

Treatment of scaphoid non-union: does graft type donor site and mechanical composition of bone autograft impact union rate and correction of humpback deformity?

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INTRODUCTION: The scaphoid plays an integral role in carpal kinematics. As such, fractures complicated by unstable nonunion may alter wrist biomechanics, leading to the development of carpal instability and progressive degenerative changes. Goals of treatment in the setting of scaphoid nonunion should be aimed at restoring carpal kinematics by repairing nonunion and correcting scaphoid alignment and height. Surgical strategies employed include non-structural bone grafts, structural grafts and vascularized bone grafts. This paper aims to determine the impact of the type of bone autograft on the rate of union and correction of humpback deformity.

METHODS: A multi-institution retrospective review was conducted, identifying patients treated operatively for scaphoid nonunion between 2014-2024 using the following CPT code 25440. Patients were categorized into three groups based on graft utilized: cancellous, corticocancellous, and pedicled vascularized bone graft. Outcomes evaluated included achievement of bony union analyzed by Fisher’s exact test and correction of scaphoid H/L ratio analyzed using a one-way ANOVA. Additionally, the preoperative presence of avascular necrosis (AVN) and its effect on union rate was investigated using Fisher’s exact test. Criteria for pre-operative AVN included intra-operative documentation by the surgeon, pre-operative documentation by the radiologist, and evidence of sclerosis on pre-operative imaging seen by the reviewer. For purposes of this study, patients were considered to have preoperative AVN when two of the three aforementioned criteria were met

RESULTS: Sixty-three patients underwent scaphoid nonunion repair with bone grafting between 2014 and 2024. Twenty-three patients were treated with vascularized bone graft, 17 patients were treated with cancellous only autograft, and 23 patients were treated with corticocancellous autograft. The pooled union rate was 50/63 (79.3%). Union rates for vascularized, cancellous, and corticocancellous groups were 73.9%, 94.1%, and 73.9% respectively. (Table 1) The preoperative presence of avascular necrosis was not found to have an effect on the post-operative union rate. (Table 1) On average, patients treated with cancellous only bone graft had less severe pre-operative humpback deformity with a mean scaphoid H/L ratio of 0.582 compared to those in the vascularized and corticocancellous groups with H/L ratios of 0.643 and 0.645, respectively. (Table 2) In general, patients who received corticocancellous bone graft experienced a greater H/L correction post-operatively, however this was not statistically significant when compared between groups. (Table 2) This analysis of H/L correction was limited by low sample size as few patients had both pre- and post-operative advanced imaging available.

DISCUSSION AND CONCLUSION:

Union rate for treatment of scaphoid nonunion was highest with the utilization of cancellous only graft and correction of the scaphoid height/length ratio was greatest with the utilization of corticocancellous graft. Neither of these trends, however, reached statistical significance likely due to low sample size. Union rate did not differ based on the presence of pre-operative avascular necrosis.

Table 1: Union rates summary

Category	Subcategory	Union Rate
Graft Type	Vascularized	17/23 (73.9%)
	Cancellous	16/17 (94.1%)
	Corticocancellous	17/23 (73.9%)
	Total	50/63 (79.3%)
P value	0.24	
Avascular Necrosis (AVN)	AVN Present	25/31 (80.6%)
	No AVN	25/32 (78.1%)
P value	1	

Table 2: Pre-operative and Delta H/L ratios by graft type

Graft type	PreOp H/L ratio	Delta H/L ratio
Vascularized	0.643	-0.009
Cancellous	0.582	0.007
Corticocancellous	0.645	-0.059
P value	0.025	0.112