

# Comparative Outcomes in Scaphoid Non-Union Surgery: A Systematic Review of Fixation Techniques and Graft Selection

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**INTRODUCTION:** Scaphoid non-union remains a complex surgical challenge, with ongoing debate regarding the optimal fixation method and graft type. This study aims to compare outcomes across surgical approaches, graft vascularity, and configuration.

## METHODS:

A systematic review of 652 studies was performed per PRISMA guidelines, yielding 135 studies for inclusion. A total of 3,506 patients were analyzed. Surgical interventions were categorized as arthroscopic or open, and grafts as vascularized bone grafts (pedicled or free) or non-vascularized. Outcomes included time to union, range of motion (ROM), PROMs, and scapholunate (SL) angle. ANOVA with Games-Howell post hoc analysis was used for group comparisons.

## RESULTS:

Free vascularized grafts had the shortest time to union (2.99 months) but the poorest functional outcomes. Time to union did not differ significantly between arthroscopic and open groups. (Table 1). Arthroscopic fixation resulted in significantly greater wrist flexion (68.59°), extension (63.76°) (Table 3), and lower DASH (9.76) and VAS (1.02) scores compared to open techniques (p < .001) (Table 2). Non-vascularized grafts demonstrated superior DASH scores relative to pedicled vascularized grafts (mean difference = 19.46, p < .001) (Table 2). SL angle was most favorable in the arthroscopic group (58.32°, p < .001) (Table 4).

**DISCUSSION AND CONCLUSION:** Scaphoid non-union presents ongoing challenges in surgical decision-making, particularly in selecting between arthroscopic and open fixation techniques and among various bone grafting strategies. This study demonstrated that arthroscopic fixation consistently yielded superior outcomes, with significantly greater wrist motion and lower DASH and VAS scores compared to open approaches. These functional benefits were accompanied by improved postoperative SL angles, suggesting enhanced preservation of carpal alignment. Importantly, time to union did not differ significantly between arthroscopic and open groups, indicating that the advantages of arthroscopy are likely due to reduced surgical trauma and improved joint integrity rather than accelerated osseous healing.

Among vascularized bone grafts (VBGs), free grafts achieved the shortest mean time to union, consistent with prior reports of their osteogenic potential in complex or revision cases. However, this was offset by poorer postoperative range of motion and higher disability scores. In contrast, pedicled VBGs showed slightly better functional outcomes but were associated with less favorable SL angles, potentially compromising long-term alignment. Non-vascularized bone grafts (NVBGs), while historically avoided in cases of suspected avascular necrosis (AVN), demonstrated comparable union rates to VBGs and more favorable patient-reported and functional outcomes. These results highlight the potential for broader use beyond currently accepted indications.

These findings reinforce the value of arthroscopic fixation as a functionally and radiographically superior approach to scaphoid non-union. When considering graft selection, NVBGs may be preferable in acute or less complex cases due to their lower associated morbidity and superior patient-reported outcomes. Free VBGs, while potentially beneficial in cases where rapid union is critical, appear to trade healing speed for functional recovery. Ultimately, these results support a tailored surgical strategy, favoring arthroscopic fixation when feasible and selecting graft type based on the chronicity, complexity, and vascular status of the non-union, to optimize both structural and patient-centered outcomes in scaphoid non-union management.

	Arthroscopic	Open	Open	Open	p-value
	Non-vascularized	Non-vascularized	Vascularized	Vascularized	
Mean Time to Union (Months)	14.80 ± 4.24	13.74 ± 3.24	8.00 ± 4.24	7.00 ± 3.00	<.001
Mean DASH	9.76 ± 3.24	12.54 ± 3.72	23.50 ± 6.12	12.50 ± 4.00	<.001
Mean VAS	1.02 ± 0.48	1.26 ± 0.54	3.00 ± 1.44	1.50 ± 0.60	<.001

Table 3. Weighted mean of postoperative patient-reported outcomes.

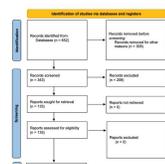


Figure 1. PRISMA Flowchart of Included Studies

	Arthroscopic	Open	Open	Open	p-value
	Non-vascularized	Non-vascularized	Vascularized	Vascularized	
Mean Time to Union (Months)	14.80 ± 4.24	13.74 ± 3.24	8.00 ± 4.24	7.00 ± 3.00	<.001
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Table 3. Weighted mean of postoperative patient-reported outcomes.

Table 1. Comparison of Time to Union

Table 2. Comparison of Functional Outcomes

Table 3. Comparison of Postoperative Patient-Reported Outcomes

Table 4. Comparison of SL Angle