Good results with unreamed nail and bone grafting for humeral nonunion

A retrospective study of 21 patients

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ABSTRACT – 21 patients with humeral shaft nonunions were treated by retrograde nailing with the unreamed humeral nail. In all cases, we reamed the fracture site and performed a bone graft. Union of the fracture occurred in every case. The mean healing time was 4.2 (4–6) months. The range of motion of the shoulder and elbow was excellent in 14 patients, that of the shoulder moderate in 6 and poor in 1, and that of the elbow moderate in 7. The functional results were excellent in 13 patients, good in 5 and fair in 3.

Given the good functional results in this series, retrograde locked nailing and bone grafting appears to be a good method for treating humeral shaft nonunions.

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Several surgical methods have been recommended for treating nonunion of the humeral diaphysis: compression plating and autologous cancellous bone grafting (Healy et al. 1987, Barquet et al. 1989), the Ilizarov external fixator (Lammens et al. 1998, Patel et al. 2000), and for complex nonunions, vascularized fibular bone graft and cancellous grafts from the iliac crest with plate osteosynthesis (Jupiter 1990).

The Seidel nail has been used by many authors for treating of humeral nonunions, but the results have usually not been satisfactory (Crolla et al. 1993, Pietu et al. 1994, Wu 1996, Emmerson and Sher 1998, Svend-Hansen et al. 1998, Thomsen et al. 1998). New intramedullary nails permit rigid stabilization of humeral shaft fractures (Rommens et al. 1995, Lin et al. 1997, Rommens et al. 1998, Williams and Shewring 1998, Zatti et al. 1998, Gaullier et al. 1999, Lin and Hou 1999).

In this retrospective study, we report our results of humeral nonunions treated by retrograde nailing and bone grafting.

Patients and methods

From 1995 to 2000, 21 (mean age 48 (18–79) years, 13 men) nonunions of the humeral shaft were treated in our Service by retrograde nailing and bone grafting (Table). We considered as nonunions fractures that had not united after 6 months of treatment.

14 fractures had been treated by closed methods and 7 by multiple retrograde pins. All of them had been closed fractures, and no primary or iatrogenic radial nerve injuries at the time of initial treatment of the fracture had been detected. The fracture was located in the middle third in 16 cases and the upper third in 5.

The average time between the fracture until nailing was 9 (6–11) months. All were atrophic nonunions. We inserted an unreamed humeral nail (Synthes, USA, Paoli, PA) retrogradely. The fracture site was reamed and the nail was always locked proximally and distally. The site of nonunion was decorticated and autologous cancellous grafting harvested from the iliac crest, also done.

After surgery, the humerus was immobilized with a sling for 2 weeks. Then motion exercises of the shoulder and elbow were encouraged. Heavy lifting was avoided until radiographic healing had occurred. Patients were followed in the outpatient department at 4-week intervals for a median of 18 (12–28) months.

Details about the 21 patients

Case	Age	Fracture level	Previous treatment	Interval [a] (months)	Time to healing [b]	Result
1	26	PT	O	6	4	E
2	19	MT	R	9	4	E
3	18	MT	O	8	4	E
4	20	MT	O	7	4	E
5	43	MT	O	9	4	G
6	31	PT	R	9	4	E
7	36	MT	O	10	4	E
8	40	MT	O	10	4	E
9	43	MT	R	9	4	E
10	31	MT	O	8	4	E
11	58	PT	R	11	4	G
12	51	MT	O	9	4	G
13	79	MT	O	10	6	F
14	36	MT	R	8	4	E
15	38	MT	O	9	4	E
16	42	MT	O	8	4	E
17	34	PT	R	10	4	E
18	57	MT	O	9	4	G
19	48	MT	O	11	5	G
20	70	MT	O	9	5	F
21	63	PT	R	11	4	F

PT proximal third, MT middle third, O orthopedic, R retrograde pinning, E excellent, G good, F fair.
[a] Interval between initial fracture and unreamed nailing (months)
[b] Time to healing after unreamed nailing (months)

Shoulder or elbow range of motion was graded as excellent when there was less than 10° loss of range in any direction, moderate when there was loss between 10° and 30° and as poor with loss of range more than 30° (Rommens et al. 1995). Functional results were evaluated, using the Stewart and Hundley (1955) classification—i.e., excellent: no pain, full range of motion and good radiographic alignment; good: occasional pain, limitation of adjacent joint mobility less than 20° and angulation less than 10°; fair: pain after effort, limitation of mobility between 20° and 40° and angulation greater than 10°; and poor: permanent pain, limitation of mobility greater than 40°and nonunion or iatrogenic radial nerve palsy.

Results

All fractures healed after mean 4.2 (4–6) months (Figures 1, 2 and 3).

An excellent range of motion of both joints was obtained in 14 patients. The range of motion of the shoulder was moderate in 6 cases and poor in 1. The range of motion of the elbow was moderate in 7 cases.

Function was excellent in 13 patients, good in 5 and fair in 3. The main cause of fair results was shoulder and elbow stiffness. Only 2 patients had pain after effort. The alignment was good in 19 cases. There were 2 cases of angulation, 1 of them of 5° varus malunion and the other of 5° valgus malunion.

No nonunions, infections or iatrogenic radial nerve palsy were noted. Intraoperative avulsion of a small bone fragment at point of the insertion occurred in 1 case. Rotational stability checked intraoperatively was good in all cases. The interlocking at the nail tip was difficult in 5 patients, and the operation took 1.5–2 hours in all of them.

Discussion

Compression plates with bone grafting, intramedullary nails and external fixators are the commonest methods used to treat humeral shaft nonunion, but it is not knwon which one is best. The need for a bone graft is unclear.

Thomsen et al. (1998) treated 12 nonunions with the Seidel nail. In 9 of them, open reduction and cancellous bone grafting were performed, and in the remaining 3, closed nailing and reaming was done. They did not specify the time from fracture to treatment of nonunion. In 5 patients, the procedure failed and they found that the distal locking seemed to be inadequate.

Wu (1996) and Wu et al. (1998) reported that the Seidel nail does not always provide distal rotational stability. They solved the problem by inserting a staple across the fracture site. The period from injury to treatment ranged from 1 to 5 years, and cancellous bone grafting was always done.

Svend-Hansen et al. (1998) used the Seidel nail and bone grafting in 7 nonunions. Only 3 fractures

Figure 1. Appearance of the fracture 9 months after pinning.

Figure 2. The fracture was treated by retrograde locked nailing and bone grafting.

Figure 3. Union occurred 4 months after nailing.

healed. In 4 fractures that did not heal, there was loss of fixation due to unscrewing of the distal bolt, although the postoperative radiographs showed correct expansion of the nail flanges.

Crolla et al. (1993) treated 9 humeral shaft nonunions with the Seidel nail. The time from fracture to treatment of the nonunion ranged from 6 to 24 months. Bone grafting was done in 1 case. Only 6 cases healed. 3 patients needed further bone grafting.

Plates require a wide dissection which entials a high risk of damage to the radial nerve. Osteoporosis because of previous surgery may prevent a stable plate fixation. Rugged bony surfaces at the nonunion site make the placement of a plate difficult, but present no problem for an intramedullary nail. Wu and Shih (1992) compared nonunions of the humeral shaft treated by plating with those treated by nailing and they reported no difference in union rate and time to union, but patients who had a plate fixation had more complications than those whose fracture was managed by interlocking nailing.

Since shoulder function is impaired with anterograde nailing (Crates and Whittle 1998, Flinkkilä et al. 1999, Gaullier et al. 1999), we prefer the retrograde technique, especially because of the good rotational control. We always include a bone graft. Rommens et al. (1998) observed several complications, such as difficult interlocking at the nail tip, fissure or avulsion at the point of insertion, difficult nail insertion, insufficient stability of locking bolts and secondary radial nerve palsy. We had problems with interlocking at the nail tip in the first cases, but not after training. The entry hole had to be made and placed correctly to avoid fissures or avulsions at the insertion.

Several fractures in our series had been initially treated by pinning. We think that this method was not effective in providing a stable fixation, probably because we did not use enough pins to fill the medullary cavity.

In our experience, the unreamed humeral locked nail is a good alternative for the treatment of humeral shaft nonunions, with few complications and good functional results.

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