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Title: Effects of a Novel Neuromuscular Training Intervention on Jump, Sprint, and Change of Direction in Adult Female Soccer Players

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Author Questionnaire

- 1. Microscopy:** Does your protocol require the use of a dissecting or stereomicroscope for performing a complex dissection, microinjection technique, or something similar? **No**

- 2. Software:** Does the part of your protocol being filmed include step-by-step descriptions of software usage? **No**

- 3. Filming location:** Will the filming need to take place in multiple locations? **No**

Current Protocol Length

Number of Steps: 26

Number of Shots: 52

Introduction

Videographer's NOTE: J25-005_ID#67401 //
Have submitted: 01 INTWs (4) >> 4 files
02 PROTOCOL (21) >> 21files
03 HEADSHOTS (4) >> 4 files
04 NOTES (1) >> 1 file
05 LUTs

Videographer: Obtain headshots for all authors.

- 1.1. **Elena Mainer Pardos:** We evaluated if a structured neuromuscular training program improves jump, sprint, and directional change performance in adult female soccer players, addressing a gap in tailored interventions.
 - 1.1.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera. *Suggested B.roll:4.2*

What research gap are you addressing with your protocol?

- 1.2. **Elena Mainer Pardos:** Limited evidence exists for neuromuscular interventions in female footballers; our protocol fills this gap with tailored, progressive exercises to improve mobility, strength, and performance.
 - 1.2.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera.

How will your findings advance research in your field?

- 1.3. **Demetrio Lozano:** This research supports female-specific training and the integration of neuromuscular programmes into competitive routines to enhance performance and prevent injuries in team sports.
 - 1.3.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera. *Suggested B.roll:4.4*

What new scientific questions have your results paved the way for?

- 1.4. **Demetrio Lozano:** Our findings raise questions about the long-term effects of neuromuscular training on seasonal injury rates and performance, especially regarding load management and recovery.

1.4.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera.

Videographer: Obtain headshots for all authors.

Ethics Title Card

This research has been approved by the Clinical Research Ethics Committee of the Government of Aragón

Protocol

Videographer's NOTE: I recorded all exercises with 4k you can take the still image that you want. File is: ID#67401_0006.MXF

2. Pre- and Post- Measurements for Jump, Sprint, and Change of Direction Tests

Demonstrator: Elena Mainer Pardos

2.1. To begin, have all players complete the RAMP (*Ramp*) warm-up protocol, just before starting the measurements [1].

2.1.1. WIDE: Players performing RAMP protocol warm-up under the instructor's guidance.

2.2. Instruct the player to start upright with feet shoulder-width apart, or in their most comfortable stance, keeping their hands on their waist to prevent arm momentum [1]. Next, have the player begin the lowering phase and push off to perform a maximal-intensity vertical jump [2-TXT].

2.2.1. Talent demonstrating the upright starting position for both bilateral and unilateral jump conditions. **Videographer's NOTE:** 2.2.1. + 2.2.2 were shot together

2.2.2. Close-up of talent performing the lowering phase followed by the maximal-intensity jump. **TXT: Conduct the test 3x with 45 s passive recovery; Record the highest jump**

2.3. Calculate the Bilateral Deficit Countermovement Jump using the formula shown here [1].

2.3.1. TEXT ON A PLAIN BACKGROUND

$$\text{BLD CMJ (\%)} = [100 \times (\text{CMJ bilateral}/\text{CMJR} + \text{CMJL})] - 100$$

2.4. To measure sprint speed with a 40-meter sprint, position each participant with their lead foot 0.5 meters behind the first timing gate, using a two-point staggered stance [1]. Place the timing gates 1.5 meters apart and set at a height of 0.75 meters [2-TXT].

2.4.1. Talent standing in a two-point staggered stance, with foot positioned behind the first timing gate.

2.4.2. Close-up shot showing the spaced timing gates set at a height of 0.75 meters. **TXT: Perform the sprint 2x with at least 3 min passive recovery**

- 2.5. After calculating split times between 10 and 20 meters and 30 and 40 meters, use the given formula to determine peak speed [1].

2.5.1. TEXT ON A PLAIN BACKGROUND

Peak speed: $[(10/\text{time } 30\text{-}40\text{m}) \times 3600] / 1000$

- 2.6. To assess agility with the 505 (*Five-Zero-Five*) change of direction test, instruct players to build up speed over 10 meters, then sprint 5 meters through the timing gate [1]. Have them perform a 180-degree turn and sprint 5 meters back [2-TXT].

2.6.1. Talent accelerating for 10 meters before reaching the timing gate.

2.6.2. Talent sprinting through the gate, making a sharp 180° turn. **TXT: Perform the text 2x with 3 min passive recovery; Record the best time for analysis**

- 2.7. Subtract the time recorded for the first 10-meter sprint from the time recorded in the 505 test to calculate the change of direction [1].

2.7.1. LAB MEDIA: 2.7.1.-COD-deficit.pdf

3. Neuromuscular Training Intervention to Improve Physical Performance in Female Soccer Players

- 3.1. Start with level 1 mobility training. To do so, perform the lunge-to-hamstring stretch by stepping into a lunge [1] and then shifting the hips back to stretch the hamstring of the front leg [2-TXT].

3.1.1. Talent stepping into a lunge position. **Videographer's NOTE: 3.1.1. + 3.1.2 were shot together**

3.1.2. Talent shifting hips back, stretching the front leg's hamstring. **TXT: Repeat the movement, alternating between the lunge and stretch positions**

- 3.2. For Level 2 mobility, perform the standing hip out. Stand with feet hip-width apart, lift one knee towards the chest [1], then rotate it outward to open the hip [2]. Lower the leg and repeat on the opposite side [3].

3.2.1. Talent standing with feet hip-width apart, lifting one knee toward the chest. **Videographer's NOTE: 3.2.1. + 3.2.2.+ 3.2.3 were shot together**

3.2.2. Talent rotating the lifted knee outward to open the hip.

3.2.3. Talent lowering the leg and repeating the motion on the other side.

- 3.3. Next, perform the 90-90 hip stretch for Level 3 mobility. Sit with the front leg bent at a 90-degree angle in front and the back leg bent at a 90-degree angle behind [1]. Keep

the torso upright, lean forward to deepen the hip stretch, hold briefly, and then switch sides [2].

3.3.1. Talent seated with legs in a 90-90 position, demonstrating alignment.

Videographer's NOTE: 3.3.1. + 3.3.2 were shot together

3.3.2. Talent leaning forward with torso upright, deepening the hip stretch.

3.4. For level 1 stability, perform the star excursion. Stand on one leg and reach the opposite leg in multiple directions, mimicking the points of a star, without touching the ground [1]. After each reach, return the leg to the center and repeat on the other side [2].

3.4.1. Talent balancing on one leg, extending the other leg outward in a star direction.

Videographer's NOTE: 3.4.1. + 3.4.2 were shot together

3.4.2. Talent resetting leg position to the center.

3.5. At Level 2, hop laterally onto one leg, land softly [1], and hold the balance for a few seconds before hopping to the opposite side [2-TXT].

3.5.1. Talent performing a lateral hop onto one leg, landing with a controlled posture.

Videographer's NOTE: 3.5.1. + 3.5.2 were shot together

3.5.2. Close-up of talent holding balance after the lateral hop. **TXT: Focus on control during each hop and balance**

3.6. For Level 3, perform forward hop with balance. Hop forward onto one leg, land softly [1], and hold the balance for a few seconds to stabilize [2]. Alternate legs, maintaining control and balance throughout each hop [3].

3.6.1. Talent hopping forward on one leg with a controlled landing. **Videographer's NOTE: 3.6.1. + 3.6.2. + 3.6.3 were shot together**

3.6.2. Close-up of talent holding balance after forward hop.

3.6.3. Talent alternating legs and repeating the forward hop with balance.

3.7. Perform the squat for level 1 anterior chain strength, stand with feet shoulder-width apart [1], and lower the hips as if sitting in a chair, keeping the chest upright [2]. Push through the heels to return to standing, then repeat for the desired number of repetitions [3].

3.7.1. Talent standing with feet shoulder-width apart, preparing for squat.

Videographer's NOTE: 3.7.1 + 3.7.2 + 3.7.3 on the clapboard corresponds to steps 3.7 / 3.8 / 3.9

- 3.7.2. Close-up of talent lowering into squat position with chest upright.
- 3.7.3. Talent pushing through heels to return to standing position.
- 3.8. For level 2 anterior chain strength, perform the squat jump. Begin in a squat position, lower down, then jump off the ground [1]. Land softly back into a squat position, maintaining control and balance before repeating [2].
 - 3.8.1. Talent lowering into a squat position and jumping off the ground from the squat position.
 - 3.8.2. Close-up of talent landing softly back into squat position, maintaining control.
- 3.9. At level 3, perform the walking lunge. Step forward into a lunge, lowering both knees to a 90-degree angle [1]. Push off the back foot to step into the next lunge [2], continuing in a controlled forward motion for the desired distance or repetitions [3].
 - 3.9.1. Talent stepping forward into lunge position with both knees bent to 90 degrees.
 - 3.9.2. Close-up of talent pushing off the back foot to transition into the next lunge.
 - 3.9.3. Talent moving forward in a controlled sequence of walking lunges.
- 3.10. For Level 1 lumbo-pelvic control, perform the front plank. Begin face down, lifting the body onto forearms and toes, keeping a straight line from head to toe [1]. Engage the core, avoiding sagging or lifting of the hips, and hold the position for the desired duration [2].
 - 3.10.1. Talent positioned face down, lifting body onto forearms and toes for plank.
Videographer's NOTE: 3.8.1 + 3.8.2 corresponds to steps 3.10 / 3.11 / 3.12
 - 3.10.2. Talent holding plank position with a stable core.
- 3.11. Perform the side plank for level 2 lumbo-pelvic control. Lie on one side with legs extended, lifting the body onto one forearm and the edge of the foot [1]. Maintain a straight line from head to toe, engaging the core, and hold for the desired time before switching sides [2].
 - 3.11.1. Talent positioned on one side, lifting body onto forearm and foot edge for side plank.
 - 3.11.2. Close-up of talent holding a straight line from head to toe with core engaged.
- 3.12. For Level 3, perform the add plank. Begin in a front or side plank position, then incorporate movements such as leg lifts, arm reaches, or weights to further challenge core stability [1-TXT].

3.12.1. Talent in plank position, performing a leg lift with controlled movement. **TXT: Maintain strong core control throughout, holding for the desired time**

3.13. For level 1 posterior chain strength, perform the single-leg glute bridge. Lie on your back with one knee bent and the other leg extended [1]. Push through the heel of the bent leg to lift the hips, forming a straight line from shoulders to knee, then lower down and repeat before switching legs [2].

3.13.1. Talent lying on back with one knee bent and opposite leg extended.
Videographer's NOTE: 3.9.1 + 3.9.2 + 3.9.3 corresponds to steps 3.13 / 3.14 / 3.15

3.13.2. Talent lifting hips off the ground, creating a straight line from shoulders to knee and lowering hips back to the ground.

3.14. At level 2, perform the single-leg touch and hop. Stand on one leg, hinge at the hips to touch the ground [1], then push off to perform a small hop, maintaining balance [2]. Land softly and repeat, then switch to the opposite leg [3].

3.14.1. Talent standing on one leg, hinging forward to touch the ground.

3.14.2. Talent pushing off for a controlled hop on one leg.

3.14.3. Talent landing softly and maintaining balance before switching legs.

3.15. For Level 3, perform the scissors lunge. Begin in a lunge position, then push off the ground to switch legs mid-air [1], landing in a lunge with the opposite leg forward. Keep the chest upright and core engaged, alternating legs dynamically with control [2].

3.15.1. Talent in initial lunge position with one leg forward, mid-air, switching legs for dynamic lunge.

3.15.2. Talent landing in a controlled lunge with the opposite leg forward, maintaining an upright posture.

3.16. For Level 1 agility, perform the lateral shuffle. Start in an athletic stance with knees bent and feet shoulder-width apart [1]. Shuffle sideways by pushing off one foot, maintaining a low, balanced posture. Repeat for the desired distance or time, then shuffle in the opposite direction [2].

3.16.1. Talent in an athletic stance with knees bent and feet shoulder-width apart.
Videographer's NOTE: 3.10.1 + 3.10.2 corresponds to steps 3.16

3.16.2. Close-up of talent pushing off one foot to initiate lateral shuffle, maintaining low, balanced posture.

- 3.17. At level 2, perform the T-Test. Set up four cones in a T shape, with one cone at the base, one at the middle, and two at the ends [1]. Start at the base cone, sprint to the middle cone, then shuffle laterally to the left and right cones [2]. Return to the middle cone and backpedal to the starting cone, maintaining fast, controlled movements throughout the drill [4].
- 3.17.1. WIDE: T-shaped cone setup for the agility T-Test. **Videographer's NOTE: 3.11.1 + 3.11.2 corresponds to steps 3.17**
- 3.17.2. Talent sprinting from the base cone to the middle cone, shuffling laterally to the left cone, then to the right cone.
- 3.17.3. Talent backpedaling to the starting cone after completing the drill.
- 3.18. For Level 3 agility, perform the 505 test. Set up two cones 5 meters apart with an additional starting cone positioned 10 meters away from the first cone [1]. Sprint from the starting cone to the second cone, make a quick turn, and accelerate back past the first cone to complete the test [2].
- 3.18.1. Talent positioned at the starting cone, preparing to sprint. **Videographer's NOTE: 3.18.1. + 3.18.2 were shot together**
- 3.18.2. Close-up of talent sprinting towards the second cone, making a quick turn at the second cone. **TXT: Progress exercises: Level 1 (Weeks 1-2), Level 2 (Weeks 3-6), Level 3 (Weeks 7-10)**
- 3.19. Instruct players to complete four rounds of the entire circuit, which includes six exercises per round [1-TXT].
- 3.19.1. LAB MEDIA: 3.19.1.-Intervention-program.pdf. **TXT: For unilateral exercises, alternate the working leg in each round**

Results

4. Results

- 4.1. The control and experimental groups had similar baseline characteristics for age, height, and body mass, with no statistically significant differences between the groups [1].
 - 4.1.1. LAB MEDIA: Table 1.
- 4.2. The 10-week neuromuscular training intervention significantly increased the CMJR (*C-M-J-R*) and CMJL (*C-M-J-L*) in the experimental group post-test, with CMJR showing an improvement and CMJL showing a smaller yet significant increase [1-TXT].
 - 4.2.1. LAB MEDIA: Figure 1A. **TXT: CMJR: Countermovement Jump Right; CMJL: Countermovement Jump Left** *Video editor: Highlight the post-test EG bars for CMJR and CMJL*
- 4.3. The experimental group's CMJ significantly improved post-test, with a small effect size [1]. The balance deficit significantly decreased post-test, with a moderate effect size [2].
 - 4.3.1. LAB MEDIA: Figure 1A. *Video editor: Highlight the post-test EG CMJ bars*
 - 4.3.2. LAB MEDIA: Figure 1A. *Video editor: Highlight the post-test EG BLD bars*
- 4.4. The 30–40-meter sprint time significantly improved in the experimental group post-test with a moderate effect size [1]. In the 180-degree change of direction test to the left, the experimental group showed significant improvement with a small effect size [2].
 - 4.4.1. LAB MEDIA: Figure 1B. *Video editor: Highlight the post-test EG 30-40 m bars.*
 - 4.4.2. LAB MEDIA: Figure 1B. *Video editor: Highlight the post-test EG 180CODL bars*
- 4.5. In the analysis of peak speed and CODD (*C-O-D-D*), a significant increase in time was observed in the CODD left for the control group, indicating a worsening in performance [1].
 - 4.5.1. LAB MEDIA: Figure 1C. **TXT: CODD: Change of Direction Deficit** *Video editor: Highlight the CODDL bars*
- 4.6. Significant group-by-time interactions in CMJR, CMJ, and CMJL were found in the experimental group, with large effect sizes indicating substantial improvements [1].
 - 4.6.1. LAB MEDIA: Figure 2. *Video editor: Highlight the markers for CMJR, CMJ, and CMJL on the effect size plot*

- 4.7. The balance deficit displayed a significant group-by-time interaction with a small effect size, with improvements in the experimental group only [1].
- 4.7.1. LAB MEDIA: Figure 2. *Video editor: Highlight the marker for BLD*
- 4.8. In the change of direction tests, significant group-by-time interactions with large effect sizes were observed for both 180-degree changes of direction left and right, showing substantial improvements in the experimental group [1].
- 4.8.1. LAB MEDIA: Figure 2. *Video editor: Highlight the markers for 180 CODL, 180 CODR, CODDL, and CODDR*

Pronunciation guides

1. Countermovement

- **Pronunciation Link:** <https://dictionary.cambridge.org/pronunciation/english/countermovement>
 - **IPA:** /'kaʊn.təˌmuːv.mənt/
 - **Phonetic Spelling:** KOWN-ter-moo-vuhnt(dictionary.cambridge.org)
-

2. Excursion

- **Pronunciation Link:** <https://dictionary.cambridge.org/pronunciation/english/excursion>
 - **IPA:** /ɪk'skɜː.ʒən/
 - **Phonetic Spelling:** ik-SKUR-zuhn(dictionary.cambridge.org)
-

3. Glute

- **Pronunciation Link:** <https://dictionary.cambridge.org/pronunciation/english/glute>
 - **IPA:** /gluːt/
 - **Phonetic Spelling:** gloot(dictionary.cambridge.org, dictionary.cambridge.org, collinsdictionary.com)
-

4. Lunge

- **Pronunciation Link:** <https://dictionary.cambridge.org/pronunciation/english/lunge>

- **IPA:** /lʌndʒ/
 - **Phonetic Spelling:** luhnj(dictionary.cambridge.org, dictionary.cambridge.org)
-

5. Scissors

- **Pronunciation Link:** <https://dictionary.cambridge.org/pronunciation/english/scissors>
 - **IPA:** /'sɪz.əz/
 - **Phonetic Spelling:** SIZ-urz(dictionary.cambridge.org)
-

6. RAMP (as an acronym)

- **Pronunciation Link:** No confirmed link found
 - **IPA:** /ræmp/
 - **Phonetic Spelling:** ramp(haroldgibbons.com)
-

7. Glute Bridge

- **Pronunciation Link:** https://forvo.com/word/glute_bridge/
 - **IPA:** /glu:t brɪdʒ/
 - **Phonetic Spelling:** gloot brij(forvo.com, dictionary.cambridge.org)
-

8. 505 (Five-Zero-Five) Test

- **Pronunciation Link:** No confirmed link found
 - **IPA:** /'faɪv 'zɪə.rʊʊ 'faɪv/
 - **Phonetic Spelling:** five zero five(sciofmultispeed.com, forvo.com)
-