

The Results of Locking Plate Fixation with Vascularized Bone Graft for High Risk Scaphoid Nonunions

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INTRODUCTION:

The good results of scaphoid nonunion in long-standing and revision cases are not always achievable, even with vascularized bone grafts (VBG). One of the reasons is the difficulty of secure fixation with rigid stability since the long-standing and revision cases are commonly associated with osteosclerosis, avascular necrosis, dorsiflexed intercalated segment instability (DISI), or bone loss around the screws placed in a previous surgery. Locking plates (LP) for scaphoids have been recently introduced and reportedly have better stability than do the headless screws (HS). The purpose of this study is to evaluate the clinical outcomes of LP in combination with VBG for high risk scaphoid nonunion.

METHODS:

The records of cases with surgically-treated scaphoid nonunion by a single surgeon between 2001 and 2023 were retrospectively reviewed. Patients aged 18–77 years with high risk scaphoid nonunion, defined as patients with >10-year history of nonunion or a history of previously failed scaphoid surgery and those who were treated with VBG were included. The patients were divided into two groups based on the fixation implant: LP or other fixation implants. As outcome measures, range of motion (ROM), grip strength, and Mayo Wrist Score were recorded. The radiological evaluation of the bone union and postoperative radio-lunate (RL) angle were also assessed. The comparisons between the two continuous and categorical variables were made using the Mann-Whitney's U test and chi square test. Statistical significance was set as $p < 0.05$.

RESULTS:

A total of 52 hands were included in the final analysis. Twenty hands underwent VBG with LP (LP-group) and 32 hands underwent VBG without LP (NLP-group). No significant difference was observed in patient demographics, preoperative and postoperative ROM, and preoperative Mayo Wrist Score (Table 1). LP-group showed a significantly better bone union rate (LP: 100% vs. NLP: 68.8%, $p=0.016$) and better DISI deformity correction (LP: 11.7° vs. NLP: 5.4° , $p=0.028$) (Table 2).

DISCUSSION AND CONCLUSION:

In this study, both VBG with LP and without LP demonstrated similar clinical results for high risk scaphoid nonunions. VBG with LP was associated with statistically significantly better bone union rate and better correction of DISI deformity compared to without LP. The locking plate fixation should be considered in the combination with VBG for long-standing or repeatedly operated scaphoid nonunions.

| | | LP (n=20) | NLP(n=32) | p-value | |
|---|-----------------------|-------------|-------------|-------------|------|
| Implant (Locking plate:Headless screw:K-wire) | | 20 : 0 : 0 | 0 : 27 : 5 | | |
| Age at surgery (years) | Mean (SD) | 45.1 (15.6) | 40.8 (15.1) | 0.34 | |
| Sex | Male:Female | 15 : 5 | 28 : 4 | 0.43 | |
| Hand affected | right : left | 17 : 3 | 21 : 11 | 0.23 | |
| Time between injury to surgery (years) | Mean (SD) | 17.5 (13.0) | 4.9 (3.0) | 0.50 | |
| More than 10 years (n) | | 13 | 18 | 0.53 | |
| Previous scaphoid surgery (n) | | 7 | 17 | 0.24 | |
| Preoperative ROM (degree) | palmar flexion | Mean (SD) | 55.8 (15.8) | 58.3 (17.5) | 0.65 |
| | dorsal flexion | Mean (SD) | 56.0 (20.5) | 62.5 (16.7) | 0.27 |
| Preoperative radio-lunate angle (degree) | Mean (SD) | 17.5 (9.0) | 13.9 (12.9) | 0.22 | |
| Fracture location | Proximal:Waist:Distal | 2 : 18 : 0 | 9 : 23 : 1 | | |

ROM, range of motion; SD, standard deviation; LP, locking plates; LP group, those who underwent vascularized bone grafts with LP; NLP, those who underwent vascularized bone grafts without LP.

| | | LP (n=20) | NLP (n=32) | p-value | |
|--|----------------|---------------|---------------|-------------|------|
| Follow-up period (months) | Mean (SD) | 14.7 (6.0) | 22.7 (20.9) | 0.33 | |
| Postoperative ROM (degree) | palmar flexion | Mean (SD) | 47.5 (14.1) | 48.1 (14.1) | 0.78 |
| | dorsal flexion | Mean (SD) | 61.7 (15.7) | 61.3 (16.0) | 0.94 |
| Postoperative grip strength (% of unaffected side) | Mean (SD) | 89.4 (18.8) | 85.1 (22.5) | 0.65 | |
| Postoperative Mayo Wrist Score | Mean (SD) | 84.2 (9.9) | 81.3 (11.8) | 0.53 | |
| Postoperative radio-lunate angle (degree) | Mean (SD) | 5.8 (8.7) | 8.5 (9.9) | 0.22 | |
| The Amount of DISI deformity Correction (degree) | Mean (SD) | 11.7 (9.0) | 5.4 (9.4) | 0.03 | |
| Avascular necrosis in Pathology | | 10/14 (71.4%) | 7/12 (58.3%) | 0.77 | |
| Bone fusion | | 20/20 (100%) | 22/32 (68.8%) | 0.02 | |

ROM, range of motion; SD, standard deviation; DISI, dorsiflexed intercalated segment instability; LP group, those who underwent vascularized bone grafts with LP; NLP, those who underwent vascularized bone grafts without LP.