FOUR-PART VALGUS IMPACTED FRACTURES OF THE PROXIMAL HUMERUS

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There is a specific type of displaced four-part fracture of the proximal humerus which consists of valgus impaction of the head fragment; this deserves special consideration because the rate of avascular necrosis is lower than that of other displaced four-part fractures. Using either closed reduction or limited open reduction and minimal internal fixation, 74% satisfactory results can be achieved in this injury.

The management of proximal humeral fractures may be difficult, especially if the patient is young and the fracture consists of three or four displaced fragments. Neer (1970a,b) based his recommendations for the treatment of these injuries on patho-anatomical considerations as well as a vast clinical experience. Our interest has centred on a specific type of proximal humeral fracture which is not specifically mentioned in Neer’s classification (Neer 1970a,b). It consists of four fragments with variable displacement of the tuberosities and valgus impaction of the humeral head (Fig. 1). A similar fracture was described by de Anquin and de Anquin (1982) as “impacted with inferior subluxation”, and in 1976 Duparc and Larger also mention it in their review of proximal humeral fractures. The AO/ASIF organisation in the early 1980s proposed a new classification which was essentially an expansion of Neer’s original work; in their review, 14% of all documented cases were found to be valgus impacted injuries and were classified as C2.1 or C2.2 type fractures (Jakob et al 1984; Mills and Horne 1985; Müller et al 1990). Most recently Stableforth (1984) in his review of four-part proximal humeral fractures makes brief mention of an ‘impacted and little displaced’ fracture; his illustrations suggest that this was a valgus impacted fracture.

Despite the fact that this fracture pattern is known, little has been written about its recognition and management. Should treatment consist of immediate prosthetic replacement, as suggested for four-part fractures where the head fragment is laterally displaced or even dislocated and the probability of avascular necrosis is high (Neer 1970a,b; Tanner and Cofield 1983; Leyshon 1984), or does this fracture deserve special consideration since the displacement of the head fragment is into valgus, which may be less disruptive of soft-tissue attachments and blood vessels? This question is particularly important in

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the young patient in whom it is desirable to preserve the anatomy and not proceed to arthroplasty.

In an attempt to resolve this issue we have performed a critical analysis of the long-term results and complications of this injury, specifically with regard to avascular necrosis. All patients who had sustained a valgus impacted proximal humeral fracture and were treated at our centre were reviewed.

MATERIALS AND METHODS
From 1974 to 1985, 18 patients who were treated for 19 four-part valgus impacted proximal humeral fractures at the University Hospital (Inselspital) in Berne, were reviewed. Only patients followed up for at least two years after injury were included. Their assessment was both subjective and objective, and included the evaluation system described by Neer (1970a), which assigns 35 points for pain, 30 for function, 25 for motion and 10 for anatomy. At follow up, all patients had anteroposterior, lateral and axillary radiographs of the affected shoulder. All previous charts and radiographs were reviewed and the results of treatment, time to union and complications were documented.

All patients were available for review. There were seven women and 11 men; the average age was 49.5 years (range 24 to 81), and the average follow-up time was 4.2 years (range 2 to 10). Of the 19 fractures, 10 involved the left shoulder and nine the right; 10 affected the dominant limb and nine the non-dominant. According to the AO classification (Jakob et al 1984), 16 of the fractures were C2.2 and three were C2.1.

All fractures were treated operatively either by closed or open reduction and were stabilised with minimal internal fixation. In five cases reduction was obtained by closed means, and maintained by percutaneous Kirschner wires. The remaining 14 cases had open reduction with minimal dissection and exposure. The surgical approach was either through a deltoit split or through the deltopectoral interval. Reduction was obtained by either a bone punch or laminar spreaders to elevate the valgus impacted head fragment (Fig. 2). After reduction, fixation was provided by AO screws in three, Kirschner wires in eight, and by Kirschner wires and cerclage in three.

RESULTS
According to Neer's criteria (Neer 1970a) four results were excellent, 10 satisfactory and two unsatisfactory; three patients were considered failures. The average clinical score was 81 points (range 41 to 94) with all shoulders showing some limitation of movement.

There were no infections, malunions or loss of reduction in any of the patients. Union occurred in all patients at an average of six to eight weeks postoperatively. The main reason for failure was the development of avascular necrosis of the humeral head fragment. In fact, all five of the poor results were due to avascular necrosis. Of these, four were male and one female; their average age was 49.4 years (range 43 to 59). There were four left shoulders and one right, three dominant and two non-dominant. Four of the fractures were C2.2 and one was C2.1. In all cases, avascular necrosis and collapse was diagnosed less than two years from the time of injury.

DISCUSSION
Almost 20 years have passed since Neer (1970a,b) published his now classic article on fractures of the proximal humerus; this provided a simple classification and guidance regarding management. We believe that the fracture pattern we have described does not fit accurately into Neer's classification and that it requires special consideration. Neer (1970a) defined displacement as more than 45° of angulation, or more than 1 cm of displacement of the fractured fragment. This implies that a head fragment which is laterally or posteriorly displaced by more than 1 cm should have the same prognosis as one which is angulated into valgus by more than 45°. It seems to us, however, that with a valgus impacted fracture which maintains bony contact the head fragment is more likely to retain its blood supply than if the fragment is laterally or posteriorly displaced. This difference in the likely incidence of avascular necrosis may well account for the large variability in the reported results (Neer 1970b; Lee and Hansen 1981; Leyshon 1984). In our series only five of the 19 fractures (26%) developed avascular necrosis, a lower incidence than that reported by Neer (1970b) for four-part fractures.

An example of a fracture in which there was no evidence of avascular necrosis is shown in Figure 3. It may be that vascularity is reduced in these valgus impacted fractures,
but because the head fragment is only angulated and not translated, there are enough soft-tissue attachments for the fragment to remain viable.

We agree that if the head fragment is laterally or posteriorly displaced, then the probability of vascularity being maintained is negligible; a prosthetic replacement is then indicated and usually gives a reasonably satisfactory result (Neer 1970b; Tanner and Cofield 1983; Stableforth 1984). But if the fracture is of the valgus impacted type which we have described, then primary prosthetic replacement may not be necessary; indeed 14 of our 19 patients (74%) obtained satisfactory or excellent results with closed or limited open reduction and minimal osteosynthesis. It may be suggested that a non-operative approach might provide similar results, but on the whole such treatment of four-part fractures has proved unsatisfactory (Neer 1970b; Leyshon 1984; Mills and Horne 1985); the most significant problem reported is avascular necrosis (Neer 1970a; Leyshon 1984), but nonunion, malunion, and shoulder stiffness may also occur.

We have two main objections to non-operative management. The first concerns reduction. If the head fragment is left to heal in situ, then joint incongruity will result because the humeral head is too low. The disturbed joint mechanics may lead to osteoarthritis, and malposition of the tuberosities may lead to impingement. Our second objection to a non-operative approach is that it may lead to shoulder stiffness. Our method of treatment overcomes both objections. It achieves reduction and provides sufficient stability to permit early movement. The minimal fixation we used was sufficient to maintain reduction and seems preferable to the more extensive exposures and fixation techniques previously reported which have been associated with poor results, and high rates of avascular necrosis (Jakob and Ganz 1981; Sturzenegger, Fornaro and Jacob 1982). We had no cases of nonunion or malunion and good shoulder movement was obtained in those patients who did not develop avascular necrosis.

Conclusions. A specific type of displaced four-part humeral fracture which involves valgus impaction of the head fragment has been described. With closed or minimal exposure for reduction and with limited osteosynthesis, 74% good results were achieved after an average of four years. The major reason for failure was avascular necrosis (26%), which accounted for all five of our poor results. This relatively low incidence suggests that discarding the humeral head and proceeding to arthroplasty is not indicated.

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REFERENCES


