Effect of the bounce technique on lower limb Kinematics and Kinetics in the free weight back squat.

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Summary

This study investigates the biomechanical effects of the bounce technique during back squats. Ten participants performed squats across five load conditions with and without a bounce. Measurements were done using force plates and a motion capture system. Results showed significant interactions between bounce and loading for hip joint moments (NJM), and main effects of bounce on hip and knee joint angles, as well as knee and ankle NJM. The increased NJM raise concerns about potential joint stress, emphasizing the need for further research.

Introduction

The back squat is a fundamental exercise for sports performance and general fitness. A common technique is the "bounce," which enhances barbell kinematics in the early concentric phase. This technique increases the likelihood of overcoming the "sticking region"—a biomechanically disadvantageous phase of the lift [1]. However, health concerns have been raised [2]. Unpublished in-house data indicate an increase of 20% in peak ground reaction force (GRF) under the bounce condition, highlighting the necessity of further investigation into its biomechanical consequences.

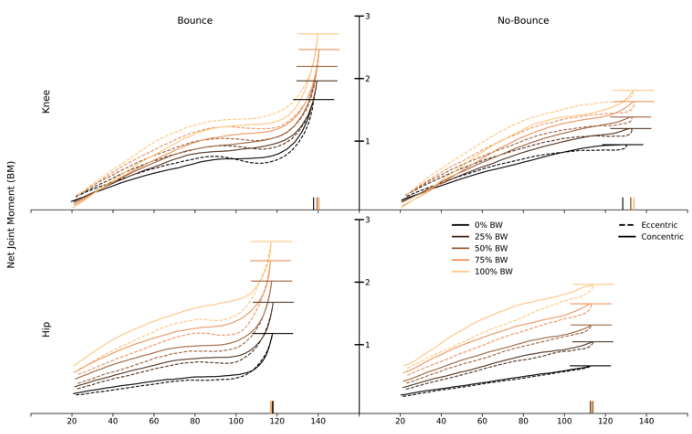

Figure 1: Illustration of NJM and joint angle. Horizontal bars represent peak NJM, while vertical bars indicate peak joint angles.

Methods

Our study employed a within-subjects cross-sectional design. 10 participants (6m, 4w) performed squats under five loads (0 to 100% bodyweight) and two technics (Bounce, No-Bounce). GRF was measured at 1000 Hz (AMTI, USA), and 67 markers were recorded at 250 Hz with 8 cameras (Optitrack, USA). For statistics a two-way repeated ANOVA was conducted.

Results and Discussion

A significant interaction between bounce and loading was observed for hip NJM (Table 1). Post-hoc analysis revealed significant differences between bounce conditions across all loading levels. Main effects of bounce were found for hip/knee angles and knee/ankle NJMs, while loading affected knee angles and knee/ankle NJMs. Increased peak joint angles suggest the bounce strategy alters joint positioning during the movement. This potentially contributes to increased performance by enhanced muscle activation or stretch-shortening cycle. Additionally, higher NJMs indicate that the bounce strategy modifies biomechanics, potentially influencing performance and musculoskeletal outcomes.

Table 1: Two-Way Repeated Measures ANOVA results. L: Load condition, B: Bounce condition, BxL: Interaction between B and L.

	Joints	*Effect*	*F*	*p*	η_p^2
Joint Angle	Hip	B	F(1,9) = 53.19	< 0.001	0.86
	Knee	B	F(1,9) = 28.85	< 0.001	0.76
	Knee	L	F(4,36)= 2.74	0.043	0.23
NJM	Hip	BxL	F(4,36)= 4.46	0.005	0.33
	Knee	B	F(1,9) = 39.67	< 0.001	0.82
	Knee	L	F(4,36)= 63.45	< 0.001	0.88
	Ankle	B	F(1,9) = 30.99	< 0.001	0.78
	Ankle	L	F(4,36)= 85.31	< 0.001	0.91

Conclusion

The bounce significantly alters joint kinematics and kinetics, particularly at the knee and hip, potentially enhancing performance. However, the increased NJM suggest heightened stress on joint structures, raising concerns about its effect on joint health. Finding a balance between performance benefits and potential biomechanical risks is crucial, underscoring the need for further research.

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References

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