

## PNPEX – Intervention Protocol

The intervention combines local vibration training with moderate aerobic and sensorimotor exercises. Each training session follows a standardized structure:

- Warm-up (10 min): ergometer or elliptical (corresponding to Borg scale 12-15)
- Vibration training (8 min): hands placed on a vibration plate in a kneeling position
- Sensorimotor training (15 min): functional balance and coordination exercises
- Cool-down (10 min): low-intensity ergometer or elliptical

### *Instructions: vibration plate*

- Starting position: kneeling on a soft pad; hands placed flat on the vibration platform
- Hand placement: middle finger pointing at markings “1” through “4” in sequential order
- Weight Distribution: body shifted backward; arms relaxed, no active support through the hands



### *Protocol: vibration plate*

| Session | Frequency (Hz) | Hand Positions | Duration per Position | Pause between Positions |
|---------|----------------|----------------|-----------------------|-------------------------|
| 1       | 18             | 1–4            | 30 sec                | 60 sec                  |
| 2       | 19             | 1–4            | 30 sec                | 60 sec                  |
| 3       | 20*            | 1–4            | 30 sec                | 60 sec                  |

\*Progression: increase in frequency by 1 Hz per session up to a maximum of 36 Hz.

Subjective exertion was monitored using the Borg scale (target 12–15). Adaptations were made in cases of overexertion, pain, or motor control issues.

### *Protocol: sensorimotor training*

- Exercises per session: 3–4
- Repetitions: 3 sets
- Duration per set: 20 seconds
- Rest intervals: 20–40 s between sets; 1–2 min between exercises

| Category                       | Exercise / Description                                                          | Material / Device             | Variation / Progression               |
|--------------------------------|---------------------------------------------------------------------------------|-------------------------------|---------------------------------------|
| <b>Fine Motor Skills</b>       | Rolling a towel, finger walking (thumb, index, middle fingers, etc.)            | Towel                         | —                                     |
|                                | Pinching clothespins with thumb–index / thumb–middle finger                     | Clothespins                   | 10 repetitions                        |
|                                | Picking up cards one by one / pushing them from the hand                        | Playing Cards                 | —                                     |
|                                | Pinching, rolling, shifting, passing cork between fingers                       | Cork                          | Individually or in series             |
|                                | Collecting and stacking coins, rotating around vertical/horizontal axis         | Coins                         | By size / axis / finger pairing       |
|                                | Lacing and tying a shoe                                                         | Shoe + shoelace               | —                                     |
| <b>Grip &amp; Coordination</b> | Lat pull down, biceps curl, butterfly, triceps pulldown, chest press            | Resistance bands / loops      | Single-arm / standing variations      |
|                                | Finger trainer, squeeze ball, grip ring, resistance chain, finger extensor band | Various hand trainers         | Static holds or repeated actions      |
| <b>Coordination / Throwing</b> | Juggling, ring toss, target throwing, hand–eye coordination                     | Beanbags, rings, tennis balls | With movement or dual-task activities |

|                            |                                                                             |                           |                                                        |
|----------------------------|-----------------------------------------------------------------------------|---------------------------|--------------------------------------------------------|
| <b>Balance / Stability</b> | Tandem / semi-tandem / single-leg stance                                    | Mat, Airex, balance beam  | With eyes closed / additional motor or cognitive tasks |
|                            | Weight shifting (forward–backward / lateral / circular)                     | Airex pad, Aero-Step      | Add ball or visual-motor task                          |
|                            | Star-shaped toe taps, guiding ball with foot                                | Spiky ball (sensory ball) | In circles / toward a target                           |
|                            | Step-up (forward or lateral), maintain stance                               | Airex + Stepper           | Single-leg, eyes closed                                |
| <b>Quadruped Stability</b> | Lifting arms / legs / diagonal combination in four-point position           | Airex pad                 | Add theraband / slower tempo                           |
| <b>Thera-/Pezziball</b>    | Sitting with eyes closed, lateral raises, trunk rotation, butterfly, rowing | Pezziball + theraband     | Combine with weights                                   |
| <b>Unstable Surfaces</b>   | Balance board or beam tasks with ball/bag or resistance band                |                           |                                                        |