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EFFECT OF RADIAL EXTRACORPOREAL SHOCK WAVE THERAPY ON MUSCLE POWER OUTPUT IN THE MAJOR THIGH MUSCLE GROUPS

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Abstract

Background: Radial extracorporeal shock wave therapy (rESWT) is widely used in sports medicine for pain relief and functional recovery; however, quantitative evidence regarding its immediate effects on neuromuscular performance in healthy athletes remains limited. Objective: To determine the acute effects of rESWT applied to the mid-quadriceps on isokinetic knee extension and flexion output in female university athletes. Methods: Eleven female university *athletes (18–22 years) completed rESWT and control conditions in a within-subject, controlled laboratory design. Isokinetic knee extension and flexion of the right leg were assessed using a Biodex dynamometer at 60°/s (two sets of five maximal concentric repetitions). In the rESWT condition, 3,000 pulses (20 Hz, 3.5 bar) were applied to the mid-belly of the right quadriceps immediately before and after the first set. The control condition followed the same protocol without stimulation. Primary analyses focused on the first set to isolate the effect of the initial rESWT application. Rep-by-rep data were analysed using linear mixed-effects models with participant ID as a random effect. Results: During knee extension, rESWT produced higher Peak Torque ($p = 0.00030$), Angle at Peak Torque ($p = 0.00050$), Peak Power ($p = 0.00041$), Total Work ($p = 0.00017$), and Peak Torque/BW% ($p = 0.00014$), with a trend for Time to Peak Torque ($p = 0.075$). T100, T200, RTD 0–100, and RTD 0–200 did not differ. No significant effects were observed for knee flexion (all $p > 0.12$). Conclusion: rESWT applied to the quadriceps acutely enhanced isokinetic knee extension output, with no detectable effects on knee flexion or early torque-rise indices.*

Keywords:

Radial Extracorporeal Shock Wave Therapy (rESWT), Isokinetic Muscle Performance, Knee Extension, Linear Mixed-Effects Model

1. Introduction

The ability to generate high levels of muscle strength and power is fundamental to athletic performance. Accordingly, a wide range of training and conditioning strategies have been developed to enhance these capacities. Among them, acute interventions performed during warm-up or immediately before and after competition are considered practical approaches to transiently optimise neuromuscular function.

In sports medicine, radial extracorporeal shock wave therapy (rESWT; also termed radial pressure wave therapy) is widely used for pain relief and functional recovery (Auersperg & Trieb, 2020; Tenforde et al., 2022). More recently, rESWT has been discussed as a potential conditioning modality that may transiently improve performance-related conditions through mechanical stimulation of the musculotendinous and fascial systems.

Although rESWT includes the term “shock wave”, it differs from focused ESWT in its physical characteristics and energy distribution. Specifically, rESWT generates a radial pressure wave with maximal pressure at the body surface that attenuates with increasing tissue depth (van der Worp et al., 2013; Tenforde et al., 2022). Terminology statements also recommend distinguishing “radial pressure waves” from focused shock waves (International Society for Medical Shockwave Treatment [ISMST], 2017). Therefore, the physiological effects of rESWT should be interpreted as changes mediated by tissue responses to mechanical stimulation (mechanotransduction), rather than as forced contraction analogous to electrical stimulation (Auersperg & Trieb, 2020; Tenforde et al., 2022).

Proposed mechanisms include pain modulation (e.g., hyperstimulation analgesia), changes in local microcirculation and angiogenesis, tissue remodelling involving cell proliferation and protein synthesis, and modulation of neuromuscular control (Simplicio et al., 2020; Wuerfel et al., 2022; Tenforde et al., 2022). Collectively, these processes may reduce pain and stiffness and improve joint range of motion and movement efficiency, thereby creating more favourable conditions for strength and power expression.

Regarding safety, ESWT is generally not expected to cause serious complications when delivered according to recommended practice; reported adverse effects are typically limited to treatment-related pain and minor subcutaneous bleeding (haematoma) (Auersperg & Trieb, 2020). Nonetheless, standard contraindications and precautions (e.g., severe coagulation disorders, exposure over the foetus, and severe local infection) must be considered when implementing

ESWT in sports settings (Auersperg & Trieb, 2020; International Society for Medical Shockwave Treatment [ISMST], 2024).

Despite growing clinical use, quantitative evidence in healthy athletes examining the immediate effects of rESWT on muscle strength and power remains limited. Joo et al. (2024) reported improved single-leg vertical jump height after a single rESWT session applied to the Achilles tendon, suggesting the potential for immediate facilitation of power output. A multimodal approach including near-daily rESWT for acute muscle injuries in elite football players has also been reported to shorten time to return to play; however, this retrospective study does not directly demonstrate immediate changes in muscle output (Morgan et al., 2021). Notably, to our knowledge, no study has evaluated knee extension and flexion strength/power using isokinetic testing immediately after rESWT applied to major lower-limb muscle groups (quadriceps femoris and hamstrings). Consequently, fundamental evidence required to judge its utility as a conditioning intervention is still lacking. Therefore, this study aimed to determine the immediate effects of rESWT applied to the mid-quadriceps on muscle power output during isokinetic knee extension and flexion in female university athletes, compared with a control condition.

2. Methods

2.1 Participants

The study included female university athletes (n = 11; 18–22 years) who belonged to university sports clubs. Participants were excluded if they had a history of significant lower-limb injury, a neuromuscular disorder, or current pain/muscle soreness that could affect the measurements. All procedures were conducted in accordance with the principles of the Declaration of Helsinki.

2.2 Study Design

This laboratory study used a within-subject, controlled design comparing an rESWT condition with a control condition in the same participants.

2.3 Isokinetic Testing

Isokinetic knee extension and flexion of the right leg were assessed using a Biodex system 4 isokinetic dynamometer (Biodex Medical Systems, USA). Participants performed two sets of five maximal concentric knee extension-flexion repetitions at an angular velocity of 60°/s. The rest interval between the first and second sets was 3 min.

2.4 Intervention Condition

An rESWT device (Storz Medical AG., Switzerland) was applied to the right quadriceps femoris using a pneumatic radial pressure wave device. Stimulation parameters were as follows: (1) application site: mid-belly (central region) of the right quadriceps femoris; (2) frequency and intensity: 20 Hz, 3.5 bar; (3) radial transmitter: C15 CERAma-x; (4) number of pulses: 3,000 pulses per application (two applications; total 6,000 pulses); (5) timing: immediately before and immediately after the first isokinetic test set.

2.5 Control Condition

The isokinetic testing protocol was performed in the same manner as in the intervention condition; however, no physical stimulation was applied to the exercised limb and participants remained seated at rest during the corresponding periods.

2.6 Experimental Protocol

After arrival at the laboratory, participants rested quietly for at least 10 min. They were then seated on the dynamometer and positioned for isokinetic knee extension and flexion testing (approximately 5 min). In the intervention condition, rESWT (3,000 pulses) was applied to the mid-thigh region (mid-belly) of the right quadriceps femoris. Participants then performed the first isokinetic set consisting of five maximal concentric repetitions of knee extension and flexion. Immediately after completing the first set, rESWT (3,000 pulses) was re-applied to the same stimulation site. Participants subsequently performed the second isokinetic set (five maximal repetitions). The rest interval between the first and second sets was 3 min. In the control condition, participants completed the identical isokinetic protocol without rESWT; no stimulation was applied to the right thigh, and participants rested quietly for the corresponding periods.

2.7 Outcome Measures

Outcome measures obtained from the dynamometer included peak torque (Nm), peak power (W), time to peak torque (s), and angle at peak torque (deg) for knee extension and flexion. Torque at 100 ms (T100; Nm) and 200 ms (T200; Nm) from contraction onset were also recorded. In addition, the rate of torque development (RTD) was calculated for the initial 0–100 ms (RTD 0–100; Nm/s) and 0–200 ms (RTD 0–200; Nm/s) intervals to quantify how rapidly torque was generated during the early phase of contraction. Total work (J) was recorded as an index of overall mechanical output.

2.8 Statistical Analysis

All statistical analyses were conducted using R (R Foundation for Statistical Computing, Vienna, Austria). Linear mixed-effects models were fitted using the lme4 package, and p values were obtained using the lmerTest package.

To evaluate the immediate effects of rESWT, the primary analysis used rep-by-rep data from Set 1, including all five repetitions obtained from each participant under each condition. Because repeated observations within the same participant are not independent, linear mixed-effects models were applied with participant ID included as a random intercept.

Each kinetic variable (Peak Torque, Time to Peak, Angle Peak, T100, T200, RTD 0–100, RTD 0–200, Peak Power, Total Work, and Peak Torque/BW%) was entered as a dependent variable, and Condition (rESWT vs control) was included as a fixed effect. Knee extension and knee flexion were analysed separately due to differences in primary muscle groups and movement characteristics. The primary model was specified as follows:

Outcome ~ Condition + (1 | ID)

To examine whether the between-condition difference observed at Set 1 was further amplified at Set 2, an additional model including Condition, Set, and their interaction was fitted:

Outcome ~ Condition * Set + (1 | ID)

The interaction term was used to test whether the magnitude of the between-condition difference changed across sets. A two-tailed p value < 0.05 was considered statistically significant. Because multiple outcome variables were analysed, Peak Torque, Peak Power, Total Work, and Peak Torque/BW% were interpreted as primary outcomes, whereas the remaining variables were treated as exploratory. Results are presented as fixed-effect estimates, 95% confidence intervals, and p values.

3. Results

3.1 Knee Extension

Descriptive statistics for knee extension outcomes are presented in Table 1, and the corresponding linear mixed-effects model results are illustrated in Figure 1. The rESWT condition showed significantly higher values than the control condition for Peak Torque ($p = 0.00030$), Angle at Peak Torque ($p = 0.00050$), Peak Power ($p = 0.00041$), Total Work ($p = 0.00017$), and Peak Torque/BW% ($p = 0.00014$). Time to Peak Torque showed a trend toward significance ($p = 0.075$), whereas no significant between-condition differences were observed for T100, T200, RTD

0–100, or RTD 0–200. Overall, during knee extension, the rESWT condition demonstrated significantly greater values in output-related parameters, including maximal strength and mechanical output indices (work and power), compared with the control condition.

Table 1. *Descriptive Statistics for Isokinetic Knee Extension and Flexion Outcomes Under Control (CON) and rESWT (INT) Conditions*

Values are presented as mean (SD) and median [IQR]. One participant had missing data in the control condition.

	Outcome	CON (n = 10)		INT (n = 11)	
		Mean (SD)	**Median [IQR]**	**Mean (SD)**	**Median [IQR]**
Knee extension	Peak Power (W)	156.8 (38.8)	163.2 [137.2, 178.1]	164.2 (31.6)	167.3 [144.9, 182.2]
	Peak Torque (Nm)	147.7 (35.8)	153.1 [129.0, 167.4]	154.6 (29.6)	157.2 [136.1, 171.7]
	Total Work (J)	142.8 (35.3)	145.1 [133.1, 169.1]	154.0 (38.6)	154.9 [124.2, 171.0]
	Peak Torque / BW (%)	257.2 (56.2)	246.1 [237.0, 287.6]	273.5 (45.2)	281.1 [244.6, 305.9]
	Angle Peak (deg)	72.3 (5.1)	71.6 [69.1, 75.7]	68.2 (9.0)	69.3 [66.1, 73.4]
	Time to Peak (s)	0.5 (0.1)	0.5 [0.5, 0.6]	0.6 (0.1)	0.6 [0.5, 0.6]
	RTD 0–100 (Nm/s)	659.2 (115.5)	664.1 [593.9, 723.5]	639.4 (105.6)	638.8 [563.9, 724.0]
	RTD 0–200 (Nm/s)	434.2 (81.7)	431.3 [389.1, 490.2]	420.7 (75.0)	432.3 [364.8, 484.6]
	T100 (Nm)	94.8 (24.3)	90.9 [85.5, 98.0]	95.3 (22.4)	92.8 [81.0, 112.2]
	T200 (Nm)	115.7 (26.6)	112.0 [102.0, 127.7]	115.5 (26.1)	111.6 [99.0, 133.4]
Knee flexion	Peak Power (W)	80.3 (19.8)	84.9 [69.1, 90.9]	77.4 (19.0)	81.0 [64.1, 85.8]
	Peak Torque (Nm)	77.2 (17.0)	80.6 [67.0, 86.0]	74.1 (18.2)	77.4 [61.2, 84.1]
	Total Work (J)	83.4 (21.7)	81.8 [66.2, 105.1]	81.1 (27.2)	78.5 [56.3, 99.2]
	Peak Torque / BW (%)	134.6 (27.1)	128.2 [121.8, 156.5]	130.6 (27.7)	131.1 [117.4, 147.8]
	Angle Peak (deg)	47.4 (13.8)	43.3 [39.7, 57.2]	47.1 (12.6)	49.0 [36.7, 58.2]
	Time To Peak (s)	0.4 (0.1)	0.4 [0.3, 0.5]	0.4 (0.1)	0.5 [0.3, 0.5]
	RTD 0_100 (Nm/s)	436.1 (55.1)	448.9 [404.3, 470.3]	434.2 (99.4)	479.8 [405.3, 505.4]
	RTD 0_200 (Nm/s)	276.5 (36.9)	280.8 [257.7, 308.5]	275.9 (59.8)	303.7 [247.2, 320.0]
	T100 (Nm)	57.0 (14.3)	55.9 [46.1, 66.5]	53.3 (16.4)	56.4 [45.4, 62.4]
	T200 (Nm)	68.7 (14.0)	68.1 [62.1, 78.3]	65.1 (17.9)	66.3 [57.3, 74.0]

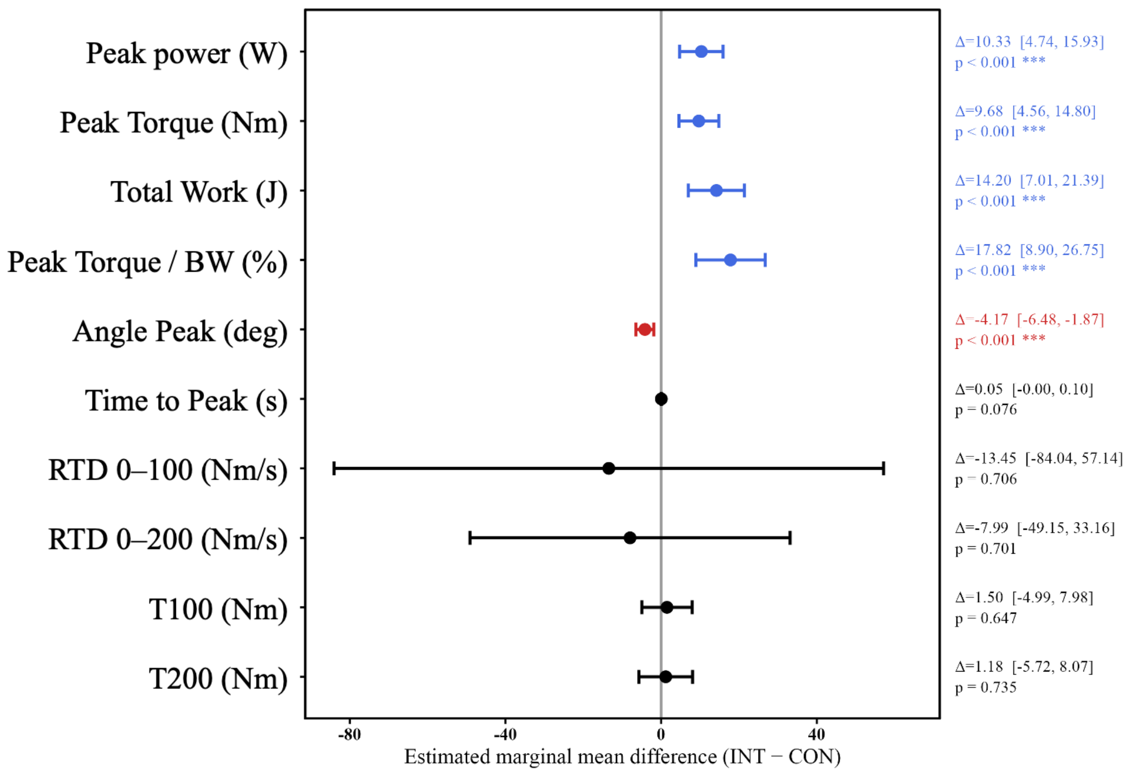

Figure 1: *Estimated Marginal Mean Differences (INT − CON) for Knee Extension Outcomes Based on Linear Mixed-Effects Models*

Points represent estimates and error bars indicate 95% confidence intervals.

3.2 Knee Flexion

Descriptive statistics for knee flexion outcomes are also summarised in Table 1, and the corresponding model-based estimates are illustrated in Figure 2. For knee flexion, the main effect of Condition (rESWT vs. control) was not significant for any outcome measure (Peak Torque, Time to Peak Torque, Angle at Peak Torque, T100, T200, RTD 0–100, RTD 0–200, Peak Power, Total Work, and Peak Torque/BW%; all $p > 0.12$). Estimated effects were small, and no consistent direction of differences was observed. Thus, no immediate between-condition difference was detected for knee flexion following the rESWT intervention.

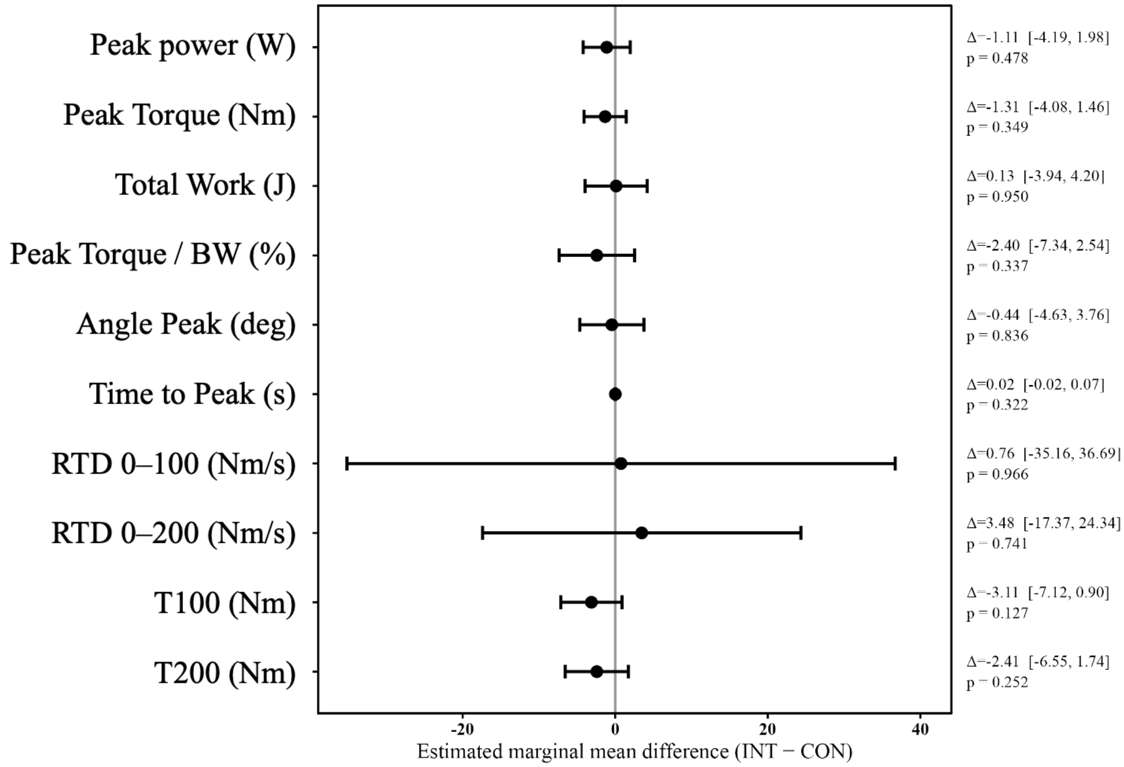

Figure 2: *Estimated marginal mean differences (INT − CON) for Knee Flexion Outcomes Based on Linear Mixed-Effects Models*

Points represent estimates and error bars indicate 95% confidence intervals.

3.3 Exploratory Analysis Across Sets

In the exploratory model including Set, there was no statistical evidence that repeated application within the session produced a cumulative amplification of the between-condition difference for knee extension (Condition × Set interaction not significant; see Table 2), indicating that any incremental gain across sets was small.

Table 2. *Interaction Effects (Condition × Set) for Knee Extension Outcomes Based on Linear Mixed-Effects Models*

Values represent estimated interaction effects and corresponding p values.

Outcomes	Interaction estimate	p value
Peak Power (W)	-0.56	0.948
Peak Torque (Nm)	-1.14	0.886
Total Work (J)	-2.15	0.772
Peak Torque / BW (%)	-2.22	0.873
Angle Peak (deg)	0.17	0.956
Time to Peak (s)	0.01	0.794
RTD 0–100 (Nm/s)	-11.16	0.723
RTD 0–200 (Nm/s)	-6.62	0.744
T100 (Nm)	-1.20	0.794
T200 (Nm)	-1.41	0.794

4. Discussion

The present study suggests that the immediate effects of rESWT are task- and site-specific, selectively enhancing knee extension output without affecting knee flexion or early-phase torque-rise indices. Specifically, during knee extension, the rESWT condition yielded significantly higher values in output-related indices representing maximal output capacity, including Peak Torque, Peak Power, Total Work, and Peak Torque/BW%, whereas no comparable effect was observed during knee flexion. Notably, the indices that improved primarily reflected how much force, work, or power could be produced, while no meaningful changes were detected in early-phase characteristics such as RTD or T100/T200. Collectively, these findings indicate that, at least acutely, rESWT may selectively influence the ability to express maximal output-level performance rather than enhancing the initial rise in torque development.

An additional strength of the repetition-level approach is that it uses all observed values across five repetitions while accounting for inter-individual variability, thereby providing relatively high sensitivity to detect small but consistent between-condition differences. In this context, significant differences were consistently detected across multiple output-related measures during knee extension. This supports the interpretation that a genuine state difference was present immediately after the intervention. In contrast, the absence of effects in knee flexion suggests that the action of rESWT may manifest differently between extension and flexion, potentially due to differences in the functional role of the target muscle group and neuromuscular control strategies.

Moreover, the exploratory across-set analysis did not support a cumulative amplification of the between-condition difference within the short time window of the present protocol. Therefore, although the effect observed in the first set may have been maintained, it cannot be concluded that repeated stimulation significantly augmented the effect.

Joo et al. (2024) reported that immediately after rESWT in individuals with Achilles tendinopathy, functional measures such as single-leg vertical jump height/flight time, ankle range of motion, and heel-rise performance improved, whereas Achilles tendon stiffness did not change. This pattern implies that acute benefits are more plausibly explained by neuromuscular and sensorimotor modulation than by structural changes. In the present study, the acute increase in quadriceps-related output observed shortly after stimulation is likewise difficult to attribute to structural remodelling processes such as collagen reorganisation or changes in tendon stiffness. Instead, it is reasonable to interpret the findings as reflecting responses that can occur on a faster time scale, including pain modulation, alterations in afferent input, and adjustments in muscle tone.

First, potential mechanisms of rESWT include the effects of mechanical stimulation on the extracellular matrix, neural structures, and vascular components, through which pain modulation, microcirculatory changes, and tissue remodelling may collectively contribute to functional improvement (Simplicio et al., 2020). When focusing specifically on acute effects, a plausible pathway is that a reduction in pain or unpleasant sensory input may attenuate inhibition during voluntary contraction, thereby increasing motor unit recruitment and/or discharge rates and ultimately enhancing net power output of the prime mover. This interpretation aligns with the present observation that isokinetic knee extension performance is strongly dependent on voluntary quadriceps output; consequently, when the stimulation site is the quadriceps, the facilitation may be more readily expressed as higher extension output. By contrast, during knee flexion the prime movers are the hamstrings, which were outside the stimulation site, and thus any benefits from altered afferent input may have been smaller, resulting in no detectable between-condition difference.

Second, rESWT may alter muscle tone and passive resistance properties over a short time period. In the spasticity literature, a clinical trial reported that a single session of rESWT immediately improved plantarflexor spasticity and joint-related characteristics (Radinmehr et al., 2017). Although the underlying muscle state differs from that of healthy athletes, the observation that neuromuscular properties can change immediately following a single intervention supports the physiological plausibility of acute effects. Regarding safety, rESWT is generally considered safe when delivered appropriately, with adverse events typically limited to transient pain and mild bruising/hematoma (Auersperg & Trieb, 2020). Therefore, the acute increase in output observed in the present study can be conceptualised as a modulation of the sensorimotor system rather than an effect that depends on unsafe mechanical overload.

Third, it is important to consider whether an acute, site-dependent facilitation of prime-mover output is unique to rESWT. Similar findings have been reported for other physical stimuli. For example, whole-body vibration (WBV) and local muscle vibration (LMV/LV) may influence muscle activation and voluntary output through increased Ia afferent input. Prior studies have reported acute improvements in isokinetic knee extension torque following WBV (Jacobs & Burns, 2009) and attenuation of reductions in knee extensor peak torque (Siu et al., 2010). However, the effects of vibration are dependent on frequency, duration, posture, and participant characteristics, and immediate increases in torque/power are not consistently observed (Borges et al., 2016). In addition, percussive massage devices have been reported to increase range of motion without clearly improving maximal voluntary contraction torque (Konrad et al., 2020), suggesting that acute responses may be better characterised as improved mobility and maintenance of output rather than direct enhancement of maximal force. Similarly, short bouts of static and dynamic stretching have been reported to have no meaningful effects on isokinetic peak torque or mean power (Ayala et al., 2015), indicating that physical stimuli do not necessarily translate into immediate improvements in power production.

Taken together, the novelty of the present study lies in demonstrating that (1) rESWT applied to the quadriceps was associated with (2) an immediate increase in isokinetic knee extension output, and (3) the effect did not generalise to the antagonist movement (knee flexion). The most plausible physiological explanation is that, rather than inducing structural changes within muscle tissue, rESWT acutely optimised conditions for voluntary output via neural regulation of pain/sensory input and muscle tone in the vicinity of the stimulation site.

5. Limitations and Future Directions

Several limitations should be acknowledged. First, the primary analysis intentionally focused on the first set to isolate the acute response to the initial rESWT application; therefore, the present findings do not allow conclusions regarding dose–response relationships or whether repeated applications produce cumulative or longer-lasting effects. Second, mechanistic interpretation remains indirect because no physiological measures were obtained to quantify changes in pain perception, muscle activation, co-contraction, passive resistance, or sensorimotor function. Given that Joo et al. (2024) reported functional improvements without changes in tendon stiffness, future studies should incorporate complementary assessments (e.g., perceived pain/discomfort ratings, surface electromyography for agonist activation and antagonist co-activation, and passive joint torque or range of motion) to clarify the pathways underlying the observed enhancement in knee extension output. Third, because sham stimulation and alternative stimulation sites were not included, expectancy and other non-specific effects cannot be fully excluded. Finally, generalisability may be limited to the present sample and testing configuration.

Future research should employ sham-controlled designs, systematically manipulate stimulation parameters (e.g., number of impulses, frequency, and pressure), and examine both immediate and time-course responses across different athlete populations and task conditions. Such studies are needed to establish causal mechanisms, dose–response relationships, and the practical relevance of rESWT as a conditioning intervention.

6. Conclusion

In female university athletes, rESWT applied to the quadriceps was associated with immediate improvements in isokinetic knee extension output, particularly in Peak Torque, Peak Power, Total Work, and Peak Torque/BW%, whereas no comparable effects were observed for knee flexion or early torque-rise indices. These findings suggest that the acute effects of rESWT are movement- and site-specific and may primarily reflect short-term sensorimotor modulation rather than structural change. Although rESWT may have potential as a pre-performance conditioning modality, sham-controlled and mechanistic studies are needed to clarify causality, dose–response relationships, and the time course of its effects.

References

Auersperg, V., & Trieb, K. (2020). Extracorporeal shock wave therapy: An update. EFORT Open Reviews, 5(10), 584–592. https://doi.org/10.1302/2058-5241.5.190067

Ayala, F., De Ste Croix, M., Sainz de Baranda, P., & Santonja, F. (2015). Acute effects of two different stretching techniques on isokinetic strength and power. Revista Andaluza de Medicina del Deporte, 8(3), 93–102. https://doi.org/10.1016/j.ramd.2015.03.003

Borges, D. T., Macedo, L. B., Lins, C. A. A., & Brasileiro, J. S. (2016). Immediate effects of whole-body vibration on neuromuscular performance of quadriceps and oscillation of the center of pressure: A randomized controlled trial. Manual Therapy, 25, 62–68. https://doi.org/10.1016/j.math.2016.06.005

International Society for Medical Shockwave Treatment. (2017). ISMST consensus statement: Terms and definitions (focused/defocused extracorporeal shockwaves; radial pressure waves). https://sitod.it/wp-content/uploads/2024/10/ISMST-CONSENSUS-STATEMENT.pdf

International Society for Medical Shockwave Treatment. (2024). ISMST guidelines for extracorporeal shock wave therapy (3rd ed.). https://shockwavetherapy.org/wp-content/uploads/2024/01/ISMST-Guidelines-for-ESWT-_-engl-20240103.pdf

Jacobs, P. L., & Burns, P. (2009). Acute enhancement of lower-extremity dynamic strength and flexibility with whole-body vibration. Journal of Strength and Conditioning Research, 23(1), 51–57. https://doi.org/10.1519/JSC.0b013e3181839f19

Joo, Y., Choi, W., Jung, J., Kim, H., Park, S., Lee, S., & Lee, S. (2024). Does radial extracorporeal shockwave therapy applied to the Achilles tendon influence ankle functionality? Journal of Functional Morphology and Kinesiology, 9(2), 67. https://doi.org/10.3390/jfmk9020067

Konrad, A., Glashüttner, C., Reiner, M. M., Bernsteiner, D., & Tilp, M. (2020). The acute effects of a percussive massage treatment with a Hypervolt device on plantar flexor muscles' range of motion and performance. Journal of Sports Science & Medicine, 19(4), 690–694.

Morgan, J. P. M., Hamm, M., Schmitz, C., & Brem, M. H. (2021). Return to play after treating acute muscle injuries in elite football players with radial extracorporeal shock wave therapy. Journal of Orthopaedic Surgery and Research, 16(1), 708. https://doi.org/10.1186/s13018-021-02853-0

Radinmehr, H., Nakhostin Ansari, N., Naghdi, S., Olyaei, G., & Tabatabaei, A. (2017). Effects of one session radial extracorporeal shockwave therapy on post-stroke plantarflexor spasticity: A single-blind clinical trial. Disability and Rehabilitation, 39(5), 483–490. https://doi.org/10.3109/09638288.2016.1148785

Simplicio, C. L., Purita, J., Murrell, W., Santos, G. S., Dos Santos, R. G., & Lana, J. F. S. D. (2020). Extracorporeal shock wave therapy mechanisms in musculoskeletal regenerative medicine. Journal of Clinical Orthopaedics and Trauma, 11(Suppl 3), S309–S318. https://doi.org/10.1016/j.jcot.2020.02.004

Siu, P. M., Tam, B. T., Chow, D. H., Guo, J. Y., Huang, Y. P., Zheng, Y. P., & Wong, S. H. (2010). Immediate effects of two different whole-body vibration frequencies on muscle peak torque and stiffness. Archives of Physical Medicine and Rehabilitation, 91(10), 1608–1615. https://doi.org/10.1016/j.apmr.2010.07.214

Tenforde, A. S., Borgstrom, H. E., DeLuca, S., McCormack, M., Singh, M., Hoo, J. S., & Yun, P. H. (2022). Best practices for extracorporeal shockwave therapy in musculoskeletal medicine: Clinical application and training consideration. PM&R, 14(5), 611–619. https://doi.org/10.1002/pmrj.12790

van der Worp, H., van den Akker-Scheek, I., van Schie, H., & Zwerver, J. (2013). ESWT for tendinopathy: Technology and clinical implications. Knee Surgery, Sports Traumatology, Arthroscopy, 21(6), 1451–1458. https://doi.org/10.1007/s00167-012-2009-3

Wuerfel, T., Schmitz, C., & Jokinen, L. L. J. (2022). The effects of the exposure of musculoskeletal tissue to extracorporeal shock waves. Biomedicines, 10(5), 1084. https://doi.org/10.3390/biomedicines10051084