Comparative results of bracing and interlocking nailing in the treatment of humeral shaft fractures

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Summary. A comparison was made between 44 humeral fractures treated conservatively with functional bracing (Group 1) and 45 treated by operation with a locking nail (Group 2). Thirty-eight of the 44 patients in Group 1 (86%) and 22 of the 45 patients in Group 2 (47%) regained full movement of the shoulder joint. The functional end results were somewhat better in Group 1 although over 90% of patients in both groups were able to clasp their fingers behind their necks and to reach up their backs without restriction. Two patients developed a pseudarthrosis in Group 1, and 2 patients in Group 2 required operative revision due to a haematoma in 1 case and as a result of an infection in the other. There were 6 cases of primary radial nerve damage in both groups, and 6 had to be decompressed operatively. Residual sensory and motor disturbance remained in 2 patients in Group 1. Both methods are useful for the treatment of humeral shaft fractures. We advocate functional bracing as the method of choice if no contra-indications exist.

Résumé. 99 fractures de la diaphyse humérale ont été analysées, dont 44 ont été traitées par brassard et 45 par clou intramédullaire. 86% du groupe: traitement conservateur et 47% du groupe: traitement opératoire présentaient un mouvement illimité de l'épaule, tandis que plus de 90% des deux groupes arrivaient à toucher la nuque (rotation

externe en abduction) et la sacrum (rotation interne en adduction) avec la main du bras blessé. Il y a eut deux pseudarthroses dans le groupe conservateur. Dans le groupe opératoire deux interventions chirurgicales ont été nécessaires en raison d'une infection et d'une hémorragie. Les deux groupes présentaient chacun 6 cas de paralysie primaire du nerf radial avec une décompression chirurgicale consécutive dans 6 cas. Des déficits moteurs et sensitifs persistaient chez deux malades du groupe conservateur. Les deux méthodes sont efficaces pour le traitement des fractures de la diaphyse de l'humérus. En cas d'absence des contre-indications nous recommandons le traitement par brassard comme traitement de premier choix.

Introduction

Despite Boehler's description of a fracture of the shaft of the humerus as "the most benign of all fractures of the long bones" [1], a considerable number of conservative and operative options for treatment exist, including an abduction splint, U-cast, hanging cast and a Desault bandage for conservative management and Buendel-nailing, plate osteosynthesis, external fixation and Rush pins as operative treatment [5, 13, 18].

Reports on functional fracture treatment were first published at the beginning of this century [9, 11]. In 1960 Sarmiento [14, 15] developed an astonishingly simple system, similar to the traditional Chinese fracture treatment [3], which al-

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Fig. 1. Initial radiographs showing oblique fracture of the right humerus in a 60-year-old female

lowed early mobilisation. The principle is based on internal circumferential compression of the components of the limb. It is then unnecessary to immobilise the adjacent joints.

In 1980 Seidel [17] introduced his humeral locking nail which allowed closed and simple nailing of the humerus by proximal access through the greater tuberosity. Distal fixation is achieved through intramedullary spreading at the point of the nail, and proximal fixation by 2 transverse and perpendicular interlocking screws.

The purpose of the present study was to compare a conservative with an operative technique using 2 homogenous groups of patients. Patients in Group 1 were treated by functional bracing and those in Group 2 by an interlocking nail.

Materials and methods

We have been using bracing and nailing techniques for treating humeral fractures since 1988, and in this study we have assessed retrospectively 2 equal sized groups of patients. The choice of conservative or operative treatment was made by the

Table 1.

	Brace (n = 44)		Nail (n = 45)	
	n	%	n	%
Age	59		56	
	Range		Range	
	11–92		19–87	
male	24	54,5	26	57,8
female	20	45,4	19	42,2
Fracture type				
Spiral	14	31,8	9	20,0
Oblique	13	29,6	9	20,0
Transverse	10	22,7	13	28,9
Multiple fragments	7	15,9	14	31,1
Position				
Proximal third	21	47,7	22	48,9
Middle third	19	43,2	20	44,4
Distal third	4	9,1	3	6,7

senior surgeon on duty. Patients with multiple injuries, 2nd and 3rd degree open fractures, lesions of the brachial artery where intramedullary nailing was preferred, and undisplaced fractures where only functional bracing was used, were excluded from our series.

In Group 1 the arm was first placed in a Gilchrist bandage for 5 days. Thereafter the brace was applied for between 7 and 10 weeks, and physiotherapy was given.

In Group 2, operative treatment with the Seidel nail was carried out within 36 h following trauma. For the first 7 days the arm was immobilised in a Gilchrist bandage and the patient was only allowed to mobilise the arm under physiotherapy supervision. Rotation of the arm was not permitted for the first 2 weeks postoperatively, but otherwise early functional rehabilitation was encouraged.

The patients were clinically and radiologically examined and were assessed according to a score described by Wulker et al. [20].

Patient sample

Over a 4 year period (1990–94), 45 patients with primary fractures of the shaft of the humerus were treated by bracing (Group 1), and 44 patients with a locking nail (Group 2). The age, sex distribution, the fracture site and its type are given in Table 1. The average duration of inpatient treatment in Group 1 was 18.7 days (range: 5–56), and in Group 2 24.3 days (range: 8–65). The time in hospital was influenced by age and social circumstances. In Group 1, 12 were treated as out-patients; the brace was worn for an average of 8.4 weeks (range: 4–17).

Results

Mobility

Patients were followed-up for a minimum of 12 and a maximum of 48 months (mean 27 months). Assessment of the mobility of the shoulder and elbow joints showed that 43/44 (97%) of patients

Fig. 2. Radiograph after reposition of the applied brace

Table 2. Extent of movement at the shoulder and elbow

	Brace		Nail	
	<i>n</i>	%	<i>n</i>	%
Shoulder: free mobility	38	86.4	22	48.9
Elbow: free mobility	40	90.9	45	100
Limited level of movement				
Abduction	3	6.8	10	22.2
Elevation	2	4.5	6	13.3
External rotation	2	4.5	12	26.7

in Group 1 were able to clasp their fingers behind their necks and that all patients were able to reach up their backs. In Group 2 the percentages were 91% and 96% respectively (41/45, 43/45). Unlimited movement of the treated shoulder joint when compared to the uninjured shoulder was seen in 38/44 (86%) of patients in Group 1 and 22/45 (47%) in Group 2.

Unlimited elbow mobility was observed in 40/44 (90.9%) of patients in Group 1, and in all patients in Group 2. All patients had full adduction, internal rotation and retroversion but there was some limitation of abduction and external rotation. In Group 2 there was an average of 80° abduction, and an average of 25° external rotation (Table 2).

Radiological results

As expected, malalignment was found more often in Group 1. The most common deformity was axial

Table 3. X-ray findings for the brace group

Axial deviation	<i>n</i>	%	Lateral displacement	<i>n</i>	%
None	18	40.9	<0.5 shaft widths	29	65.9
<10°	20	45.5	0.5–1 shaft widths	13	29.5
>10°	6	13.6	>1 shaft widths	2	4.5

Table 4. Subjective evaluation

	Brace		Nail	
	<i>n</i>	%	<i>n</i>	%
Comfort	42	95.5	38	84.4
Less comfort	1	2.3	5	11.1
No comfort	1	2.3	2	4.4
Pain free	22	50.0	24	53.3
– after much use	20	45.5	15	33.3
– after little use	2	4.5	6	13.3
No reduction in function	40	90.9	36	80.0
Day to day reduction in function	4	9.1	9	20.0

deviation of the shaft in 26/44 patients (59%), while 15/44 patients (34%) showed a lack of apposition from 50% to more than 100% of the width of the shaft (Table 3).

In Group 2 a varus malalignment of 15° was seen in 1 patient who also had a subcapital fracture which prevented nailing.

Subjective evaluation

The majority of patients in both groups were content with the treatment and reported no major impairment of function.

In Group 1, 22/44 (50%) patients were free of pain, as were 24/45 (54%) patients in Group 2 (Table 4). The average score was 90.8 points in Group 1, and 85.4 points in Group 2.

Complications

1. Neurological problems. Six patients (13%) from each group showed an initial paresis of the radial nerve. There were 3 spiral, 2 transverse and 1 comminuted fracture in the middle third of the humeral shaft in each group. At the time of follow-up, 4 patients from Group 1 had noticed a partial improvement or complete recovery of motor and sensory function, whereas all 6 patients from Group B had recovered completely. Neurolysis was carried out on 4 patients from Group 1, and on 2 from Group 2, at a minimum of 12 weeks post injury. Two patients from Group 1 had residual

Fig. 3. After 8 weeks of brace treatment the fractures are healed (radiograph 36 months after trauma)

motor and sensory deficiency which was treated by nerve graft 8 months after injury. There was no palsy related to excessive callus formation.

2. Pseudarthrosis. Pseudarthrosis occurred in 2 patients from Group 1 with transverse fractures

and successful operative treatment by nailing was carried out.

3. Post-operative complications. In 2 cases the operations had to be revised due to a deep infection with abscess formation in 1 patient, and in order to release a haematoma in the other. A radial nerve paresis occurred in 1 patient postoperatively and this recovered spontaneously. After mobilisation 2 fractures required refixation with a longer nail.

Discussion

Good results can be achieved by a brace and by a Seidel nail [4, 7, 8], but when a brace is compared with other conservative treatments it gives better results [2]. Camden et al. [2] compared brace treatment with plaster U-slab immobilisation, and found no difference in healing time and final alignment. However there was a greater range of elbow motion in the brace group ($P < 0.05$).

Although the postoperative care is relatively easy, patients treated by operation (Group 2) had a slightly worse functional result. Lesions of the rotator cuff produced by insertion of the nail may interfere with function. Schweiberer et al. [16] report lesions of the radial nerve in 9.7% following plating, and this is a good reason for avoiding osteosynthesis. One advantage of the interlocking nail is that no instrumentation is needed in the elbow region. We now use plate fixation only when there is a large defect necessitating bone grafting or when there is concomitant damage to the brachial artery.

In contrast to other authors [10, 19] we do not consider that a primary radial nerve paresis is an absolute indication for operation, as in our series 90% of these lesions recovered spontaneously [6, 7, 12], and none deteriorated.

Angulation and shortening can often be accepted and radiological malalignment in Group 1

Fig. 4a, b. Functional result. Despite visible lateral displacement of the shaft and 2 cm shortening, no major functional impairment is seen. In patients with short and obese arms malalignment tends to be greater. Radiological features of malalignment may not affect the clinical outcome

Fig. 5. 43-year-old female patient with a transverse 1st degree open fracture

Fig. 6a, b. Radiographs after nailing

Fig. 7. Radiograph after implant removal 1 year later. Follow-up showed 20% limitation in abduction, elevation and external rotation

did not correlate with the functional result. Angular deviation of up to 10° , and shortening of up to 2 cm, did not significantly affect the functional outcome. Zagorski et al. [21] stated that up to 25° of varus-valgus angulation is functionally and cosmetically acceptable. We have seen non-union in 2 transverse fractures where there was only minimal bone contact between the fragments. In these cases, accurate reduction is necessary. Both cortices should be in contact, and regular weekly supervision is necessary during the first month.

Patients like conservative treatment which can often be carried out without admission to hospital [2, 7]. This is important when considering the increasing costs of health care. Confused, non-cooperative and polytraumatised patients, however, are not suitable for bracing.

Malalignment of humeral fractures does not result in osteoarthritis. Inadequate reduction is usually well compensated by mobility in the shoulder and elbow joints.

Ideal prerequisites for bracing of upper arm fracture include closed, minimally displaced spiral or oblique fractures of the middle or proximal third of the humerus, and a cooperative and not too overweight patient. With experience, comminuted fractures, as well as fractures of the distal third of the humerus, can also be treated with a brace [15]. Absolute indications for operative treatment are 2nd and 3rd degree open fractures, probable lesions of the brachial artery, and interposition of

soft tissue. Nailing is appropriate in polytraumatised patients and those with severe associated trauma to the thorax. Both methods allow early and comfortable rehabilitation, and both can give good results.

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