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Peer Review

Review of: "Modelling Skeletal Muscle Motor Unit Recruitment Contributions to Contractile Function: Part 1 — Velocity, Force and Power"

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This manuscript presents a computational model of human vastus lateralis motor unit recruitment that integrates single-fibre contractile data with assumed motor unit size distributions to estimate whole-muscle velocity, force, and power. The work attempts to move beyond the traditional “black box” representation of muscle and instead model sequential recruitment under the Size and All-or-None principles.

The conceptual aim is ambitious and relevant. The attempt to mechanistically scale single-fibre data to whole-muscle behaviour is intellectually interesting and potentially valuable for future neuromuscular energetics modelling. However, the current model relies heavily on assumptions that substantially limit physiological validity and predictive confidence. As a result, the work reads more as an exploratory conceptual simulation than a validated physiological model.

The manuscript would benefit from clearer positioning as a hypothesis-generating framework rather than an applied predictive model.

Major Concerns

1. Assumed Motor Unit Size (Critical Limitation)

The model assumes:

100–180 fibres·unit^{-1} across fibre types.

±15% normal distribution.

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However:

These values are not derived from human experimental data.

Motor unit sizes in humans vary widely and nonlinearly.

Recruitment threshold is not solely determined by fibre number.

Since motor unit size is a foundational parameter, all downstream force and power predictions depend directly on speculative inputs.

This must be emphasised as a primary limitation.

2. Simplistic Treatment of Velocity

Velocity of the whole muscle is calculated as the arithmetic mean of recruited motor unit velocities. This is physiologically problematic:

Whole-muscle shortening velocity is constrained by load (Hill relationship).

Motor units contract in parallel within the same mechanical system.

Faster units do not simply increase mean velocity unless load conditions allow it.

The averaging approach likely overestimates velocity contributions from fast units at submaximal recruitment.

Declarations

Potential competing interests: No potential competing interests to declare.