Original Research

Evaluation of Herbert Screw Fixation for the Treatment of Displaced Scaphoid Nonunions

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ABSTRACT

Ten cases of unstable scaphoid nonunions treated with Herbert screw fixation were compared to nine cases treated with Herbert screw fixation supplemented with a single Kirschner wire (K-wire) across the fracture site. Corticocancellous bone graft from the distal radius was used in all cases to reconstruct the scaphoid. The age of the patients and duration of the nonunions were similar in both groups. Postoperative radiographs demonstrated that only 5 of 10 patients with Herbert screw fixation alone healed, while 8 of 9 patients with Herbert screw and K-wire fixation healed. The time to union averaged 4.9 months in the patients supplemented with a K-wire and 7.8 months in those patients without the K-wire.

Since the introduction of the Herbert screw in 1984 for nonunion of the scaphoid, union has been reported in approximately 80% of cases. Careful review indicates a much lower rate for those nonunions associated with significant displacement or angulation ("humpback deformity"), or those associated with carpal instability. Presumably, the lower union rate is thought to be secondary to increasing forces on the fracture site.

Cooney et al. have shown that forces acting on a fractured scaphoid induce dorsal and radial angulation at the fracture site, and limited apposition of the fracture surfaces. Additionally, secondary forces on the scaphoid resulting from the displacement or carpal instability may also be significant enough to cause motion at the fracture site, thus delaying or preventing union. Consequently, treatment of displaced scaphoid nonunions by increasing the rigidity of fixation should potentially result in an increase in the union rate by decreasing the motion.

Because our results of treating displaced and unstable scaphoid nonunions with the Herbert screw did not parallel our results of Herbert screw fixation of scaphoid nonunions for other reasons (i.e., avascular necrosis, small proximal pole), we modified the procedure to include a temporary supplemental Kirschner wire (K-wire) across the fracture site. The function of the K-wire was to create a more rigid construct to resist motion, especially those due to rotational forces. The purpose of this study is to review the incidence of healing following supplementation of Herbert screw fixation.

MATERIALS AND METHODS

The charts and radiographs of all patients with scaphoid nonunions treated operatively with Herbert screw fixation between 1985 and 1991 were reviewed. Only those patients with significant angulation or displacement at the nonunion site and who required reconstruction of the scaphoid with a corticocancellous bone graft were included in this study. All patients had "humpback" deformity at the fracture site; none had avascular necrosis of the proximal scaphoid pole. Patients who did not have fracture angulation or displacement and had Herbert screw fixation with cancellous bone graft were excluded. Nineteen patients satisfied...
## Study of scaphoid nonunions treated with Herbert screw fixation

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These requirements and were divided into two groups (Table). Group A patients comprised 10 patients (Fig 1A); 8 were reported in a previous study.7 Group B included nine patients who had Herbert screw fixation supplemented with a single K-wire across the fracture site (Fig 2). The two groups were generated in different time periods, but the indications for operation were the same.

All patients were surgically treated as previously described.7 In addition, the Group B patients had a single 0.062 K-wire passed from distal to proximal across the fracture site. The K-wire was cut just beneath the skin, and did not penetrate the scapholunate, scaphocapitate, or radioscapophoid joints. Intraoperative anteroposterior and lateral radiographs confirmed reduction of the scaphoid and adequate placement of the Herbert screw and K-wire.

The patients were immobilized in a thumb spica cast for 4 to 12 weeks. The K-wire was removed in the office under local anesthesia at 6 to 8 weeks postoperatively. A removable thumb spica splint was used until union occurred or treatment failure was apparent. Radiographs were performed at regular intervals to determine if and when union occurred. Tomograms and/or computed tomography scans were used in those cases where radiographs were inconclusive. Patient follow up was discontinued when healing of the fracture or persistence of the nonunion was apparent.

## RESULTS

The results are noted in the Table. The average age at presentation and duration of nonunion prior to surgery were similar in both groups. Follow up after surgery averaged 17.4 months (range: 5 to 40) for Group A patients, and 14.0 months (range: 3 to 29) for

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**Fig 1A:** Preoperative radiograph of Group A patient showing nonunion of 30 months duration.

**Fig 1B:** Postoperative radiograph showing adequate alignment and position of the Herbert screw.

**Fig 1C:** Postoperative radiograph at 33 months demonstrating persistent nonunion.
Group B patients. The difference in follow up was related to the longer healing time required for Group A patients.

Postoperative radiographic studies demonstrated that 5 of 10 (50%) Group A patients with Herbert screw fixation alone healed, while 8 of 9 (89%) Group B patients with Herbert screw and K-wire fixation healed. The average time to union was 7.8 months (range: 4 to 14) in the 5 Group A patients, and 4.9 months (range: 3 to 8) in the 8 Group B patients.

Although all of the 5 Group A and 1 Group B patients who failed to unite after surgery had wrist pain and discomfort, none wished to have additional surgical procedures to obtain union.

The only complication associated with K-wire placement was a transient dysesthesia at the K-wire removal site in one patient, which resolved completely. No other complications were directly or indirectly attributed to K-wire supplementation.

**DISCUSSION**

Scaphoid fractures comprise 50% to 60% of all carpal fractures. While early recognition and appropriate treatment will result in 90% to 95% healing, 5% to 10% will still progress to nonunion and require further treatment.

Corticocancellous bone grafting of scaphoid nonunion alone as described by Matti and Russe results in 73% to 100% rate of healing. However, the procedure requires prolonged wrist immobilization up to 5 months to obtain union. Because of the inconvenience of cast immobilization and the resulting wrist stiffness, internal fixation techniques were developed to decrease the length of plaster cast immobilization. Rigid fixation allows earlier wrist motion, and presumably preserves wrist function. Although many types of fixation have been reported, the Herbert screw has become a popular fixation device, since it is completely interosseous.

Using this device, Herbert and Fischer reported an overall union rate of 80%. Generally, good results were also reported by Bunker et al. However, not all reports have been enthusiastic, particularly for established nonunions. Careful review of the report by Herbert and Fisher indicates that "sound union" (ie, complete radiographic confirmation of healing) was obtained in only 61% of patients with established nonunions (ie, Type D) fixed with the Herbert screw and corticocancellous graft reconstruction. Ford et al reported "sound union" in 18% and Pring et al reported only 54% union. We noted only 38% healing in scaphoid reconstruction of angled or displaced scaphoid nonunions treated with a corticocancellous graft and Herbert screw fixation.

One of the potential reasons for the discrepancy in results of various different authors may be related to the method of assessment for healing. Several early reports did not use radiographs at all; many used standard AP and lateral radiographs, but did not use tomography or multiple views to assess healing as we did in this study. We suspect the reported rate of healing may be inappropriate high without use of the supplemental imaging techniques. Furthermore, authors refer to "apparent union," which may represent painless nonunion.

However, another reason for the discrepancy is that displaced or angled ("humpback") scaphoid nonunions or those associated with carpal instability do not heal as well as some nondisplaced nonunions. This displacement may produce interfragmentary motion and may be responsible for the increased nonunion rate. Reducing the deformity and using rigid fixation techniques would theoretically decrease the forces across the fracture and provide more effective healing.

**CONCLUSION**

The Herbert screw is a strong fixation device; however, the compression forces are not as great as comparable screw head fixation devices according to cadaver studies. Furthermore, it is unlikely that the single screw prevents rotational motion, thereby resembling use of a compression hip screw for femoral neck fractures without a supplemental fixation pin.

To increase the stability of Herbert
screw fixation in patients with an unstable fracture pattern, we added a supplemental K-wire across the fracture site. Presumably, this increased rotatory stability and decreased the motion across the fracture site. Consequently, an increase in the union rate and the decrease in the time to union should be observed. Although the sample sizes are small, this was clearly seen in our study, as the rate of union increased from 50% to 89% while the time to union decreased from 7.8 months to 4.9 months. We advocate the use of a temporary supplemental K-wire in the surgical reconstruction of unstable scaphoid nonunions.

REFERENCES

EDITORIAL COMMENT
The authors have observed, at least according to their criteria for judging union, that the addition of a parallel K-wire for approximately 7 weeks improved the rate of healing and shortened the healing time in a small series of patients with unstable scaphoid nonunions, as compared to an equally small series of patients with Herbert screw fixations and grafting without K-wire. Although the numbers are probably too small to provide true statistical significance, it is important that we have these figures so that we can add them to those that might be forthcoming from other authors. It makes sense that an additional K-wire should provide increased rotational stability.