再録　報文

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Female Athletes Genetically Susceptible to Fatigue Fracture Are Resistant to Muscle Injury: Potential Role of COL1A1 Variant

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Abstract

Purpose: We aimed to investigate the hypothesis that type I collagen plays a role in increasing bone mineral density (BMD) and muscle stiffness, leading to low and high risks of fatigue fracture and muscle injury, respectively, in athletes. As a potential mechanism, we focused on the effect of the type I collagen alpha 1 chain gene (COL1A1) variant associated with transcriptional activity on bone and skeletal muscle properties.

Methods: The association between COL1A1 rs1107946 and fatigue fracture/muscle injury was evaluated in Japanese athletes. Effects of the polymorphism on tissue properties (BMD and muscle stiffness) and type I collagen α1/α2 chain ratios in muscles were examined in Japanese nonathletes.

Results: The C-allele carrier frequency was greater in female athletes with fatigue fracture than in those without (odds ratio = 2.44, 95% confidence interval [CI] = 1.17-5.77) and lower in female athletes with muscle injury than in those without (odds ratio = 0.46, 95% CI = 0.24-0.91). Prospective validation analysis confirmed that in female athletes, muscle injury was less frequent in C-allele carriers than in AA genotype carriers (multivariable-adjusted hazard ratio = 0.27, 95% CI = 0.08-0.96). Among female nonathletes, the C-allele of rs1107946 was associated with lower BMD and lower muscle stiffness. Muscle biopsy revealed that C-allele carriers tended to have a larger type I collagen α1/α2 chain ratio than AA genotype carriers (2.24 vs 2.05, P = 0.056), suggesting a higher proportion of type I collagen α1 homotrimers.

Conclusion: The COL1A1 rs1107946 polymorphism exerts antagonistic effects on fatigue fracture and muscle injury among female athletes by altering the properties of these tissues, potentially owing to increased levels of type I collagen α1 chain homotrimers.