

Closed Reduction and Percutaneous Kirschner-Wire Fixation of a Varus-Impacted Four-Part Proximal Humeral Fracture in an 80-Year-Old Woman: A Case Report

Abdelrahman Al Akkoui¹, Reda Bahij^{1*}, Abdelhamid Chlouchi¹, Omar Aguenau¹, Mohamed Reda Fekhaoui¹, Jalal Mekkaoui¹, Moncef Boufettal¹, Reda Allah Bassir¹, Mohamed Kharmaz¹, Moulay Omar Lamrani¹

¹Department of Orthopaedic and Trauma Surgery, Ibn Sina University Hospital (CHU Ibn Sina), Faculty of Medicine and Pharmacy, Mohammed V University, Rabat, Morocco

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*Corresponding author: Reda Bahij

Department of Orthopaedic and Trauma Surgery, Ibn Sina University Hospital (CHU Ibn Sina), Faculty of Medicine and Pharmacy, Mohammed V University, Rabat, Morocco

Abstract

Case Report

Varus-impacted four-part fractures of the proximal humerus are the least forgiving pattern within this family of injuries, since varus angulation implies shortening of the medial calcar or disruption of the medial hinge, both of which are strong predictors of humeral head ischaemia. Published series of percutaneous fixation report markedly poorer outcomes in four-part patterns than in simpler configurations, and some authors advise that alternative strategies be preferred. We report an 80-year-old woman who sustained a varus-impacted four-part fracture of the right proximal humerus after a low-energy fall with direct impact on the shoulder, confirmed by computed tomography. She underwent same-day closed reduction and percutaneous fixation with three Kirschner wires under general anaesthesia and fluoroscopic guidance, the wire ends being bent and left protruding through the skin. The postoperative course was free of complication, with no pin-tract infection despite nine weeks of transcutaneous wire retention, no secondary displacement and no neurological deficit. The wires were removed at nine weeks once consolidation was radiographically evident. At three months the fracture had united and the patient had regained a restricted but functionally adequate shoulder, essentially free of pain and sufficient for independent activities of daily living. Percutaneous fixation remains a defensible option in low-demand elderly patients whose fracture reduces closed, particularly where arthroplasty is not readily accessible, but a three-month assessment cannot exclude avascular necrosis and longer surveillance is obligatory.

Keywords: Proximal humeral fracture; four-part fracture; varus impaction; percutaneous pinning; Kirschner wire; elderly; osteoporosis.

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INTRODUCTION

Fractures of the proximal humerus represent approximately 5-6% of adult fractures and rank third in frequency among fractures of the elderly, after those of the proximal femur and the distal radius [1,2]. They occur characteristically in osteoporotic women following a low-energy fall, and their incidence is rising with population ageing. Four-part patterns, as defined by Neer, form a small minority but concentrate most of the therapeutic difficulty: the articular segment is separated from both tuberosities and from the shaft, and the bone available to hold any implant is of poor quality [3].

Within this group the direction of head displacement carries prognostic weight. Valgus-

impacted four-part fractures frequently retain an intact posteromedial periosteal hinge and are the configuration most often cited to justify minimally invasive reduction and fixation. Varus-impacted patterns are the opposite case. Hertel et al., assessing humeral head perfusion intraoperatively in 100 intracapsular fractures, identified the length of the dorsomedial metaphyseal extension (accuracy 0.84 for calcar segments under 8 mm) and the integrity of the medial hinge (accuracy 0.79 for a disrupted hinge) as the strongest predictors of ischaemia, with combined positive predictive values approaching 97% when a short calcar, a disrupted hinge and an anatomical neck component coexisted [4]. Campochiaro et al., subsequently found that these criteria alone were insufficient and that the quality of reduction was itself strongly associated with necrosis [5]. Varus

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malreduction is also the commonest mode of mechanical failure after fixation.

Management in the elderly remains contested. The PROFHER randomised trial found no significant difference in patient-reported outcome between surgical and non-surgical treatment of displaced fractures involving the surgical neck, a result sustained at five years [6,7]; few four-part fractures were included, however, and its conclusions cannot be extended wholesale to this subgroup. Where surgery is elected, percutaneous fixation as developed by Jaberg and by Resch and their groups has been applied to three- and four-part fractures in patients over 70 [8,9,10]. The results in four-part patterns are sobering: Bogner *et al.*, reported a mean Constant score of 49.5 points, 68.5% of the uninjured arm, against 61.2 points (84.9%) in three-part fractures [10], and a larger later series from the same centre recorded 43.0 points (56.7%) with a higher complication rate, leading the authors to recommend that other treatment strategies be considered for this subgroup [11].

We report an octogenarian woman with a varus-impacted four-part fracture managed by closed reduction and percutaneous Kirschner-wire fixation, in order to examine what this technique can and cannot be expected to deliver in the least favourable four-part configuration.

CASE REPORT

An 80-year-old right-handed woman presented to the emergency department after a mechanical fall from standing height at home, with direct reception on the right shoulder. There was no syncope or neurological prodrome. She was ambulatory and independent for activities of daily living before the injury with no known comorbidities. She had no previous symptoms or surgery involving the right shoulder.

Examination showed a painful, swollen right shoulder with loss of the normal deltoid contour and complete functional impotence of the limb. The skin was intact and distal pulses were present and symmetrical. Neurological examination was normal, with preserved sensation over the lateral deltoid and no motor deficit in the axillary, radial, median or ulnar distributions.



Fig-1: Preoperative imaging of the right shoulder. Three-dimensional volume-rendered computed tomography reconstructions in two projections, showing the displaced fracture of the proximal humerus with the head fragment in varus and separation of the articular segment from both tuberosities and from the shaft, confirming the four-part configuration

Anteroposterior and lateral scapular radiographs demonstrated a displaced fracture of the right proximal humerus with the head fragment in varus. Computed tomography with multiplanar and three-dimensional reconstruction confirmed a varus-impacted four-part fracture in the Neer classification (Fig-1), with separation of the articular segment from both tuberosities

and from the shaft. No head-splitting component and no glenohumeral dislocation were identified, and there was no associated scapular or clavicular injury.

The patient was operated on the day of admission, under general anaesthesia, in the beach-chair position with the image intensifier brought in from the

contralateral side to permit anteroposterior and axial projections. Closed reduction addressed the varus deformity directly, combining longitudinal traction with abduction and controlled rotation of the arm, the aim being to restore a head-shaft angle within the physiological range rather than merely to obtain bone contact. Reduction was verified in two fluoroscopic planes.

Three Kirschner wires were then inserted percutaneously through stab incisions in the lateral aspect of the arm, at least 5 cm distal to the lateral border

of the acromion, and advanced retrogradely across the fracture into the subchondral bone of the humeral head in a divergent configuration. Wire position and the absence of articular penetration were confirmed on multiple projections through an arc of internal and external rotation, and stability was assessed under image intensification during gentle passive motion. The external ends of the wires were bent through 180 degrees, cut, and left protruding through the skin to permit later removal without a return to theatre. The limb was immobilised in a sling.

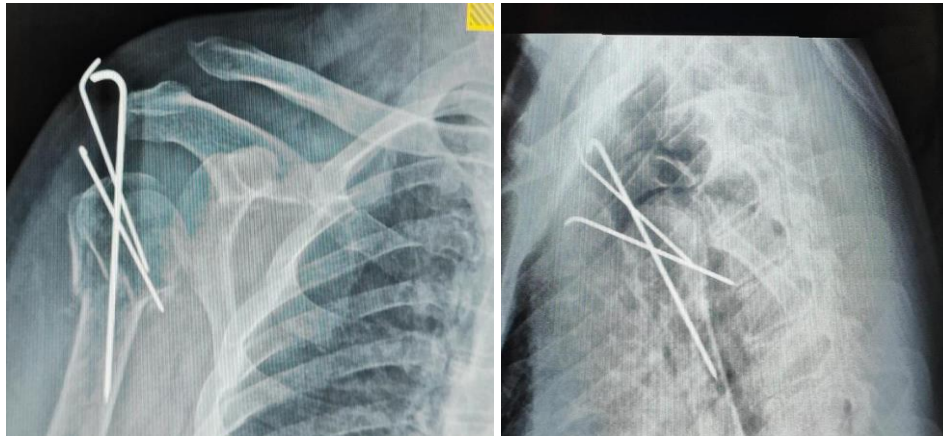


Fig-2: Immediate postoperative radiographs demonstrating correction of the varus and three divergent Kirschner wires inserted retrogradely from the lateral humeral cortex into the humeral head, the external ends bent to prevent proximal migration, with an oblique projection confirming the wire trajectory without articular penetration

Immediate postoperative radiographs confirmed correction of the varus, satisfactory reduction and correct wire placement (Fig-2). Pin-site care was taught to the patient and her family. Pendulum exercises and mobilisation of the elbow, wrist and hand were encouraged early, while active elevation of the shoulder was deferred. The postoperative course was free of complication: there was no pin-tract infection despite nine weeks of transcutaneous wire retention, no wire

migration or back-out, no loss of reduction into varus on serial radiographs, and no postoperative neurological deficit.

The Kirschner wires were removed at nine weeks, once bridging callus was visible. Active-assisted and subsequently active rehabilitation was progressed thereafter under physiotherapy supervision.

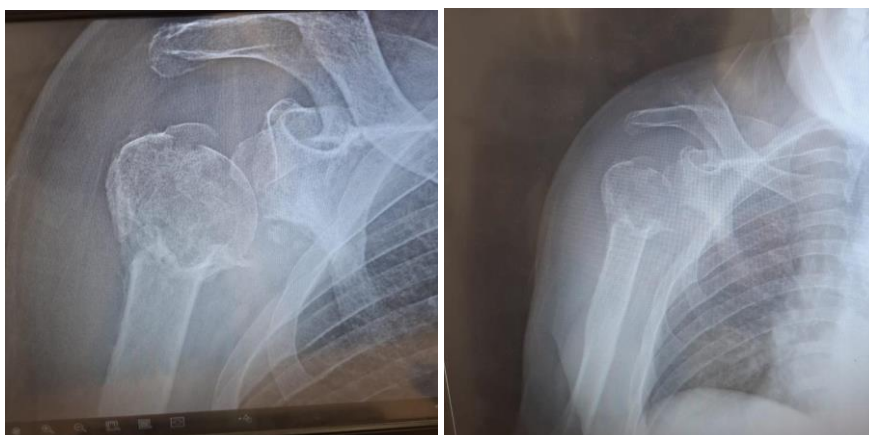


Fig-3: Radiographs at three months, after wire removal, showing consolidation of the fracture with no radiographic evidence of humeral head collapse at this interval

At review three months after injury, the fracture had consolidated and there was no radiographic sign of humeral head collapse, hardware-related bone loss or glenohumeral degenerative change at this interval (Fig-3). Clinically the patient was essentially free of pain. Active motion of the right shoulder was restricted by comparison with the uninjured side, but was sufficient for feeding, dressing, combing her hair and personal hygiene. She had returned to her preinjury level of independence, required no assistance with walking or dressing, expressed satisfaction with the result and declined any further intervention.

DISCUSSION

The varus-impacted four-part fracture as a distinct problem

The therapeutic objective in an octogenarian is not the restoration of a normal shoulder but the return of a painless, stable limb capable of meeting the demands of daily living. That framing is what allows an outcome such as the present one - restricted motion, absence of pain, preserved independence - to be reported as a success rather than qualified as a partial failure. It does not, however, soften the specific difficulty of the configuration treated here.

Two features compound. First, the four-fragment pattern strips the articular segment of most of its soft-tissue attachments. Second, varus impaction implies that the medial calcar is short or the medial hinge disrupted, and these are precisely the variables identified as the strongest intraoperative predictors of head ischaemia [4]. Since quality of reduction is itself associated with subsequent necrosis [5], the adequacy of the closed reduction in such a fracture is not merely a mechanical concern but a vascular one. The present case therefore cannot borrow the justification usually invoked for minimally invasive fixation, which rests on the preserved posteromedial hinge of the valgus-impacted pattern.

Rationale for percutaneous fixation

Three considerations supported the choice. Because the fracture site is never opened, whatever periosteal and vascular attachments survive the injury are preserved rather than further compromised by dissection, an argument that gains rather than loses force when the medial supply is already suspect. Operative time, blood loss and anaesthetic burden are all reduced, which is of substance at this age. Finally, the implant cost is negligible, a consideration of real weight in settings where arthroplasty implants are rationed and where the practical alternative to percutaneous fixation may be conservative treatment rather than joint replacement.

Set against this, published outcomes for four-part fractures treated percutaneously are modest, with mean Constant scores of 49.5 and 43.0 points in the two large geriatric series [10,11], and significantly better

Constant scores after reverse shoulder arthroplasty than after minimally invasive osteosynthesis in the comparative study of Ortmaier *et al.*, [12]. A single favourable case does not displace that evidence. What it illustrates is that a varus-impacted four-part fracture which reduces closed can unite without complication and deliver adequate short-term function at a fraction of the surgical, anaesthetic and economic cost of arthroplasty.

Technical determinants of safety

The margin for error in percutaneous pinning is narrow and the relevant anatomy has been quantified. Rowles and McGrory, in a cadaveric study, found the proximal lateral pins to lie a mean of 3 mm from the anterior branch of the axillary nerve, with four of twenty lateral pins penetrating the articular cartilage of the humeral head; greater tuberosity pins lay a mean of 6 and 7 mm from the axillary nerve and the posterior humeral circumflex artery respectively, and moved away from the nerve with external rotation of the arm [13]. Three practical rules follow, all observed in the present case: lateral entry points must lie sufficiently distal to the lateral acromion; articular penetration must be excluded across several projections through a rotational arc rather than on a single anteroposterior view; and rotation of the arm should be used deliberately to displace neurovascular structures away from the wire trajectory.

Migration of wires from the shoulder girdle is a documented and occasionally catastrophic complication, with reported destinations including the lung, mediastinum, spinal canal and spleen [14]. Bending the external ends, using terminally threaded wires and planned removal are the accepted preventive measures.

Duration of wire retention

The wires were retained for nine weeks, longer than the six to eight weeks usual in published series [15]. In a varus-impacted four-part fracture in osteoporotic bone this is a defensible choice, since collapse back into varus is the dominant failure mode and premature removal risks losing the reduction before the construct is biologically redundant. The cost is paid in stiffness, and prolonged relative immobilisation is the most plausible explanation for the restricted terminal motion observed at review. This represents a deliberate trade-off rather than an error: fixation was protected at the expense of range of motion, which in a low-demand octogenarian is the appropriate side on which to err. Retention of transcutaneous wires for this period also raises the risk of pin-tract infection, which did not occur here, an outcome attributable to structured pin-site care.

Limitations

Avascular necrosis of the humeral head is the dominant late complication of four-part fractures and characteristically becomes radiographically apparent between twelve and twenty-four months after injury. A radiograph at three months showing no collapse therefore excludes very little, and in a varus-impacted

pattern with a probably compromised medial hinge the pretest probability is high rather than low. The defensible statement is that no early sign of necrosis was present at three months, not that necrosis has been excluded; the patient requires clinical and radiographic surveillance to at least eighteen to twenty-four months, with secondary arthroplasty held in reserve should the head collapse. This report further describes a single patient, without formally recorded validated functional scores such as the Constant-Murley score [16], and no conclusion regarding comparative effectiveness can be drawn from it.

CONCLUSION

Closed reduction and percutaneous Kirschner-wire fixation achieved union and an uncomplicated postoperative course in an 80-year-old woman with a varus-impacted four-part proximal humeral fracture, with restricted but functionally adequate shoulder motion at three months. Given the adverse vascular profile of this configuration and the modest results reported for four-part patterns treated percutaneously, the technique should be reserved for fractures that reduce closed in low-demand patients, and is most defensible where arthroplasty is not readily accessible. Entry points must respect the axillary nerve, articular penetration must be excluded fluoroscopically in several planes, and correction of the varus must be achieved rather than approximated. Surveillance to at least two years is required before such a result can be regarded as durable.

DECLARATIONS

Patient consent: Written informed consent was obtained from the patient for publication of this case report and the accompanying images.

Conflict of interest: The authors declare no conflict of interest.

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