Exposure of the head of the radius using the Wrightington approach

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Surgical access to the head of the radius is usually performed through a lateral approach. We present an alternative technique through a modified posterior approach which was developed following dissections of 22 human cadavers. An osteotomy of the supinator tuberosity was performed and reflected as a single unit with the attached annular ligament. Excellent exposure of the head of the radius was achieved, replacement of the head was undertaken and the osteotomy site repaired. The elbows were stable and had a full range of movement. The approach was then carried out on 13 patients for elective replacement of the head and was found to be safe and reproducible. In the patient group all osteotomies united, the elbows were stable and had an improved range of supination and pronation. There was no change in flexion and extension of the elbow. Complications included a haematoma and a reflex sympathetic dystrophy.

The modified posterior approach provides excellent access to the head and neck of the radius, gives good stability of the elbow and allows early mobilisation of the joint.

Access to the head of the radius for fracture fixation or its prosthetic replacement is usually performed through a lateral approach. The muscle splitting lateral approach is a tight exposure and access is limited. That through Kocher’s interval is more expanse but good access to the head can still be difficult. The posterior interosseous nerve is at risk and the annular ligament may need to be released. There may be post-operative instability if the lateral ligament complex is damaged during exposure or not repaired.

The posterior approach requires incision and repair of the annular ligament, can be difficult and can fail, leading to posterior instability.

Our aim was to find an easy approach to the head of the radius that is safe, reproducible and gives good exposure but leaves the annular ligament intact.

Development of the approach. Dissections were carried out on 22 human cadavers. All were placed in the lateral decubitus position with the limb over an arm rest. The exposure and the concept of performing an osteotomy of the supinator tuberosity with the attached annular ligament and reflecting it as a unit was developed. Replacement of the head was undertaken in 15 of the specimens. The fit of the component and soft-tissue balancing were assessed. The strength of fixation was evaluated in the specimens by putting them through a full range of movement and looking for a gap at the osteotomy site. The stability of the elbow was also examined.

The supinator tuberosity normally acts as a bony block to posterior dislocation of the head of the radius. An osteotomy through the supinator crest removes this mechanical block and releases the constraint of the annular ligament without damage. This allows the head to be dislocated posteriorly (Fig. 1). After the head has been replaced, excised or fixed, the tuberosity is then re-attached. This restores the attachment of the annular ligament and maintains its anatomical length.

Patients and Methods

Elective replacement of the head of the radius was carried out in 13 patients. Their mean age was 54 years (30 to 65). There were nine men and four women. The indication for surgery was either elbow or wrist pain. Four patients had chronic Essex-Lopresti lesions, one had rheumatoid arthritis and eight malunion after a fracture.

Surgical technique. The patient lies in the lateral position with the limb placed over an arm rest. A tourniquet may be applied to the upper arm. The surgical landmarks are the olecranon, the lateral epicondyle and the head of the radius. A curvilinear incision is made,
extending from the lateral epicondyle to a point 3 cm to 4 cm distal to the olecranon. This incision is then extended proximally for a further 2 cm to 3 cm towards the midline. This incision has the advantage of being a smaller wound, centred over the head of the radius (Fig. 2).

An alternative is to use the posterior midline skin incision, which allows access to the medial side of the joint, facilitates future surgery and is associated with less risk of neuroma formation.

The incision is made through skin, subcutaneous tissues and superficial fascia. Full thickness flaps are raised to expose the deep fascia over the anconeus muscle. This fascia is incised, leaving a 1 cm flap attached to the ulna. The anconeus muscle is dissected from the ulna, and an arthroscopy is performed exposing the head of the radius, the annular ligament inserting into the supinator tuberosity and the interosseous membrane. The supinator tuberosity can be seen and palpated.

An osteotomy of the supinator tuberosity is then performed using an osteotome; the cut through the tuberosity should be flush with the shaft of the ulna (Fig. 3). Pre-drilling the tuberosity can be performed to aid its re-attachment if screw fixation is to be used.
At least 0.5 cm of bone is osteotomised with the annular ligament still attached. It is important to detach sufficient bone, to make re-attachment possible. The head can now be dislocated giving full access (Fig. 4).

We developed this approach primarily for replacement of the head of the radius. It allows the trial prosthesis to be easily subluxed in and out of the joint to obtain the optimum size. The detached bone fragment and annular ligament can now be placed back to its original site, allowing assessment of the head size by the tension in the annular ligament.

Next, the bone fragment with the annular ligament is re-attached. Our preferred method of fixation is with the Mitek G-2 mini bone anchors into cancellous bone (Depuy/Mitek Inc., Raynham, Massachusetts) This decreases the risk of fracturing the tuberosity (Figs 5 and 6). We have also used mini-fragment screws and tension band wiring.

When performing anchor fixation, the quality of the cancellous bone should be carefully assessed. In rheumatoid arthritis the quality of bone may be poor. Anchor fixation must be tested prior to repair. If there is concern about fixation, the anchors should be placed into the adjacent cortical bone. Alternatively, a 5 mm screw-in Mitek anchor will give better purchase (Depuy/Mitek Inc.) The aim of the repair is to get an anatomical, stable reduction of the supinator fragment, allowing early mobilisation.
The anconeus muscle is re-attached to the ulna, the deep fascia and the subcutaneous tissues are repaired and the skin closed. This repair gives a stable elbow allowing mobilisation to commence on the first or second post-operative day, pain permitting.

Results
The cadaver study showed the approach to be reproducible. In all of the 22 dissections, we were able to obtain good exposure of the head and neck of the radius. We dissected out the course of the posterior interosseous nerve and found it to be 3 cm from the osteotomy site. No other neurovascular structures were at risk.

The head of the radius was easily dislocated posteriorly. Once replacement of the head had been performed, we appreciated the benefit of being able to easily interchange different-sized prostheses. This allowed us to re-oppose the supinator fragment with the attached annular ligament and assess soft-tissue balancing of the joint. Through this technique we were able to get the best-fit prosthesis and avoid over-stuffing the joint.

We experimented with screw fixation, tension band wiring and bone anchor/sutures for re-attaching the supinator fragment. Nine specimens were re-attached with a bone anchor, eight with small fragment screws and five with wires. We found using two bone anchors to be the easiest. With screw fixation in the cadaver model we found a risk of fracturing the tuberosity fragment. The elbows were put through a full range of movement and stability was assessed. No significant gap developed at the osteotomy site.

All the patients had the modified posterior approach. This consistently enabled the head to be easily dislocated posteriorly for excellent surgical access. All patients had a pyrocarbon prosthesis (Wright Medical Technology Inc., Arlington, Tennessee) inserted. The supinator tuberosity was re-attached with washer and screw in four patients, Mitek bone anchors (Depuy/Mitek Inc.) in eight and tension band wiring in one. All elbows were stable on the operating table and were put through a full range of movement. No significant gap developed at the osteotomy site.

The patients were managed in a sling for comfort and encouraged to move the elbow, pain permitting. The mean length of follow-up was for 15 months (12 to 20). Post-operative radiographs showed that all the osteotomies had united and there was no evidence of heterotopic ossification (Fig. 5). All the elbows have remained stable.

One patient developed a small haematoma, which was treated conservatively, and another developed a mild reflex sympathetic dystrophy which recovered. There were no neuromas or neurovascular injuries.

All patients achieved a better range of pronation and supination. Pronation improved from a mean of 10° (5° to 15°) pre-operatively to 25° (15° to 40°) at post-operative assessment and supination from 15° (5° to 20°) to 50° (30° to 80°). Pre-operatively the mean range of flexion/extension was 30’ (15’ to 40’) to 110’ (90’ to 125’), this remained relatively unchanged (35’ (15’ to 40’) to 105’ (90’ to 130’) post-operatively).

Discussion
The main indication for the modified posterior approach is in the patient who has no associated deficiency of the lateral collateral ligament complex and requires reconstruction for chronic pathology of the head of the radius. If there is an injury to the lateral ligament as in an acute fracture dislocation, a lateral approach would be preferred so that it can be assessed and repaired.

Exposure of the head of the radius is most commonly performed via the lateral approach. Whether it is a muscle splitting, or a Kocher approach, the exposure of the radiocapitellar joint is tight.1,3 It involves incising the lateral ligament. Dislocation of the head is difficult due to the constraints of the interosseous membrane and the annular ligament. The posterior interosseous nerve is at risk with these exposures.1,2

The modified posterior approach provides an excellent exposure. The head is easily subluxed making its replacement a much easier procedure and decreasing the risk of damage to the capitellum through forced reduction of the prosthesis. It leaves the lateral ligament complex, annular ligament, ulnohumeral ligament and interosseous membrane intact and is well away from the posterior interosseous nerve.

The lateral approach involves incising the lateral ligament complex. The exact structure of the lateral ligament is debated but it acts as an important constraint to varus and valgus external rotatory laxity.5,9 A major advantage of the modified posterior approach is that it leaves the lateral ligament complex intact.

Few cutaneous nerves cross the posterior, midline aspect of the elbow, and those that do are relatively small in diameter. The risk of a painful cutaneous neuroma is least with a posterior approach.7 The posterior interosseous nerve is at less risk with this approach than with lateral approaches.

Recurrent subluxation of the head of the radius secondary to traumatic rupture of the annular ligament has been well documented.7,10 Wiley et al10 described ten cases of isolated dislocation and emphasised the importance of the annular ligament in preventing this. Treatment can be difficult, requiring procedures such as a fascia lata graft for reconstruction.7 The modified posterior approach compared with a standard posterior approach1,2,6,11 preserves the annular ligament and interosseous membrane.

Potential risks of the approach include performing an inadequate osteotomy through the supinator tuberosity and detaching too small a fragment. If too much tuberosity is left behind, this may impede posterior dislocation of the head and also make re-attachment of the fragment difficult. Failure of this repair could cause posterior in-
stability. Care must be taken with re-attachment of the fragment. Our preference is to use bone anchors, because screws have the risk of fracture especially if the fragment is small.

We did not have any cases of heterotopic ossification. However, our study group only involved 13 patients and this is certainly a potential complication of dual exposure of the radius and ulna.12-14

Many surgeons find the surgical approach to the head of the radius difficult. The modified posterior approach is easy, safe and reproducible. It avoids injury to important nerves, especially the posterior interosseous nerve. It preserves the annular ligament, ulnohumeral ligament, lateral ligament complex and the interosseous membrane. It allows the head to be dislocated posteriorly giving excellent surgical access and avoiding injury to the capitellum. After appropriate bony and soft-tissue closure the elbow is stable and the patient can move their arm, pain permitting, on the first day after operation. The most critical step of the exposure is to osteotomise the supinator tuberosity flush with the ulna.

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References