



Treatment of scaphoid non-unions with a corticocancellous graft and Herbert screw fixation : Results at five years follow-up

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In a retrospective survey, 16 patients with 18 established nonunions of the scaphoid treated with a sandwich graft and Herbert screw fixation, were reviewed : 14 patients were very satisfied with the outcome. The mean DASH score was 17 (SD 18.4). Flexion was 76%, extension 79% and gripping force 85% of the contralateral side. Union was achieved in 13 scaphoid bones. There was a significant increase in carpal height. Despite these findings there was also an increase in osteoarthritis. However this was not related to the correction or absence of correction of the preoperatively existing DISI. There was no correlation between radiological presence of osteoarthritis and clinical outcome.

Keywords : scaphoid ; fracture ; non-union ; bone graft ; Herbert screw.

INTRODUCTION

The natural history of a scaphoid nonunion is well established (7,8,11). There is a progression to secondary radiocarpal osteoarthritis by 10 years after the initial fracture. The initial development of osteoarthritis at the scaphostyloid joint is strongly associated with a dorsiflexed intercalated segment instability (DISI) (20). The frequency of the development of a DISI pattern increases with time in a scaphoid non-union, and DISI is more likely to occur if the scaphoid fracture affects the middle or distal third (7,13,16,17,22).

The purpose of our study is to evaluate the outcome and presence or progression of degenerative changes in the wrist after standard corticocancellous bone grafting and Herbert screw fixation. Furthermore we want to evaluate the influence of the presence and correction of a DISI deformity on the radiological and clinical outcome.

MATERIAL AND METHODS

Patients

Between November 1998 and October 2003, 37 scaphoid nonunions in 35 patients were treated by a corticocancellous graft and a Herbert screw fixation. Five patients completed only the questionnaires and refused physical examination. Three patients needed further surgery : two proximal row carpectomies (PRC) (11 and 43 months postoperatively) and one vascularised bone graft for proximal pole necrosis. Five patients were

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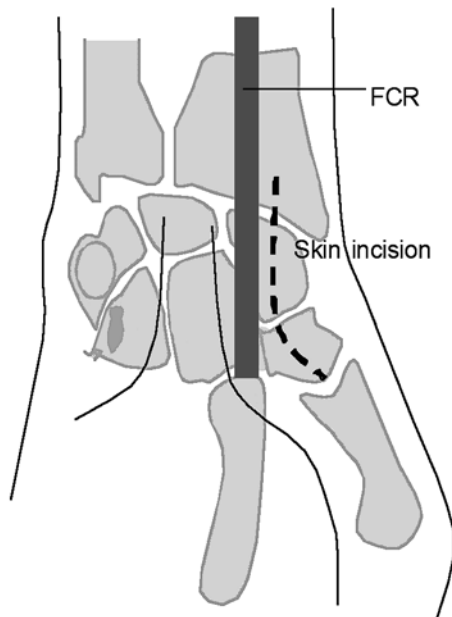


Fig. 1. — Anterior approach to the scaphoid

not able to participate because of their busy schedule, five patients were lost to follow-up and one patient died. In total 16 patients with 18 wrists were assessed clinically and radiographically. One patient with full assessment did not complete the questionnaires. Seven wrists had undergone prior surgery including screw fixation of the scaphoid with or without a bone graft. The dominant wrist was involved in twelve. The age at surgery ranged from 18 to 63 years with a mean age of 32.3 years. The interval between the fracture and surgery ranged from 3 to 96 months with a mean interval of 27 months. The postoperative follow-up ranged from 30 to 90 months with a mean follow-up of 61 months.

Surgical technique

The scaphoid was approached through a volar approach (Matti Russe), lateral to the flexor carpi radialis (FCR) tendon (fig 1). The bed of the FCR was incised in line with the skin incision. This opened the radiocarpal joint. The scaphoid was inspected and the pseudarthrosis tissue was resected up to normal looking bone. The scaphoid was reduced and its length restored by introducing a lamina spreader in the gap. A tricortical graft was harvested from the ipsilateral iliac crest. This graft was tailored and brought into the defect. One K-wire was used to fix the graft, a second K-wire was

introduced under fluoroscopic control, in the center of the scaphoid, parallel to the first one. A cannulated Herbert screw of appropriate length was then brought in. After radiographic control, the joint and skin were closed. The wrist was immobilised for 4 weeks in a below-elbow cast without thumb immobilisation.

Assessment

At final follow-up the range of motion (ROM) of both wrists was measured with a standard hand held goniometer and expressed as a percentage of the contralateral side. In three male patients both wrists were involved (two bilateral cases and one case with a severe injury at the contralateral wrist), and we compared the involved side with the average of the uninvolved side of the other patients. We measured grip strength with a Jamar dynamometer and pinch strength with a key pinch-meter. The DASH questionnaire (disabilities of the arm, shoulder and hand) (3,6,21), and the patient related wrist evaluation (PRWE) (9,10) questionnaire scores were completed for the subjective assessment. Pain was assessed using question 24 of the DASH score (Likert scale from 1 (no pain) to 5 (severe pain)).

Standard preoperative radiographs were available in all but one patient. On the radiographs we determined the location of the scaphoid fracture. The stage of non-union was classified into four types according to the modified Herbert and Fisher classification for scaphoid non-unions type D (5) (table I). Standard postoperative anteroposterior and lateral radiographs were obtained at final follow-up. On these films we evaluated healing of the scaphoid fracture as 1 definite, 2 probable, 3 doubtful, 4 none (20).

On both the pre- and postoperative films, we determined the severity and location of osteoarthritis. We measured the scapholunate angle (DISI when $> 70^\circ$),

Table I. — Location and grade of non-union according Herbert and Fisher (6) (including 3 wrists with salvage procedures)

Herbert & Fisher	distal third	middle third	proximal pole	Total
D1	—	5	—	5
D2	—	—	—	0
D3	4	10	—	14
D4	—	—	2	2
Total	4	15	2	21

radiolunate angle (DISI when $> 10^\circ$) and Nattrass carpal height index (carpal height divided by the length of the third metacarpal) to evaluate carpal instability (15). Osteoarthritis was evaluated according to Lindstrom and Nystrom (8). Grade I is the presence of one of the following features : (1) narrowing of the joint space, (2) sclerosis, (3) osteophytes. In grade II, two features are present, in grade III all three are present. We added a Grade IV corresponding to complete collapse of the carpus.

RESULTS

Of the patients with a complete final follow-up, 14 were satisfied with the result, one had a fair result and one was not satisfied. They all would undergo the same procedure again when faced with the same clinical conditions and knowledge of their current condition. The mean DASH score was 17 (± 18.4), the mean PRWE 22.7 (± 18.6).

The ROM was significantly reduced in all directions compared to the contralateral side : flexion 76% (SD : 18), extension 79% (SD : 21), ulnar deviation 73% (SD : 19) and radial deviation 59% (SD : 22). Grip force was 85% of the contralateral side. Forearm rotation was not affected : 102% pronation (SD : 9) and 98% supination (SD : 10). The key pinch force was similar to the normal side (99%, SD : 21). The mean pain score was 1.6 (SD : 0.95) (between no pain (= score 1) and slight pain (= score 2)) (table II).

Radiological assessment

Bone healing was achieved in 13 of the 18 scaphoid bones (table III).

The SL angle and RL angle were not significantly corrected (SL angle correction $3.84^\circ \pm 11$ ($p = 0.17$) RL angle correction $6.06^\circ \pm 18$ ($p = 0.19$)). Carpal height was significantly improved (Nattrass index correction 0.04 ± 0.06 ; $p = 0.05$ (paired t-test)). The DISI deformity was corrected in 6 (31.2%) out of 16 wrists with a preoperative DISI deformity.

The grades of osteoarthritis preoperatively and at follow-up are listed in table IV (we included the two patients who needed a proximal row carpectomy). The interval from fracture to final reconstruc-

Table II. — Postoperative range of motion of involved and uninvolved wrists (N = 18 wrists)

	% involved/uninvolved	p
Flexion	76.4 \pm 18	< 0.0001
Extension	79.1 \pm 21	< 0.001
Ulnar deviation	72.5 \pm 19	< 0.0001
Radial deviation	58.6 \pm 22	< 0.0001
Pronation	102.4 \pm 9	0.26
Supination	97.9 \pm 10	0.38
Grip strength	84.9 \pm 18	< 0.005
Pinch strength	98.6 \pm 21	0.77

tion was not significantly correlated with the severity of osteoarthritis.

Compared with the preoperative status a significant increase in osteoarthritis was noted ($p < 0.01$; Wilcoxon paired) at final follow-up. No significant difference in grade or progression of osteoarthritis was noted in the patients with a correction of the DISI deformity compared to the wrists where correction was not achieved. There was no significant correlation at each progressive grade of osteoarthritis with the DASH or PRWE score (table V).

DISCUSSION

The results of this cohort are to be reviewed critically because of the relatively small number of patients and the low response to follow-up assessment (57%).

The results of clinical assessment confirmed the already established significant decrease in wrist motion. Our DASH score was higher compared to the result of 9.2 on average reported by Daecke *et al* (2) but the preoperative grade of osteoarthritis in that group was 43% compared with 73% in our group and in most patients only a cancellous graft was necessary because there was no carpal instability, so both groups cannot be compared.

In this study a union rate of 72% was achieved. This result compares well with the union rates reported in larger series such as Filan *et al* (4) 70%, Preisser *et al* (18) 89%, Shah *et al* (19) 80%, Daecke *et al* (2) 84% and Chantelot *et al* (1) 64%, with the remark that one third of these patients had already

Table III. — Bone healing versus grade of non-union according to Herbert and Fisher (6)

Herbert & Fisher	Definite	Probable	Doubtful	Absent	Total
D1	2	1	1	1	5
D2	—	—	—	—	0
D3	8	2	1	1	12
D4	—	—	—	1	1
Total	10	3	2	3	18

Table IV. — Osteoarthritis grade (OA) before surgery and at follow-up (with one set of radiographs missing)

OA grade	Preoperative	At follow-up
None	11	3
Grade 1	3	3
Grade 2	3	4
Grade 3	0	4
Grade 4	0	3

undergone a previous surgical attempt to achieve union. The negative influence of previous surgery on bony healing was stated by Shah *et al* (19). Two recent meta-analysis studies reported a union rate of 74% (12) and 84% (14).

Correction of the DISI deformity was achieved in 31%. Only one other study is available comparing the pre- and postoperative DISI deformity, which describes a correction in five out of six wrists with a preoperative carpal instability in a total population of fifty patients (2). In this study we could not find a difference in progression of osteoarthritis in the corrected wrists compared to those not completely corrected. Shah *et al* (19) concluded from their study that the outcome is mainly negatively influenced by a prolonged interval when the interval is 5 years or longer. This could not be confirmed in this survey. In our group there was an average interval of 27 months, with only three patients with an interval exceeding five years.

Four patients had a DASH score higher (> 35) than average without an identifiable cause : neither a higher grade of nor more progression of osteoarthritis nor any difference in union rate.

Table V. — Questionnaire scores in relation to the grade of osteoarthritis. DASH = Disability of Arm, Shoulder and Hand score ; PRWE = Patient Related Wrist Evaluation Score

OA grade (8)	DASH (6)	PRWE (9,10)
0	9.6 ± 14	7.3 ± 10
1	23.9 ± 20	26.5 ± 11
2	16.5 ± 14	22 ± 17
3	22.3 ± 23	31 ± 24
4	34 ± 27	47.8 ± 26
Kruskal-Wallis	p = 0.5	p = 0.38

Other factors than those described may be present to explain these higher subjective scores.

CONCLUSION

With this study we can conclude that most patients are satisfied with their outcome, which is somewhat unexpected looking at the radiographic results. But their opinion is confirmed by their average result , with no pain or only slight pain in activities of daily living (question number 24 of the DASH score).

In the future it may be useful to select the patients purely based on the preoperative carpal instability in order to have a more homogenous group of patients.

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