Modified rush pin technique for two- or three-part proximal humeral fractures

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ABSTRACT

Purpose. To report the outcomes of modified Rush pin fixation for proximal humeral fractures.
Methods. 42 men and 20 women aged 19 to 94 (mean, 64) years with 2- or 3-part proximal humeral fractures underwent reduction and fixation using the modified Rush pin technique. 11 patients died from reasons unrelated to the surgery.
Results. Of 40 (out of 51) patients completing a subjective functional assessment using an Oxford Shoulder Questionnaire, 28 (70%) had 2-part and 10 (25%) had 3-part displaced fractures, and the remaining 2 (5%) had fracture-dislocations (one being 2-part and one 3-part). 25 (63%) patients were very satisfied (including one with a 3-part fracture after 6 months of rehabilitation), 7 (17%) were moderately satisfied, and 8 (20%) were not satisfied. There were 8 complications, including pin cut-out from the proximal fragment (n=2), proximal pin migration (n=2), distal pin migration (n=1), cortical perforation during surgery (n=1), mild ulnar nerve symptoms (n=1). No patients had non-union, myositis ossificans, avascular necrosis of the humeral head, or axillary nerve injury.
Conclusion. The modified Rush pin fixation minimises tissue dissection; the implants are cheap and readily available; and the technical expertise is easily learnt. This technique is a suitable alternative of fixing proximal humeral fractures, especially in the elderly.
Key words: humeral fractures; fractures, bone

INTRODUCTION

Fractures of the proximal humerus are common, accounting for 4 to 5% of all fractures presenting to a regular fracture clinic.1,2 They mostly occur in elderly patients and are treated on an out-patient basis. 85% of proximal humeral fractures are minimally or non-displaced and are treated conservatively with early mobilisation.3 Of these, about 49% are minimally

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displaced, 28% are 2-part surgical neck fractures, and 9% are 3-part fractures of the greater tuberosity and surgical neck. Four-part fractures and those with displacements or dislocations comprise only 3% of the proximal humeral fractures. Hemiarthroplasty is the treatment of choice for such severely comminuted and grossly displaced fractures. The treatment of 2- or 3-part displaced fractures remains controversial and challenging. Emphasis is placed on restoration of the anatomy, stability, cuff integrity, movement, and function. Conservative management often results in severe malunion and poor functional outcome. Open reduction and internal fixation is recommended for accurate reduction, but extensive soft tissue dissection and implant insertion may cause avascular necrosis. In elderly osteoporotic patients, it is difficult for the screws to get a good hold in the bone. To enable biological healing and avoid risking avascular necrosis and complications following extensive soft tissue dissection, closed intramedullary nailing, percutaneous fixation, and Rush pin fixation are suitable alternatives.

Rush pins are cheap and readily available and have been used in osteoporotic bones with good results. However, they tend to migrate proximally and distally in the humeral shaft. We report the outcomes of 40 patients (27 were elderly) who underwent a modified Rush pin fixation for proximal humeral fractures. This technique entails minimal dissection, prevents distal migration and late impingement, and is associated with minimal blood loss and operating time.

MATERIALS AND METHODS

Between January 1991 and February 1999, 42 men and 20 women aged 19 to 94 (mean, 64) years with proximal humeral fractures underwent reduction and fixation using the modified Rush pin technique. Fractures were categorised according to the Neer classification.

Patients were placed in a beach-chair position under general anaesthesia. The deltoid and rotator cuff were split using a 3-cm anterolateral incision. Under image intensification, the fragments were reduced indirectly or by sliding a finger through the incision. The Rush pins were inserted across the fractures, avoiding the articular surface and biceps tendon. The hook of the Rush pin was rotated 90º and attached to the rotator cuff to prevent its distal migration. The cuff and the incision were repaired and the wound was closed in layers.

Postoperatively early pendulum exercises were started and progressed to passive exercises when callus formation was visible (at 2 to 3 weeks), and active exercises (at about 6 weeks). Under general or local anaesthesia, rush pins were electively removed in 18 patients when adequate bone union was seen on radiographs. Patients may opt not to have the pin removed if they felt well and able to cope with it, or deemed unfit for anaesthesia. Prolonged physiotherapy was prescribed if needed.

11 patients died from reasons unrelated to the surgery. The remaining 51 patients were available for subjective functional assessment using an Oxford Shoulder Questionnaire after a mean follow-up period of 3 (range, 0.5–8) years. The questionnaire contained 12 questions, 4 related to pain and 8 to activities of daily living, each with 5 responses (1 to 5 in ascending order of severity). A total score of 12 was the best possible score and 60 the worst; patient satisfaction was classified as very satisfied (score 12–20), moderately satisfied (score 21–40), and not satisfied (score 41–60).

RESULTS

27 of the 51 patients aged ≥65 years. Of 40 (out of 51) patients completing the questionnaires (response rate, 64%), 28 (70%) had 2-part (Fig. 1) and 10 (25%) had 3-part displaced fractures (Fig. 2), and the remaining 2 (5%) had fracture-dislocations (one being 2-part and one 3-part).

Of the 40 patients, 25 (63%) were very satisfied (including one with a 3-part fracture assessed after 6 months of rehabilitation), 7 (17%) were moderately satisfied, and 8 (20%) were not satisfied. Of those not satisfied, 3 had 3-part fractures, 2 were only 6 months from surgery, one had a fracture-dislocation, one had a pin cut-out from the proximal fragment, and one had no identifiable reason. One patient underwent manipulation under anaesthesia 16 months after fixation and was able to resume playing the violin.

There were 8 complications, including pin cut-out from the proximal fragment (the pins were not removed until bone union) [n=2, Fig. 3], proximal pin migration (n=2), distal pin migration (n=1), cortical perforation during surgery (n=1), mild ulnar nerve symptoms that resolved completely (n=1). No patient endured non-union, myositis ossificans, avascular necrosis of the humeral head, or axillary nerve injury.

DISCUSSION

Numerous implants and techniques have been
Surgery with minimal dissection and rigid fixation has been advocated for preservation of vascularity to the articular fragments. Closed or mini open reduction and fixation using Rush pins offers the advantage of biological fixation. Rush pins are cheap, readily available, and easy to apply without special instrumentation. They minimise soft tissue dissection and preserve vascularity to the humeral head. Therefore, they decrease the operating time and peri-operative blood loss, compared to other more extensive surgical procedures. Nonetheless, the use of Rush pins has become less popular because of complications such as migration and impingement, insufficient stabilisation to enable early mobilisation, and the availability of other modern intramedullary devices. In our study, the incidences of pin migration or impingement was minimal because of modification of the technique and elective pin removal.

Age has a major bearing on proximal humeral fractures. Like other fractures that occur in osteoporotic bones, women aged 80 to 89 years are most often affected. The incidence of more complex fractures increases with age. Plate and screw fixations do not provide an adequate hold in the osteoporotic humeral head and risk impingement. For older patients, it is more important to regain activities of daily living, rather than a full range of movement and strength. We aimed to achieve a reasonable reduction and stable fixation to enable early mobilisation within 2 to 3 weeks. 63% of our patients achieved this goal.
patients were very satisfied, which is comparable to fixation with plates and screws or more expensive intramedullary devices.\textsuperscript{4,11,12,14,15,18,20,21,26} Even modern intramedullary devices with multi-planar fixation such as the Polarus nail have high failure rates.\textsuperscript{25} Treatment for humeral fractures differs from that for long bones of the lower extremity.\textsuperscript{5,7} As the humerus does not bear weight, slight axial or rotational malalignment is acceptable. Its treatment should be as biological as possible (avoiding open surgery, wide dissection, and rigid fixation).\textsuperscript{7,8,12,14,15,21,24,26,29–32} Good to mixed outcomes have been reported following open reduction and internal fixation with repair of the greater tuberosity using non-absorbable suturens,\textsuperscript{31} semitubular plates,\textsuperscript{18} or intramedullary nails.\textsuperscript{4,6,20,26} Studies comparing different techniques of fixation for proximal humeral fractures have been reported,\textsuperscript{18,20,27} including ones entailing closed reduction and percutaneous fixation with Kirschner wires,\textsuperscript{3,7,14,32} non-absorbable rotator cuff incorporating sutures,\textsuperscript{33} and elastic, Prevot or nancy nails.\textsuperscript{15,20,21}

There was no correlation between postoperative radiographs and functional outcomes, probably because surgeons and patients have different opinions about priorities and concerns. After all, patients are capable of providing reliable and valid judgements about their own health status and the benefits of treatment.\textsuperscript{30,31} The Oxford Shoulder Questionnaire is a short, practical and reliable scoring system, highly sensitive to clinical changes,\textsuperscript{34} and has already been validated against other scoring systems such as the Constant score, Rowe score, and Short Form-36. It is much better at distinguishing between patient subgroups.

Our study has limitations. It was not a prospective randomised trial and did not have a control group for comparison. Moreover, it was confined to a single hospital and the patient sample was heterogeneous.

**CONCLUSION**

For the treatment of proximal humeral fractures, modified Rush pin fixation minimises tissue dissection, the implants are cheap and readily available, and the technical expertise is easily learnt. It is a suitable alternative of fixing proximal humeral fractures, especially in the elderly.

**REFERENCES**