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The souter-strathclyde elbow prosthesis in rheumatoid patients : an in-depth clinical, radiological and biomechanical analysis

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PRIMARY SOUTER-STRATHCLYDE TOTAL ELBOW PROSTHESIS IN RHEUMATOID ARTHRITIS, SURGICAL TECHNIQUE

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Abstract

Background: Total elbow arthroplasty is a well-established treatment for the painful elbow joint in patients with rheumatoid arthritis. We present the results of what we believe to be the first prospective study of the Souter-Strathclyde total elbow prosthesis.

Methods: Between June 1982 and December 2000, 204 primary total elbow prostheses were inserted in 166 patients who had rheumatoid arthritis. No patient was lost to follow-up. The mean duration of follow-up was 6.4 years. All patients were examined preoperatively, at one and two years postoperatively, and at regular intervals thereafter.

Results: Six of the 204 elbows had pain at rest at the time of the latest follow-up. Ten patients (ten elbows) without previous neurological symptoms had development of paresthesias in the distribution of the ulnar nerve postoperatively. Patients who had pain at rest or at night and those who had ulnar nerve symptoms preoperatively were found to have a significant chance of having the same complaints postoperatively. Pain at rest or at night and a decrease in function during the follow-up period were associated with humeral loosening. Twenty-four elbows had revision of the total elbow prosthesis because of loosening of the humeral component (ten), loosening after fracture (six), dislocation (four), infection (two), restricted range of motion (one), or fracture of the middle part of the humeral shaft, proximal to the prosthesis (one). One prosthesis was removed because of humeral loosening, and eight were removed because of deep infection. Another five prostheses were radiographically loose at the time of the latest follow-up. The rate of implant survival, according to the method of Kaplan-Meier, was 77.4% after ten years and 65.2% after eighteen years.

Conclusions: Total elbow replacement is associated with a high complication rate and therefore may be warranted only for seriously disabled patients. Currently, the results associated with the Souter-Strathclyde total elbow prosthesis are comparable with the results associated with other prostheses, but loosening of the humeral component remains a concern.

Introduction

The Souter-Strathclyde total elbow prosthesis (Fig. 1) is mainly used in patients with rheumatoid arthritis or juvenile rheumatoid arthritis. The indications are pain and restriction of motion of the elbow joint combined with grade-IV or V destruction of the elbow, according to the criteria of Larsen *et al.*¹ When a patient has grade-III destruction, his or her age and profession or occupation are factors to consider when deciding whether

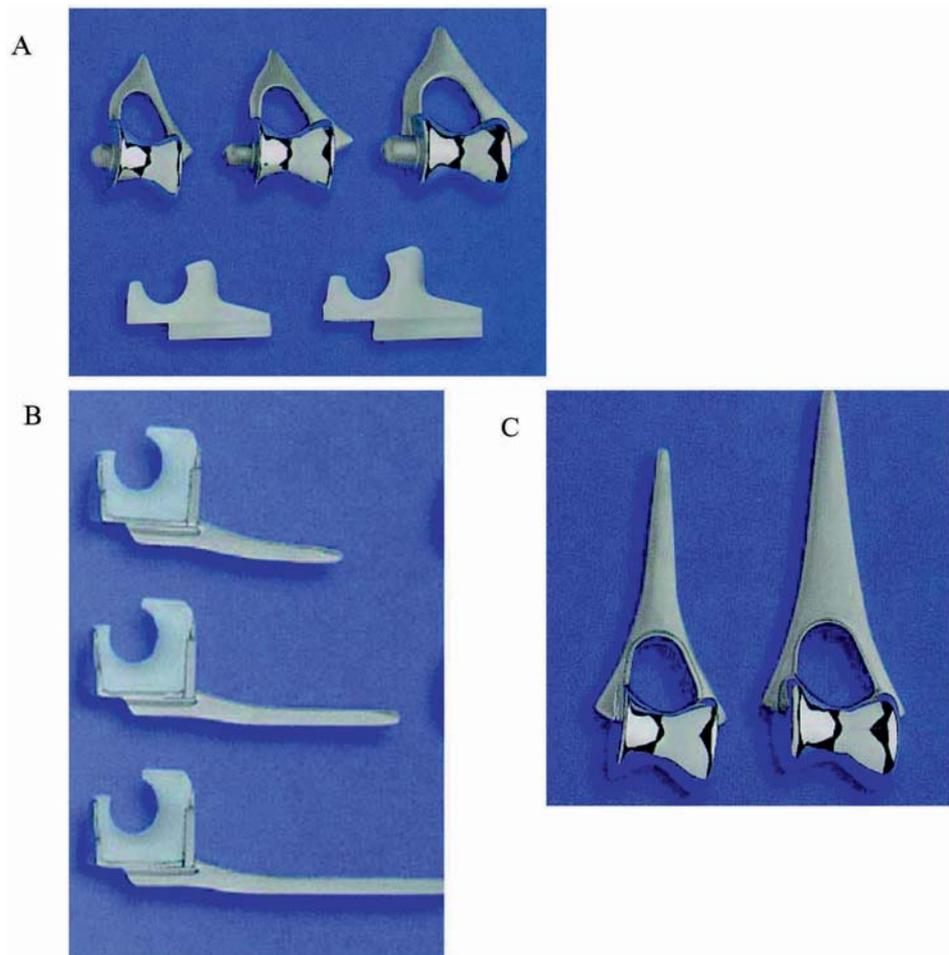


Fig. 1. Clinical photographs of the components of the Souter-Strathclyde prosthesis. A, Small, medium, and large humeral components, and small and medium ulnar components. B, Metal-backed ulnar components. (The snap-fit is optional.) C, Long-stemmed humeral components.

to perform a synovectomy². The Souter-Strathclyde prosthesis might be used in an osteoarthritic elbow, but the long-term clinical results are not known. The prosthesis is not suitable for treatment of posttraumatic distal humeral fractures in the elderly. In such cases, a semiconstrained design with a long intramedullary stem is preferred.

Surgical technique

The patient is positioned in a stable lateral position with the upper arm resting in a separate arm support (Fig. 2). The elbow is flexed 90° with the forearm hanging freely. A longitudinal, slightly laterally curved skin incision (to avoid the tip of the olecranon) is made on the dorsal side of the elbow (Fig. 3), as described by Crenshaw³. The skin flaps are reflected as far as the medial and lateral epicondyles, and, on the ulnar side, the ulnar nerve is localized medial to the triceps muscle. The fibrous arch that covers the ulnar sulcus is incised, and the ulnar nerve is left undisturbed in its bed; transposition is not performed. The posterior aponeurosis of the triceps is mobilized and is transversely incised approximately 8 cm proximal to the elbow. On the radial side of the olecranon, a longitudinal incision is made through the fascia of the triceps and the anconeus. The posterior aponeurosis of the triceps is reflected distally as a tongue separating it medially from the underlying deep tendinous lamina of the triceps. It remains attached distally to the olecranon (Fig. 4). The muscle of the deep part of the triceps is then divided longitudinally along the lateral side of this deep tendinous lamina. This deep tendon of the triceps is released from the olecranon and, with the muscle, is reflected medially as far as the epicondyle.

On the lateral side, the superficial fascia of the anconeus is undermined to the ulnar crest. The anconeus is released from the ulna with a periosteal elevator, and, in continuity with the medial head of the triceps, is reflected laterally. The annular ligament is exposed and is divided sharply from its insertion on the ulna. Two small retractors are placed around the neck, and the neck is osteotomized with a micro-oscillating saw just distal to the radial head. Cutting the whole circumference of the neck is made easier by pronating and supinating the forearm when sawing. The radial head is then removed.

On the medial side of the ulnar crest, the fascia over the flexor carpi ulnaris and the flexor digitorum profundus is incised longitudinally, and the interval between the two muscle bellies is opened proximally. The ulnar head of the flexor carpi ulnaris is stripped medially, and consequently the ulnar nerve is protected by this muscle belly. The anterior band of the medial collateral ligament is saved for stability. After this ligament is lifted with a small periosteal elevator, any osteophytes along the medial side of the olecranon can be removed. At this stage, a synovectomy can be performed. Flexing

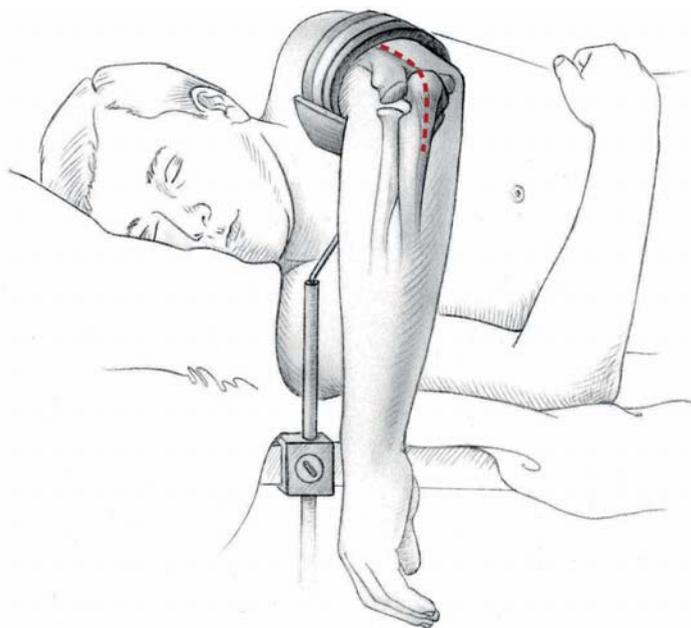


Fig. 2. Positioning of the patient.

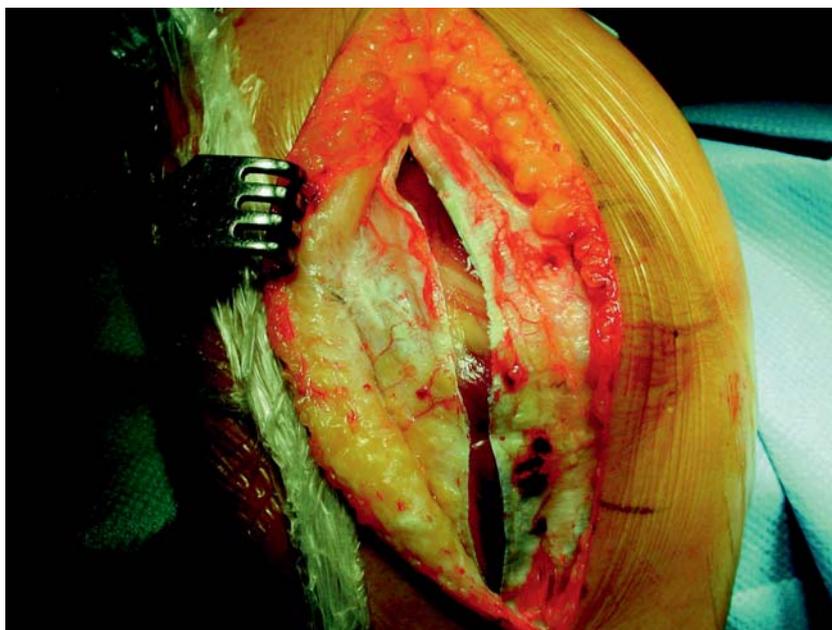


Fig. 3. Incision of the posterior aponeurosis of the triceps and the fascia of the anconeus.

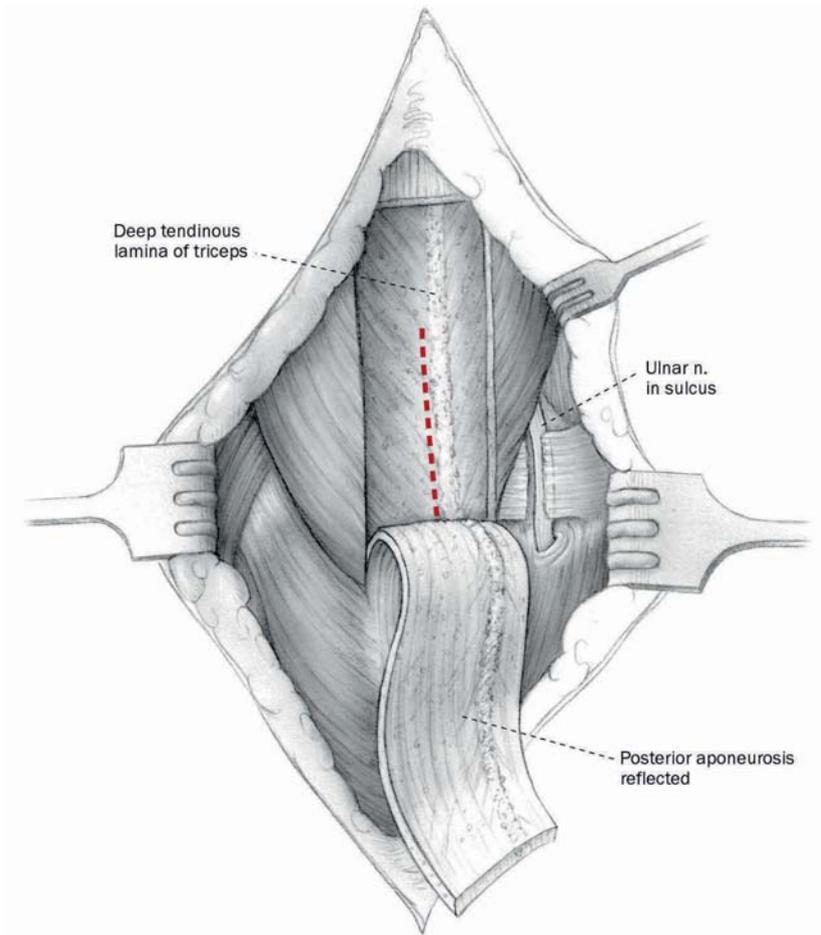


Fig. 4. Reflected posterior aponeurosis with the deep tendon still attached to the tip of the olecranon.

the elbow maximally exposes the distal part of the humerus. If necessary, osteophytes at the margin of the trochlea are removed to allow adequate exposure of the trochlea. A humeral saw guide, with the size defined by the size of the humeral component as determined by preoperative templating, is aligned over the distal part of the humerus in such a manner that its stem lies parallel to the shaft of the humerus while the medial margin is lined up with the medial tip of the trochlea (Fig. 5). The bone to be resected as defined by the saw guide is marked with methylene blue. It is also helpful to mark the axis of the humeral shaft. At this time, the trochlear cuts are made with the micro-oscillating saw. The medial trochlear cut is made through the medial lip of

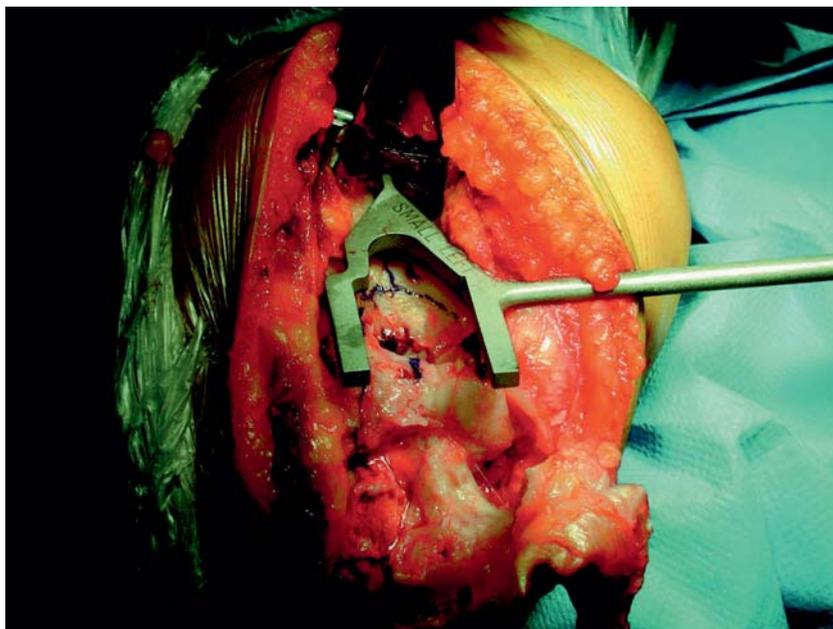


Fig. 5. Exposure of the elbow joint by hyperflexion, and positioning of the humeral saw guide.

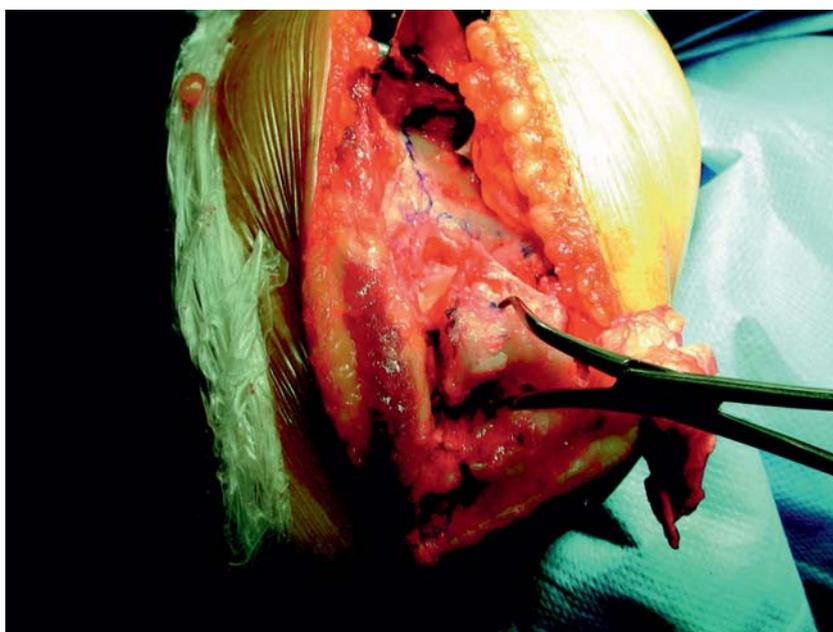


Fig. 6. The trochlea is removed after the cuts have been made with the micro-oscillating saw.

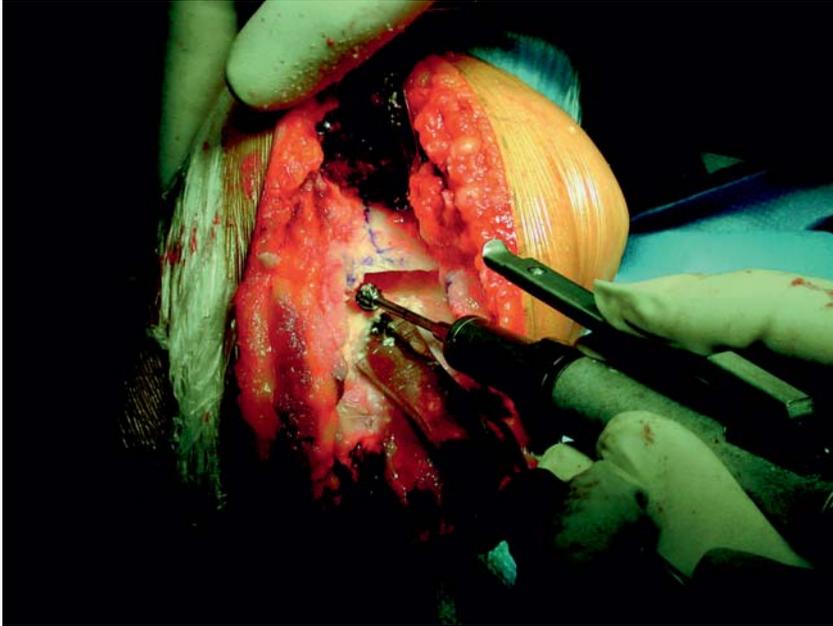


Fig. 7. Excavation of the distal part of the humerus with the ball-shaped burr.

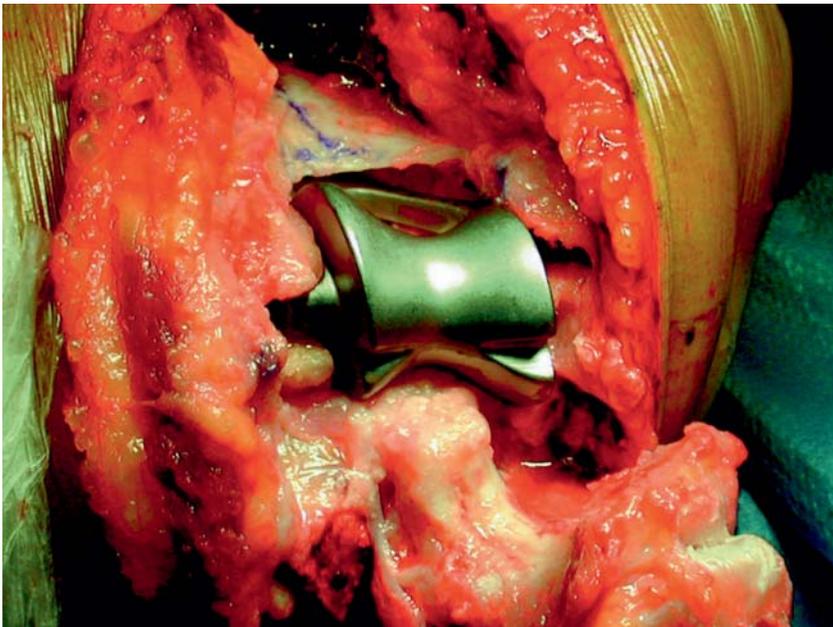


Fig. 8. Humeral trial component in situ.

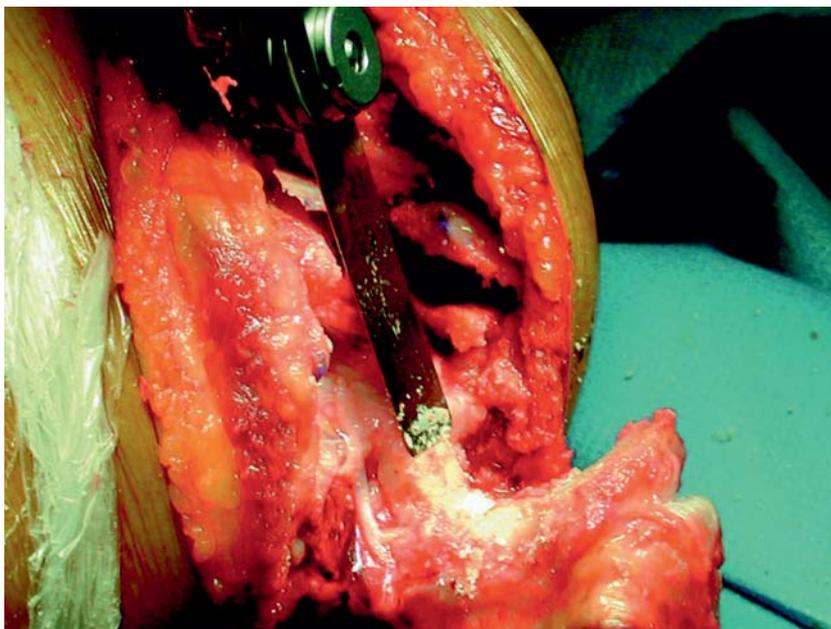


Fig. 9. Resection of the articular surface of the olecranon and coracoid.

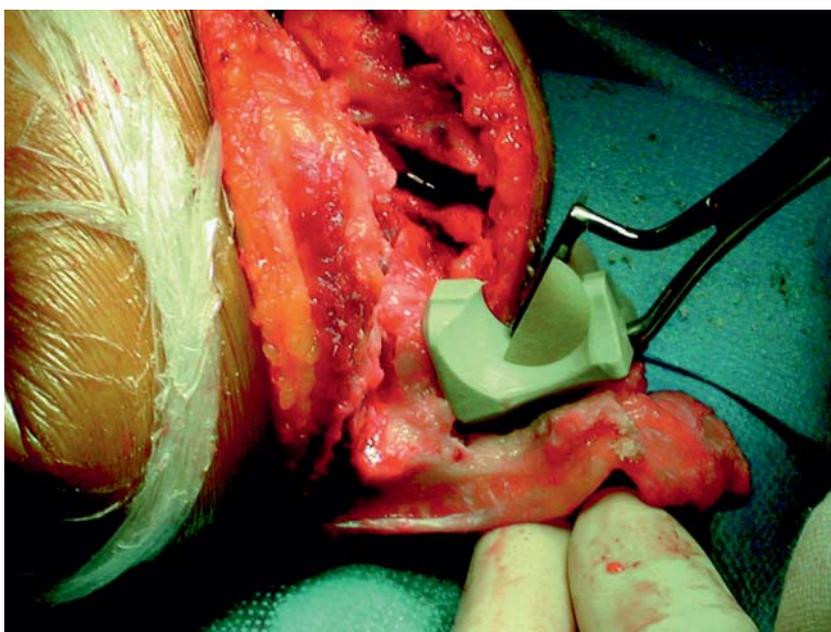


Fig. 10. Insertion of the trial ulnar component.

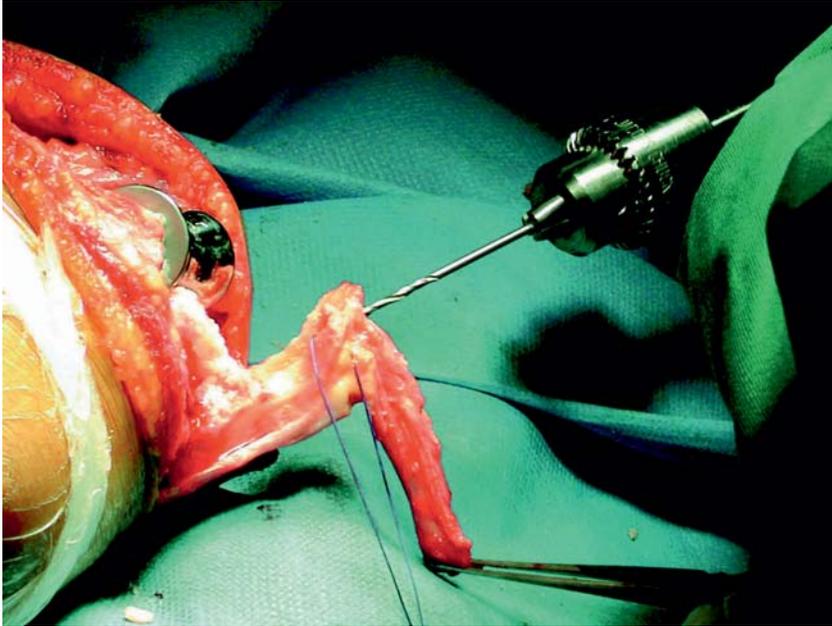


Fig. 11. Transosseous sutures in situ.

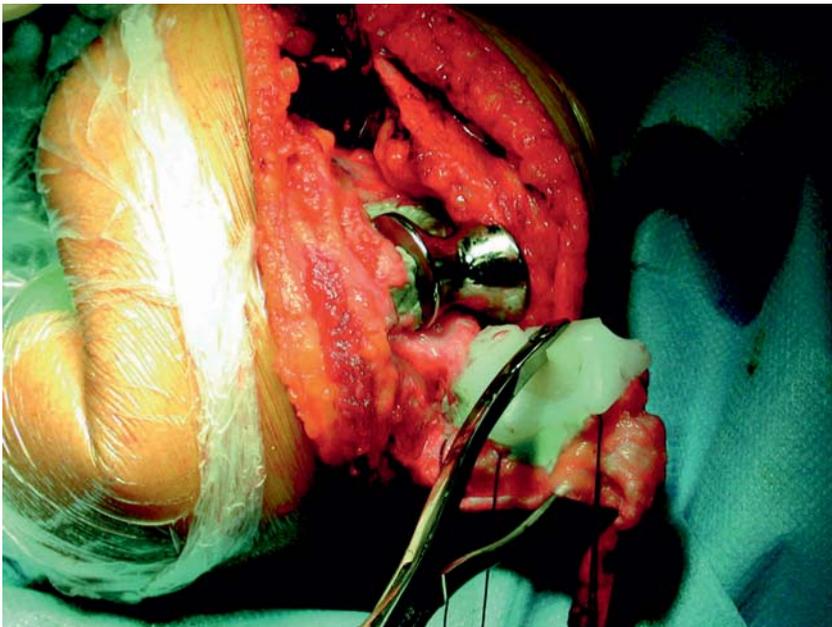


Fig. 12. Cementing of the ulnar component. The humeral component has been cemented in situ.

the trochlea with its top at the apex of the olecranon fossa. When the cuts are completed, the whole trochlea can be removed without force (Fig. 6). The saw cut is made conservatively, and sometimes a small remnant of the medial lip of the trochlea has to be removed with a rongeur.

The medullary cavities of the medial epicondyle, the supracondylar ridge, and the capitellum are opened with a ball-shaped burr (Fig. 7). For protection of the soft tissues, a broad periosteal elevator is placed anterior to the humeral shaft. A trial humeral prosthesis of the proper size is then fitted, but no force should be used. Often, some additional excavation is needed before the trial component can be inserted (Fig. 8).

The ulna is prepared without the use of a cutting guide. The articular surface and the tip of the olecranon and coracoid are removed with a micro-oscillating saw, with two cuts made perpendicular to each other (Fig. 9). The cut in the olecranon determines the rotation of the ulnar component, and the coracoid process and the outer bone contour of the olecranon are the best landmarks to use. The ulnar shaft is then opened with a ball-shaped burr until the properly sized ulnar component fits (Fig. 10). The trial prosthetic components, starting with the humeral one, are then inserted, and the joint is reduced to check the stability and the range of motion. A small flexion contracture of $\leq 30^\circ$ is accepted. If the contracture is greater, the humeral component has to be fitted more deeply through more excavation of the distal part of the humerus, or a volar capsulotomy has to be performed.

After a successful trial insertion of the components and reduction of the joint, the humeral component and then the ulnar component are inserted and fixed with cement. An 8-mm cement restrictor is inserted into the humerus to avoid excessive proximal penetration of the cement. Before cementing, three small holes are drilled into the ulna for perosseous suturing of the annular ligament and the triceps muscle (Fig. 11). After the cementing (Fig. 12) and before the closure, the tourniquet is released and the bleeding points are coagulated. A suction drain is inserted. At closure, the annular ligament is sutured back to the ulna under proper tension. If too much tension is created in the reconstituted ligament, the ulnar component has a tendency to tilt. Similarly, the deep tendinous band of the triceps is sutured to the posteromedial tip of the olecranon under proper tension so that the soft tissues on both sides of the joint are well balanced without any tilting of the ulnar component. The reflected musculotendinous flaps of the triceps are sutured to the olecranon, and the reflected triceps aponeurosis is sutured to its original position. After the operation, a bulky compressive bandage is applied with the elbow held in 90° of flexion.

The elbow is immobilized for five days, after which time supervised active motion is started. For six weeks, a collar and cuff is used during the day and a splint is worn at night.

Critical concepts

Indications

- Grade-IV or V destruction of the elbow due to rheumatoid arthritis or juvenile rheumatoid arthritis

Contraindications

- Recent septic arthritis or bursitis
- Insufficient bone stock of the distal part of the humerus or the proximal part of the ulna
- Severe ligamentous instability of the elbow
- Paralysis of the muscles around the elbow or a neuropathic joint
- An acute comminuted distal humeral fracture

Pitfalls

- Intraoperative fracture of the medial or lateral epicondylar ridge. The bone of the distal part of the humerus may be destroyed by the rheumatoid process, weakening the epicondylar and supracondylar ridges. The radial head is often subluxated anteriorly, and the anterior cortex of the capitellum and the supracondylar ridge may be eroded by direct contact with the subluxated radial head in flexion. Excavation of this ridge will further weaken the bone support, and a long-stemmed prosthesis is indicated in these cases.
- Dislocation during the trial reduction. After trial insertion of the prosthesis and reduction of the joint, the ulnar component might be tilted from the cut surface (resection area) of the olecranon. This might be caused by a malrotation of the cut surface of the olecranon and should be corrected before cementing to avoid dislocation of the prosthesis. If it cannot be corrected, it is better to use a snap-fit ulnar component to provide stability.
- If the bone mass of the olecranon is too weak to support the ulnar component, it is better to use a long-stemmed metal-backed ulnar component.
- If the elbow is distracted because the humeral component was not inserted deeply enough, closure of the triceps and the skin may be compromised.

Author update

All patients in the series reported on in our original article were operated on with the same surgical technique, as was taught by the designer of the prosthesis, W.A. Souter. New instruments have since been developed, but they are not yet available for use.

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