig. 5). Asymptomatic joint space narrowing and subchondral cysts of the proximal carpal row were present.

Fig. 4 Clinical results at 10 years.

Fig. 5 (A, B) Radiological results at 10 years. (C) Sagittal T1-weighted, (D) coronal T1-weighted, and (E) axial T1-weighted through metaphyseal line after 10 years.

Discussion

Correction of posttraumatic articular malunion of the distal radius is desirable, as significant step or gap deformities of the articular surface lead to increasing risk of arthritis. Treatment of articular incongruity is challenging, and the challenge is increased in patients with shortening and angulation. Early intra-articular osteotomy can restore the articular congruity and preserve the articular cartilage. In cases where a portion of the articular surface needs to be resurfaced, an osteochondral graft from the rib or the knee can be used.⁵

Osteoarticular allograft replacement has been used for the reconstruction of the distal end of the radius since the 1970s after en bloc malignant tumor resection.⁶ Posttraumatic osteoarticular allograft replacement of the distal radius has not been previously described. However, the use of osteoarticular allograft in posttraumatic conditions in other osteoarticular joints has been reported with a favorable outcome.⁷

This procedure preserves the anatomy and bone stock of the distal radius while maintaining congruency of the radiocarpal joint and soft tissue attachments. The radiocarpal joint is preserved and subsequent limited wrist arthrodesis such as radioscapulohumeral fusion is not precluded. Structural bone allograft has osteoconductive properties and is similar to native tissues allowing progressive incorporation by the host. However, the mechanical properties of structural bone allografts may be a disadvantage in the initial postoperative phase. Fracture of structural allografts has been well documented as the most common complication, with a reported incidence of 14 to 29% in the recent literature.⁸ Bone resorption resulting from creeping substitution,⁹ and immune response¹⁰ has been implicated in some cases, especially for replacement of large defects used after tumor excision. The vascularity of

the bed and the mechanical stability of the graft are of vital importance to allow initiation of a healing response from the host-graft interface. The bed must be prepared to leave bleeding bone. The host-graft interface should be stable to allow vascular ingrowth, while a step-cut improves the contact surface of the bone ends and its stability.¹¹ These factors are largely dependent on the surgeon and emphasize the importance of the surgical approach and preparation of the host site.

Integration of the allograft with good functional and radiological outcome seen after 10 years supports this technique. An entire osteoarticular allograft of the radius with a periarticular step-cut can be a reliable surgical option in posttraumatic arthritis of the whole articular surface of the radius. It can be an alternative solution to prosthetic devices for young patients without articular degeneration of the proximal carpal row. A preoperatively radiographic evaluation is required to find a size-matched fresh frozen osteoarticular allograft of the distal radius. Contraindications include inflammatory arthritis disease and presence of local or systemic infections.

Funding

None.

Conflict of Interest

None.

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