



# Pseudarthrosis of the surgical neck of humerus treated by buttressing with a medial cortico-cancellous graft

J Maheshwari, Vinay K Pandey<sup>1</sup>

## ABSTRACT

**Background:** Pseudarthrosis of surgical neck of humerus is uncommon condition. Different methods of improving the stability of fixation have been described, including impaling the shaft into the head, placing a tension suture through the rotator cuff, or using an intramedullary cortical graft. We report our results of cortico-cancellous strut graft medially to counter the varus force, in conjunction with a fixed-angle implant on the lateral side.

**Materials and Methods:** We used this technique in seven cases of pseudarthrosis of surgical neck of the humerus. There were four women and three men, ranging in age from 22 to 65 years. All were treated with a tricortical medial buttress bone graft and fixed-angle fixation device on the lateral side. A locking proximal humerus plate (Synthes) was used in six cases, and a bent reconstruction plate (Synthes) was applied in one case. The one in which reconstruction plate was applied was operated before the advent of locking plates. The limb was immobilized in 30° of abduction over a cushion for 6 weeks, followed by a sling for another 6 weeks.

**Results:** The followup varied from 18 to 96 months. All our cases healed within mean 5.1 months (range 4–6 months). There was one case of avascular necrosis. All cases had useful function of shoulder.

**Conclusion:** The medial buttressing by strut graft with external fixation by laterally placed fixed angle plate is successful to achieve fracture union in pseudarthrosis of surgical neck of humerus.

**Key words:** Pseudarthrosis, surgical neck humerus, medial buttressing, bone graft

## INTRODUCTION

Pseudarthrosis of surgical neck of humerus is an uncommon condition.<sup>1,2</sup> Various treatment methods, from reconstruction to replacement, have been described.<sup>3,4</sup> Reconstruction continues to be the preferred method as reported results of replacement surgery have been poor.<sup>4</sup> It is difficult to achieve stable reduction and internal fixation due to mismatch between the sizes of shaft and head fragment. Cavitation of the head and osteoporosis add to the difficulty [Figure 1]. Different methods have been described for improving the stability of fixation,<sup>5,6</sup> including

impaling the shaft into the head, placing a tension suture through the rotator cuff, or using an intramedullary cortical graft. We used cortico-cancellous strut graft medially in conjunction with a fixed-angle implant on the lateral side.

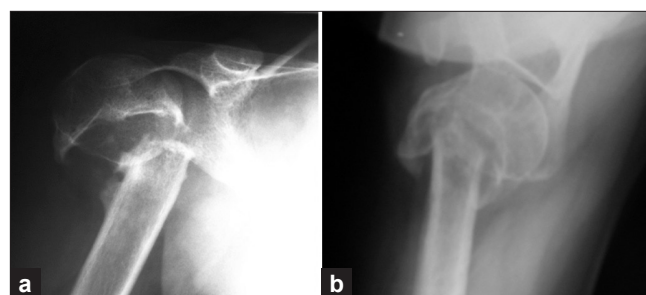
## MATERIALS AND METHODS

We treated seven cases of pseudarthrosis of the surgical neck of the humerus between 2004 and 2010. There were four women and three men, ranging in age from 22 to 65 years. The initial treatment was a sling in three patients, U-slab in two patients and internal fixation in two. The diagnosis of pseudarthrosis was obvious in all cases because of mobility and crepitus at the fracture site.

Department of Orthopaedics, Joint Replacement and Arthroscopy Unit, Indian Spinal Injuries Center, New Delhi, <sup>1</sup>Heritage Hospitals, Varanasi, India

**Address for correspondence:** Dr. J. Maheshwari, Joint Replacement and Arthroscopy Unit, Indian Spinal Injuries Center, New Delhi, India. E-mail: drjmaheshwari@hotmail.com

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**Figure 1:** X-rays of shoulder joint with proximal humerus (a) anteroposterior view (b) lateral view showing cavitation effect of long standing pseudarthrosis of fracture of surgical neck of humerus

All the cases were treated with a tricortical medial buttress bone graft and fixed-angle fixation device on the lateral side. A locking proximal humerus plate (LPHP Synthes) was used in six cases, and a bent reconstruction plate (Synthes) was applied in one case. The one in which reconstruction plate was applied was operated before the advent of locking plates. The limb was immobilized in 30° of abduction over a cushion for 6 weeks, followed by a sling for another 6 weeks. Patient was walking with arm immobilized over a 6-inch cushion, wrapped with sticking tape to the chest [Table 1].

Patients were permitted to use their limb for day-to-day activities after 3 months. They were evaluated radiologically every 6 weeks. The fracture was declared united clinically as there was no abnormal mobility and also no pain. Radiologically, the union was confirmed by the presence of new bone formation across fracture and incorporation of bone graft.

### Operative procedure

The fracture was exposed through delto-pectoral approach. The scar tissue was excised, and the fracture surfaces were freshened. The head was reduced on the top of the shaft. The head *per se* was not visible; as it was intracapsular; only its fracture surface was visible. The reduction was checked on an image intensifier, and the construct was temporarily stabilized with one or two K-wires. A fixed-angle fixation device (locking compression plate or LCP) was used to fix the fracture. The space was now created on the medial side of the fracture by careful sharp dissection. A 3–4 cm tricortical graft taken from ipsilateral iliac crest was placed in this space, supporting the head. The strut graft was held to the shaft with two cortical screws, through the plate or outside it [Figure 2]. The stability and range of motion of the shoulder was checked. The shoulder was immobilized in 30° abduction over a pillow in the axilla, for 6 weeks, after which intermittent shoulder mobilization was started.

### RESULTS

The follow-up varied from 18 to 96 months. The union occurred in all the cases. The average healing time was 5.1 months (range 4–6 months). All cases had useful function of the shoulder [Figure 3]. Although we did not use any instrument for quantifying shoulder function, the patients were satisfied with a stable shoulder with useful activity. We did not encounter any intraoperative and immediate postoperative complications. In one case, avascular necrosis (AVN) was noticed [Figure 4]. This was an incidental finding, as the patient continued to do well. Patients were assessed as successful cases if union occurred and

**Table 1: The clinical details of the cases**

Cases	Age (years) / sex	Previous treatment	Healing time (months)	Follow-up (months)
1	45/f	Conservative	4	96
2	40/m	Open reduction and internal fixation	6	48
3	45/f	Closed reduction and rush pins	5	42
4	22/m	Conservative	5	30
5	60/f	Conservative	5	36
6	65/f	Conservative	6	24
7	55/m	Open reduction and internal fixation	5	18



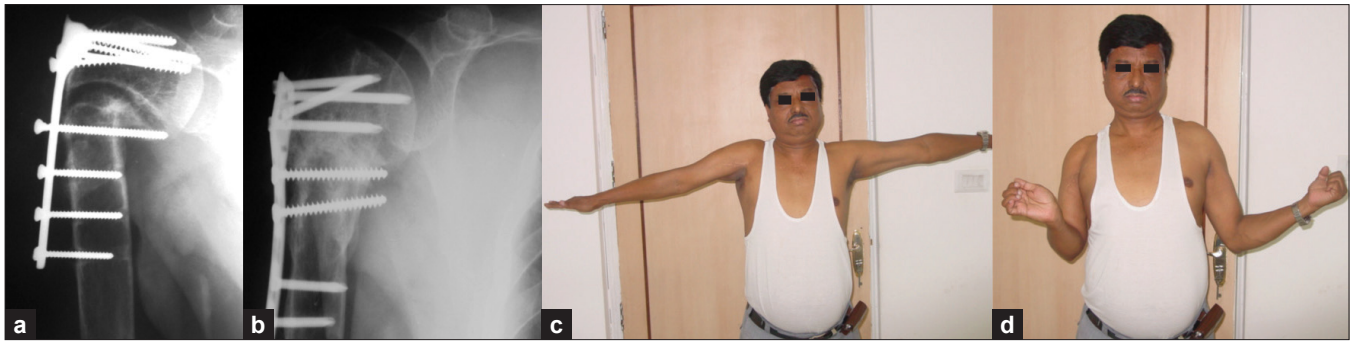
**Figure 2:** X-ray shoulder joint with arm (anteroposterior view) showing strut graft held with two long screws

they could do activities of daily living. We did not assess functional scoring of shoulder.

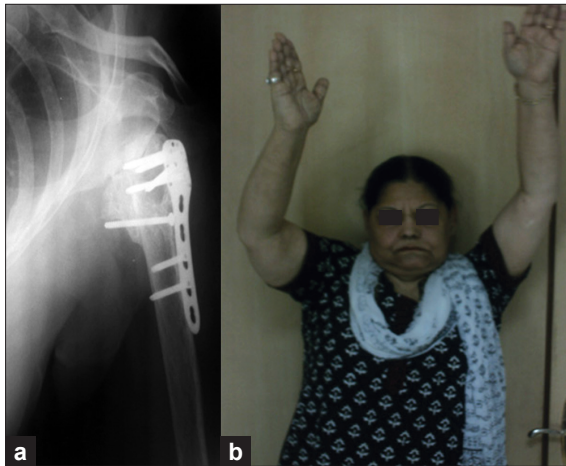
### DISCUSSION

Nonunion of surgical neck of humerus is not a common problem.<sup>1,2</sup> From treatment viewpoint, these can be divided into two types: one, where the bone stock is essentially preserved, and the other where pseudarthrosis has developed. The former is relatively easy to treat by conventional methods of internal fixation, but the ones with pseudarthrosis are difficult treatment issues due to the deranged patho-anatomy. Persistent mobility at the pseudarthrosis, by pestle and mortar effect, causes cavitation of the head, and over a period, the head fragment becomes like a shell of bone. This makes open reduction and internal fixation a challenging clinical situation to treat. The replacement in such cases is described, but reported results are not good.<sup>3,4</sup> Attempts continue to achieve healing in these rather complex cases.<sup>7-9</sup>

The stable internal fixation is crucial if one has to achieve union in such nonunions. Achieving stable internal fixation is difficult in nonunion of surgical neck of humerus



**Figure 3:** (a) Preoperative X-rays of shoulder joint (Anteroposterior view) with arm showing nonunion of the surgical neck, (b) postoperative anteroposterior X-ray shows fracture union, (c and d) clinical photographs showing shoulder functions



**Figure 4:** (a) X-ray shoulder joint (case no. 5) anteroposterior view shows fracture union with avascular necrosis of head of the humerus, (b) clinical photograph of same patient showing good function despite AVN of the head of the humerus

considering that the proximal fragment is small and osteoporotic and there is excessive mobility at the fracture site (pseudarthrosis). Sheek reported improved stability of the basic internal fixation by impaling the distal fragment into the head and by tension-band wiring of the rotator cuff to the shaft.<sup>5</sup> The author also used extramedullary strut on the lateral side to add to stability. Disadvantage of this technique is that most of the cases so managed needed spica immobilization and second surgery for removal of implants. Walch *et al.*<sup>6</sup> used intramedullary cortical strut autograft obtained from fibula, tibia or iliac crest to regain the length and improve stability. Though good results have been shown with the use of this technique, there are disadvantages. Firstly, there is reasonable morbidity of harvesting cortical graft. Secondly, the procedure requires preparation of the cortical graft to make it fit to go into the medullary cavity. Furthermore, preparation of the medullary cavity to accept the graft needs extensive dissection, a rather non-biological approach in a nonunion situation. Failure due to graft fracture and persistent nonunion has not been reported by the author.

Our current technique is simpler and is based on the

understanding of mechanical forces involved in this fracture. Brunner *et al.*<sup>10</sup> have reported varus collapse in fresh cases treated with LCP due to loss of medial support at the fracture. We observed intraoperative difficulty in exposure of fracture site (due to extensive scarring) and subperiosteal elevation of tissues from medial side. The temporary stabilization of hypermobile pseudarthrosis, proper placement of plate and ensuring the secure hold of bone graft to the main bone with one or two screws was most important. Gardner *et al.*<sup>11</sup> have reported 30% loss of reduction in these fractures, where medial buttress was missing. These reports support our hypothesis that medial buttressing is important in achieving a stable construct in these fractures, particularly in those with pseudarthrosis. Our results in this rather small series support our belief that buttress cortico-cancellous graft on the medial side along with a fixed-angle device on the lateral side makes it a stable construct and helps in the union of this rather unstable and difficult nonunion. Technically, it is an easier procedure as there is little graft harvest morbidity and no preparation of the graft or host side is required. It is recommended, particularly, for cases of pseudarthrosis where the head is osteoporotic and unstable, and there is a significant cavitation of the head. The small sample size and lack of functional objective evaluation of cases are limitations of the study.

This technique is easier than the previously described techniques. We have used this technique in seven cases of pseudarthrosis of surgical neck of the humerus to achieve fracture union.

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