Δ Comparing BMP-2 Versus PDGF for the Treatment of Bone Defects in a Small Animal Model

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Purpose: Bone defects and nonunion continue to be challenging to treat. Consequently, innovations in the use and application of growth factors have been developed in an attempt to improve the rates of bone regeneration and healing. Two molecules of interest, bone morphogenetic protein-2 (BMP-2) and platelet-derived growth factor-BB (PDGF-BB) have been incorporated into commercially available delivery systems designed to improve bony union. Although evidence exists for their individual potency, their comparative efficacy is unknown. We therefore sought to evaluate their individual and relative effectiveness for the management of nonunions utilizing a critical-sized bone defect model.

Methods: Adult male rats had a 5-mm defect created in the right femur, stabilized with a mini-plate and screws, with the defect treated as follows. Animals were randomly assigned to 1 of 5 groups (n = 10 per group): control group: no treatment; PDGF-BB carrier group (n = 9): β-tricalcium phosphate (β-TCP) carrier; BMP-2 carrier group: absorbable collagen scaffold (ACS) carrier; PDGF-BB treatment group: β-TCP carrier with PDGF-BB; and BMP-2 treatment group: ACS with BMP-2. Radiographic assessment was performed at 10 weeks to compare rates of union and degree of healing within the defect using a standardized radiographic scoring system. Pairwise comparisons were made for observed rates of union between groups using Fisher's exact tests. One-way analysis of variance (ANOVA) with Tukey's post-hoc test was used to compare radiographic scores.

Results: BMP-2 treatment significantly improved healing relative to controls and all other treatment groups ($P<0.05$). Notably, 100% of all animals with BMP-2 treatment achieved full union, while only 20% of those with PDGF-BB treatment achieved radiographic union. This difference was statistically significant ($P<0.0001$). One-way analysis of variance demonstrated statistically significant differences in radiographic union scores in favor of BMP-2 treatment over controls (7.1 ± 0.32 vs 3.95 ± 2.27, $P = 0.0008$), BMP-2 treatment over PDGF-BB carrier (7.1 ± 0.32 vs 4.5 ± 1.73, $P = 0.0097$), and BMP-2 treatment over PDGF-BB treatment (7.1 ± 0.32 vs 4.6 ± 1.51, $P = 0.011$).

Conclusion: Our results demonstrated that BMP-2 treatment (ACS + BMP-2) is superior to PDGF-BB treatment (PDGF-BB + β-TCP) for inducing healing in a small animal model of fracture nonunion using a critical-sized defect. Further investigation of these powerful proteins with basic science and clinical studies across a variety of trauma applications is warranted.

Radiographic Union Rates

	Nonunion/Partial Union	Union
Control group	90% (9)	10% (1)
PDGF-BB carrier group	89% (8)	11% (1)
PDGF-BB treatment group	90% (8)	20% (2)
BMP-2 carrier group	50% (5)	50% (5)
BMP-2 treatment group	0% (0)	100% (10)

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