Cancellous Versus Corticocancellous Bone Grafting for Scaphoid Fracture Nonunion: A Systematic Review and Meta-Analysis with Meta-Regression

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INTRODUCTION: Nonunion is a complication following scaphoid fracture that can be treated with open reduction internal fi ation and bone grafting. While man grafting options are available, there is a paucit of studies directl comparing different graft compositions. This review aimed to compare outcomes between cancellous (C) and cortico-cancellous (CC) graft for scaphoid nonunion.

METHODS: Following PRISMA guidelines, PubMed, Embase, and CENTRAL databases were searched to identif clinical studies with isolated graft outcomes. Demographics, time-from-injur -to-surger (TIS), primar outcomes (union rate and time-to-union), and secondar outcomes were e tracted. Meta-anal sis was done using random effects model and mean difference, standard mean difference, and risk ratios where appropriate. Meta-regression was done using the following covariates: [1] mean TIS (C and CC TIS average), [2] TIS difference (C TIS minus CC TIS).

RESULTS: Twelve studies with 423 total patients (mean follow up: 14.7m; mean age: 30.6 , 36 [10%] females and 310 [90%] males) were included. Meta-anal sis showed both C and CC-grafts having similar rates of union (p=0.828) (Figure 1A). However, C-grafts reached union 2.2 weeks faster than CC-grafts ([95% CI] [-4.30; -0.11], p=0.039, I^2=63%, I^2 p=0.03) (Figure 1B). Subsequent meta-regression showed TIS difference was positivel associated with time-to-union, accounting for 100% of the heterogeneit (p=0.002) (Figure 2D). The C-graft reached union 4.1 weeks faster than the CC-graft in subgroup anal sis of studies with a TIS difference<0 (p<0.001) but was not faster for the difference>0 subgroup (p=0.736) (Figure 1C-D). Compared to C-grafts, CC-grafts had greater radiolunate angle (3.55 [1.11; 5.99], p=0.004) and grip strength improvement (-0.29 [-0.57; -0.01], p=0.045) but similar complications, reoperations, sagittal range-of-motion, scapholunate angle, scaphoid height-length-ratio, and intrascaphoid angle improvement (p>0.05 for all).

DISCUSSION: This review found that (1) C-grafts had faster time-to-union while CC-grafts had better radiolunate angle and grip strength improvements and (2) TIS difference was associated with time-to-union. Given this association, the time-to-union finding should be carefull interpreted as the disproportionatel shorter TIS in the C-graft group can serve as a confounder. Nonetheless, both grafts having mostl similar outcomes indicates no unanimous superiorit in graft composition. Moreover, since both grafts provide unique benefits, the should be selected on a case-b -case basis. Future studies should identif covariates affecting outcomes to develop a detailed treatment protocol.

SIGNIFICANCE/CLINICAL RELEVANCE: This is one of the first studies to quantitativel assess C and CC bone grafting head-to-head for scaphoid nonunion. TIS might be a potential confounder when assessing time-to-union for scaphoid nonunion. Nonetheless, since both grafts have similar union rates and time-to-union with unique benefits, there appears to be no unanimous superiorit among the two grafts.

IMAGES AND TABLES:

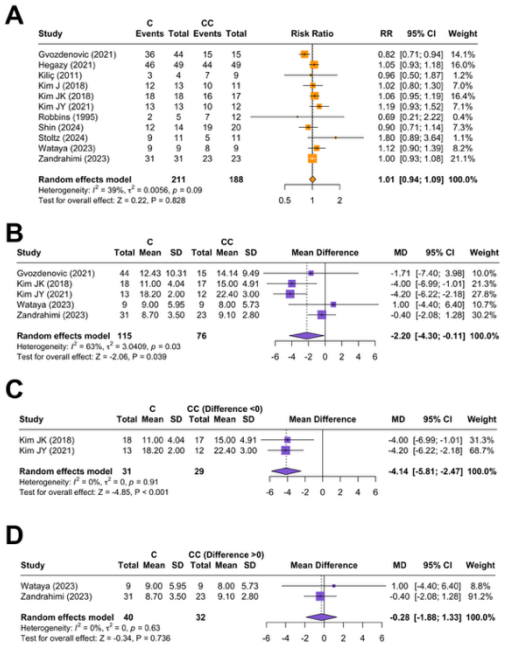

Figure 1. Meta-anal sis results for primar outcomes; (A) union rate, (B) time-to-union in weeks, (C) time-to-union subgroup anal sis with difference in time from injur to surger of <0, and (D) time-to-union subgroup anal sis with difference of >0. C = cancellous, CC = cortico-cancellous, RR = risk ratio, CI = confidence intervals, SD = standard deviation, and MD = mean difference.

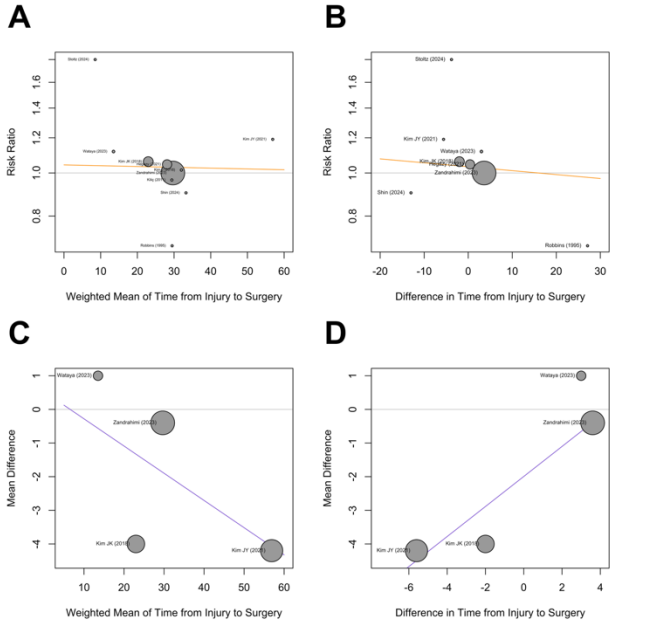

Figure 2. Meta-regression investigating the effect of covariates ([1] mean time from injur to surger for cancellous and cortico-cancellous grafts in months [2] difference in time from injur to surger in months between cancellous and cortico-cancellous grafts) on union rate and time-to-union in weeks; (A) mean and union rate, (B) difference and union rate, (C) mean and time-to-union, and (D) difference and time-to-union.