IMMERSIVE
LOCOMOTION
REHABILITATION

SUMMARY

1. Introduction

a. Why the ILR (Immersive Locomotion Rehabilitation) C2Care Method

Traditional rehabilitation methods rely on technique and the relationship between the therapist and the patient (6). The repetition of sessions leads to fatigue, resulting in a decrease in effectiveness. The ILR method is based on specific exercises and on motivational encouragement as well as the enjoyment of the game felt by the patient (5). It is a comprehensive method available to the therapist that groups exercises by pathology, allowing for the specific management of patients.

b. Augmented Reality (AR) and Virtual Reality (VR)

Augmented reality (AR) and virtual reality (VR) are two immersive technologies, but they differ significantly in their design and application.

Augmented Reality (AR): It overlays digital elements (such as images, graphics, information) onto the real world. It thus enriches the existing environment without replacing it.

Virtual Reality (VR): VR immerses the user in an entirely digitally simulated environment, instantly cutting the user off from the real world.

These two technologies are not in opposition but are complementary. For example, virtual reality is favored for all vestibular rehabilitation parts, while augmented reality is preferred when mobilizing the patient's locomotive functions. Augmented reality avoids creating a conflict between the inner ear and vision, thus limiting cases of motion sickness. The risks of dizziness, nausea, and loss of balance are virtually eliminated.

c. To Which Types of Patients the ILR Method is Directed

The C2Physio software is suitable for all patients with a locomotor system pathology, regardless of their comorbidity, general state, and cognitive capacity. It is advisable to exclude epileptic patients and pregnant women.

2. What is the ILR Method?

a. Reminder of the Functioning of the Central Neurological System

Our brain is built on the communication between neurons belonging to 4 major neurological systems:

- *The frontal cortex*: the site for muscle coordination, head movements, memory centers, decision-making, and reasoning by analogy. It is connected to the basal ganglia.
- *The motor nervous system*: it enables the execution of movements by the locomotor system.
- *The sensory nervous system*: it conveys to the central cortex all information about the surrounding environment, peripheral sensitivity, and movement analysis.
- *The sympathetic nervous system*: it automatically regulates vital functions, including cardiac, digestive, and respiratory functions.

Neuroscience has shown the existence of areas that activate during pleasure, serving as crossroads between the different neurological systems that make up the brain. There are two loops that allow neurons to communicate through these crossroads. Stimulation of the first loop leads to satisfaction, while the second loop decreases this sensation. The use of augmented reality allows the brain to integrate a safety dimension into the execution of the exercise. By drawing on memory, incorporating the instructions provided by the therapist, and using augmented reality, the ILR method facilitates an action that engages the satisfaction loop. The ILR method is based on the positive reinforcement obtained from successfully completing exercises (1)(2). The objectives are clear because they are determined by the ILR system and commented on by the therapist. Trust in the therapist is essential for gaining the patient's adherence, compliance, and thus achieving the desired result. The playful aspect helps reduce the tedious, repetitive nature of the sessions, making them enjoyable. (4)(5) Through this method, the therapist can increase the patient's motivation and commitment to achieve healing, with the variety of exercises increasing the chances of success.

b. Content

The ILR method enables the therapist to identify the most useful exercises based on the patient's pathology and general state. We have distinguished global exercises that will interest patients who have seen their locomotive autonomy decreased due to an accident or health deterioration with age. Device-specific exercises allow for specific anatomical region targeting, thus more closely approaching physiotherapy techniques. In this chapter, we have distinguished pathologies affecting the upper limbs, referred to as praxis, from those affecting the lower limbs, referred to as locomotor. The software includes treatment for vertigo, which we see as an integral part of locomotion. The system relies on the neocortex, reward, and emotions.
Relaxation exercises are an integral part of the method and should be used to enhance the exercises and improve patient engagement.

The C2Physio application undergoes regular updates, including technological advancements related to computer hardware, such as new sensors, gyroscopes, and accelerometers, as well as feedback from all health professionals who co-construct with us the specifications and protocols.

The ILR method is based on a proposal for a standard session with specific exercises. These exercises can also be used independently as a therapeutic tool. For example, in the rehabilitation of the lower limb in an athlete who has undergone anterior cruciate ligament surgery, the session can be exclusively focused on squat exercises, varying the intensity and frequency of repetition.

c. Application Areas

The ILR method allows for the holistic care of a patient. Its implementation begins with an analytical examination of the patient, their medical history, and their lifestyle habits.
The ILR method can be used exclusively or in addition to usual therapies. It is suitable for all patients, regardless of their pathologies, care pathways, and stages of progression.

3. Relaxation

It seems essential to emphasize the possibility within the ILR method of having tools that optimize the session by disconnecting the patient from their daily life. Relaxation between exercises will allow the patient to re-motivate themselves regardless of the difficulties they experienced during the previous exercise.

Content:
The relaxation exercise, in augmented reality, allows the continuity of the session while keeping the same visual markers. During the relaxation phases, we will adapt the visual perception by reducing the light intensity and playing with different graphical filters. An adapted sound environment will divert the patient's attention away from the rehabilitation session.

Implementation:
We distinguish between patients experiencing a loss of autonomy, who do not require preparation before rehabilitation sessions, and patients undergoing device-specific sessions, often active ones who will benefit from disconnecting from their daily life before the physiotherapy session. Preparatory relaxation helps to reduce the patient's stress and anxiety, which can cause muscle tension and hypertonia. We recommend a 3-minute relaxation phase at the beginning of the session. (12)
Between each exercise, the patient can independently initiate this relaxation phase. It will allow them to re-motivate themselves for the next exercise regardless of the difficulties they encountered in the previous one. The relaxation session should not be started before regaining a basic cardio-respiratory rhythm.

4. Global Exercises

a. Objective

- To engage the entire locomotor system by achieving scores that allow for tracking progress. (11)
- To assess the patients' capabilities and choose exercises that can be performed safely.
- To recover the patient's overall physical condition.

- To prevent the decline of elderly patients under care. The exercises can be performed early thanks to immersive technologies.

b. Protocols

i. Session Organization

The sessions include active phases in Augmented Reality that engage an entire region of the locomotor system. Systematically, these sessions comprise:

- Specific exercise phases
- Relaxation phases between each exercise, lasting 3 minutes.
- At the end of the session, there will always be a 3-minute relaxation time.
- A phase of manual therapies should be performed at the end of the session: draining massage, and if necessary, in case of a painful joint, the application of analgesic physiotherapy through mud therapy or cryotherapy.

ii. Patient with Loss of Autonomy and Locomotor Pathology

	Phase 1	*Phase 2*	*Phase 3*	*Phase 4*
S1-2-3	**Basketball** Level 1 2 min	**Sword** Level 1 2 min	**Dance** Level 1 2min	**Crossbow** Level 1 2min
S4-5-6	**Basketball** Level 1 2 min	**Sword** Level 2 2 min	**Squat** Level 1 2 min	**Robot** Level 1 2 min
S7-8-9	**Basketball** Level 2 2 min	**Dance** Level 2 2 min	**Squat** Level 2 2 min	**Soccer Hand** Level 2 2 min
S10-11-12	**Dance** Level 3	**Tennis** Level 2	**Squat** Level 2	**Archery** Level 2

	2 min	2 min	2 min	2 min
S13-14-15	**Dance** Level 4 2 min	**Tennis** Level 2 2 min	**Squat** Level 2 2 min	**Archery** Level 3 2 min

iii. Patient with Loss of Autonomy and Praxic Pathology

	Phase1	*Phase2*	*Phase3*	*Phase4*
S1-2-3	**Dance** Level 1 2 min	**Squat** Level 1 2 min	**Basketball** Level 1 2min	**Sword** Level 1 2min
S4-5-6	**Dance** Level 2 2 min	**Squat** Level 2 2 min	**Basketball** Level 2 2 min	**Visual Pursuit** Level 2 2 min
S7-8-9	**Basketball** Level 2 2 min	**Soccer feet** Level 2 2 min	**Squat** Level 2 2 min	**Sword** Level 2 2 min
S10-11-12	**Soccer Hand** Level 2 2 min	**Tennis** Level 2 2 min	**Dance** Level 2 2 min	**Visual Pursuit** Level 2 2 min
S13-14-15	**Dance** Level 2 2 min	**Tennis** Level 2 2 min	**Squat** Level 2 2 min	**Archery** Level 3 2 min

c. Control Evaluations

- The duration of the exercise should not be imposed; it is indicative. When the patient finds the exercise difficult, they should stop. Conversely, if the

patient feels well and wishes to continue, the duration of the exercise can be extended. It is repetition that leads to muscle strengthening.

- Only the score should be recorded and written in the patient's file.
- The initial sessions should be conducted under the therapist's supervision to assess the patient's ability to safely perform the exercise, their endurance, and the quality of movement.
- The comfort of the patient should be prioritized over gaining range of motion for the upper or lower limb. The ultimate goal is to enable functional reintegration into the patient's usual environment.

5. Dedicated Joint Exercises

a. Objective

- To use Augmented Reality to allow the patient to perform a controlled rehabilitation movement by relying solely on their willpower.
- The exercises mobilize muscular chains for a targeted movement.
- Opportunity for pure analytical work on a custom-built movement.
- Based on the reward system and the observation of progression on a quantitative score (Except for neurodegenerative conditions)

b. Protocols

i. Session Organization

- Each session will be preceded by a 3-minute relaxation session to prepare the patient.
- A relaxation time of 2 minutes between each phase.
- At the end of the session, there will always be a 3-minute relaxation time.

ii. Painful Stiffness of the Cervical Spine

	Phase 1	*Phase 2*	*Phase 3*
S1-2-3	**Horizontal Pins** Level 1 2 min	**Vertical Pins** Level 1 2 min	**Pins Inclination** Level 1 2 min
S4-5-6-7-8-9	**Horizontal Pins** Level 2 2 min	**Pins Inclination** Level 2 2 min	**Visual Pursuit** Level 2 2 min
S10-11-12	**Pins Inclination** Level 3 3 min	**Vertical Pins** Level 3 3 min	**Visual Pursuit** Level 3 3 min
S13-14-15	**Visual Pursuit** Level 3 3 min	**Pins Inclination** Level 3 3 min	**Visual Pursuit** Level 3 3min

iii. Painful, Stiff, Unstable Shoulder

	Phase 1	*Phase 2*	*Phase 3*	*Phase 4*
S1-2-3	**Visual Pursuit** Level 1 2 min	**Basketball** Level 1 2 min	**Sword** Level 1 2 min	**Tennis** Level 1 2 min
S4-5-6	**Visual Pursuit** Level 2 2 min	**Sword** Level 2 2 min	**Crossbow** Level 2 2 min	**Tennis** Level 2 2 min

S7-8-9	**Basketball** Level 3 2 min	**Tennis** Level 2 2 min	**Visual Pursuit** Level 3 2 min	**Archery** Level 2 2 min
S10-11-12	**Visual Pursuit** Level 2 3 min	**Sword** Level 3 3 min	**Soccer Hand** Level 2 3 min	**Archery** Level 3 3 min
S13-14-15	**Sword** Level 3 3 min	**Tennis** Level 3 3 min	**Soccer Hand** Level 3 3 min	**Archery** Level 3 3 min

iv. Stiff, Painful Elbow

	Phase 1	*Phase 2*	*Phase 3*	*Phase 4*
S1-2-3	**Crossbow** Level 2 2 min	**Sword** Level 1 2 min	**Basketball** Level 2 2 min	**Soccer hand** Level 1 2 min
S4-5-6	**Sword** Level 2 2 min	**Basketball** Level 2 2 min	**Soccer hand** Level 1 2 min	**Visual Pursuit** Level 3 2 min
S7-8-9	**Crossbow** Level 3 2 min	**Tennis** Level 3 2 min	**Visual Pursuit** Level 3 2 min	**Soccer hand** Level 2 2 min
S10-11-12	**Basketball** Level 3 3 min	**Tennis** Level 3 3 min	**Soccer hand** Level 3 3 min	**Archery** Level 3 3 min
S13-14-15	**Basketball** Level 4 3 min	**Tennis** Level 4 3 min	**Soccer hand** Level 4 3 min	**Archery** Level s4 3 min

v. Stiff, Painful Hip

	Phase 1	*Phase 2*	*Phase 3*
S1-2-3	**Squat** Level 1 2 min	**Soccer feet** Level 1 2 min	**Tennis** Level 2 2 min
S4-5-6	**Tennis** Level 2 2 min	**Squat** Level 3 2 min	**Dance** Level 3 2 min
S7-8-9	**Dance** Level 3 2 min	**Squat** Level 3 2 min	**Soccer feet** Level 3 2 min
S10-11-12	**Tennis** Level 3 3 min	**Dance** Level 3 3 min	**Soccer feet** Level 4 3 min
S13-14-15	**Squat** Level 4 3 min	**Tennis** Level 4 3 min	**Dance** Level 4 3min

vi. Knees

1. Anterior Knee Pain

	Phase 1	*Phase 2*	*Phase 3*
S1-2-3	**Dance** Level 1 2 min	**Squat** Level 1 2 min	**Soccer feet** Level 1 2 min
S4-5-6	**Dance** Level 2 2 min	**Squat** Level 2 3 min	**Soccer feet** Level 2 3min

S7-8-9	**Dance** Level 3 3 min	**Squat** Level 3 3 min	**Soccer feet** Level 3 3 min
S10-11-12	**Dance** Level 4 3 min	**Squat** Level 4 3 min	**Soccer feet** Level 4 3 min
S13-14-15	**Dance** Level 4 3 min	**Squat** Level 5 3 min	**Soccer feet** Level 5 3min

2. Painful and Stiff Knees (Arthritis)

	Phase 1	*Phase 2*	*Phase 3*
S1-2-3	**Dance** Level 1 2 min	**Squat** Level 1 2 min	**Tennis** Level 1 2 min
S4-5-6	**Dance** Level 2 3 min	**Squat** Level 2 3 min	**Tennis** Level 2 3min
S7-8-9	**Dance** Level 3 3 min	**Squat** Level 3 3min	**Tennis** Level 3 3min
S10-11-12	**Dance** Level 4 3 min	**Squat** Level 4 3min	**Tennis** Level 4 3min
S13-14-15	**Dance** Level 4 3 min	**Squat** Level 5 3min	**Tennis** Level 5 3min

3. Deafferented Knee

	Phase 2	*Phase 3*	*Phase 4*
S1-2-3	**Tennis** Level 1 2 min	**Squat** Level 1 2min	**Soccer hand** Level 1 2min
S4-5-6	**Tennis** Level 2 2 min	**Squat** Level 2 2 min	**Soccer hand** Level 2 2 min
S7-8-9	**Tennis** Level 3 3 min	**Squat** Level 3 3 min	**Soccer hand** Level 3 3 min
S10-11-12	**Tennis** Level 4 3 min	**Squat** Level 4 3min	**Soccer hand** Level 4 3 min
S13-14-15	**Dance** Level 4 3 min	**Squat** Level 5 3min	**Soccer feet** Level 5 3min

vii. Painful, Unstable Ankles

	Phase 1	*Phase 2*	*Phase 3*
S1-2-3	**Squat** Level 1 2 min	**Soccer feet** Level 1 2 min	**Dance** Level 1 2 min
S4-5-6	**Squat** Level 2 2 min	**Soccer hand** Level 3 2 min	**Soccer feet** Level 3 2 min
S7-8-9	**Tennis**	**Squat**	**Soccer feet**

	Level 3 2 min	Level 3 2 min	Level 3 2 min
S10-11-12	**Dance** Level 3 3 min	**Squat** Level 3 3 min	**Soccer hand** Level 3 3 min
S13-14-15	**Squat** Level 4 3 min	**Tennis** Level 4 3 min	**Soccer feet** Level 4 3min

viii. Special Cases

Some patients have joint limitations that prevent them from performing the various exercises on the upper limb within the proposed ranges. It remains possible to create a custom repetition exercise that allows the patient to achieve optimal praxis with the Customizable Movement activity.

c. Evaluation of Progress

i. Duration

The duration of the exercise should not be imposed; it is indicative. It must consider the patient's tolerance throughout the session and should be re-evaluated based on the therapist's analysis. A short but well-performed session is preferable to a longer, adaptive session.

ii. Difficulty

The exercises have several levels of difficulty that engage the patient's mobility, understanding of instructions, and cardiorespiratory status. A comprehensive evaluation of the session is necessary to establish the optimal level of difficulty for the next session.

iii. Method of Execution

Emphasis should be placed on learning the movement before focusing on the score. All ankle exercise movements should be performed with the foot flat on the ground. In squat practices, knee flexion must be controlled to avoid pain. If the patient cannot pass under the gate, the exercise can still continue. In open-chain exercises, the patient should be advised to maintain a rhythm that allows them to keep their balance and to link the exercise to their breathing. During impact movements, exhalation occurs on the impact: soccer and tennis.

iv. Evaluation - Score

The evaluation must be both qualitative and quantitative. The qualitative evaluation is crucial for the therapist when introducing an exercise. They must focus on the quality of posture, core stability, and respiratory synchronization.
The quantitative evaluation is performed automatically after each phase. C2Physio provides a quantitative score. This score should help track the patient's progression and contribute to the reward system through the therapist's encouragement regarding score improvement. This score must be meticulously recorded to construct the progression curve presented to the patient at the beginning of the session. By fostering this motivation, the therapist encourages more regular compliance and supports the healing process.

6. Respiratory Physiotherapy

a. Objective

The C2Physio application, by altering attentional processes and creating an immersive experience, reduces the sensation of dyspnea during endurance training in patients with chronic respiratory pathology. This reduction in dyspnea improves performance during rehabilitation, thereby improving muscle function and ultimately quality of life. The exercises are based on increasing the expansion of thoracic capacity.

b. Protocol

	Phase2	*Phase3*	*Phase4*
S1-2-3	**Basketball** Level 1 2 min	**Squat** Level 1 2min	**Dance** Level 1 2min
S4-5-6	**Basketball** Level 2 2 min	**Squat** Level 2 2 min	**Dance** Level 2 2 min
S7-8-9	**Basketball** Level 3 3 min	**Squat** Level 3 3 min	**Dance** Level 3 3 min
S10-11-12	**Basketball** Level 4 3 min	**Squat** Level 4 3 min	**Dance** Level 4 3 min
S13-14-15	**Basketball** Level 4 3 min	**Squat** Level 5 3 min	**Dance** Level 5 3 min

c. Progress Evaluation

The exercise duration should not be mandatory; it is indicative. It should remain with an inhalation of 2 seconds followed by an exhalation of 3 seconds. When the patient experiences difficulty, they should stop the exercise. Only the score should be recorded and written in the patient's file. The exercise presentation must emphasize the inhalation-exhalation rhythm. Each exercise should help the patient become aware of thoracic expansion and the importance of the abdominal muscles and diaphragm.

7. Vestibular Physiotherapy

a. Objective

Introduction to Vestibular Physiotherapy

Vestibular physiotherapy is a specialized approach to treating balance disorders and dizziness, often caused by abnormalities in the inner ear or the nervous system. This therapy uses specific techniques to improve coordination and reduce the unpleasant sensations associated with vestibular disorders.

Incorporation of Virtual Reality

The integration of virtual reality in vestibular physiotherapy is a significant innovation. Virtual reality creates a fully immersive environment, allowing patients to be exposed to various visual and sensory stimuli in a controlled setting. This technology offers a new dimension in vestibular rehabilitation, enabling more targeted exercises and the simulation of situations that may be difficult to replicate in a traditional clinical setting.

Benefits of Virtual Reality in Physiotherapy

- Customization of Exercises: Virtual reality allows for the adjustment of environments and stimuli according to the specific needs of each patient, offering a more personalized approach.
- Progress Tracking: With integrated sensors and software, it's possible to accurately track patient progress by measuring parameters such as coordination, reaction to different stimuli, and overall symptom improvement.
- Safety and Comfort: Patients can be exposed to potentially disorienting or dangerous situations in real life, in a secure virtual environment.
- Increased Engagement: Virtual environments can make therapy more interactive and engaging, which may enhance motivation and active participation from patients.

b. Protocol

C2Physio contains advanced modules designed for virtual reality vestibular physiotherapy. It includes several modules to simulate specific environments and stimuli to treat vestibular disorders.

Optokinetic Simulation Module

Objective: This module simulates the movement of the environment to stimulate the vestibular system and improve visuo-vestibular coordination.

Settings:

- Point Density: Adjust the density to modulate the intensity of the stimulation.
- Rotation Axes: Choose different axes (horizontal, vertical, oblique) to simulate various movement situations.

Vection Module

Objective: This module aims to create a sensation of movement in space, crucial for treating imbalances and dizziness.

Settings:

- Direction: Horizontal or vertical, to simulate different types of movement.
- Rotation Speed: Adjustable to gradually increase the difficulty level.
- Number of Lines: Modify to change the visual complexity of the exercise.

Visual Flow Module

Objective: This module helps to strengthen motion perception and oculomotor coordination.

Settings:

- Shape: Ring or tunnel, offering varied visual experiences.
- Speed and Rotation: Adjustable to simulate different speeds and directions of movement.

Treatment Protocols

Initial Assessment: Start by assessing the patient's capabilities and limitations to determine the appropriate settings for each module.

Therapeutic Progression: Gradually increase the intensity of the exercises based on the patient's response and improvement.

Adaptability: Be ready to adjust settings based on the patient's reactions and progress.

Practical Tips

- Monitoring: During sessions, closely monitor the patient's reactions to ensure their safety and comfort.
- Patient Feedback: Encourage patients to share their sensations and experiences to better adjust the program.

c. Progress Evaluation

Importance of Evaluation in Vestibular Physiotherapy

Evaluation plays a crucial role in the vestibular rehabilitation process. It helps measure treatment effectiveness, adjust the protocol based on patient needs, and monitor symptom progression.

Evaluation Methods

- Software-Based Evaluations: Use the analytical tools integrated into C2Physio to track progress in terms of responses to stimuli, coordination, and the ability to handle complex virtual environments.
- Subjective Patient Feedback: Collect feedback from patients about their feelings, comfort, and perception of progress.
- Standard Clinical Tests: Complement the evaluation with traditional clinical tests to assess balance, coordination, and other functional aspects.

Ongoing Monitoring

- Treatment Adjustment: Use evaluation data to adjust treatment in real time, increasing or decreasing the intensity and complexity of exercises as necessary.
- Preventing Regression: Monitor for signs of regression or deterioration to intervene promptly.

Specific Evaluation Examples

- Before and After Comparison: Compare the patient's performance before and after specific sessions to assess immediate changes.
- Long-Term Tracking: Conduct regular evaluations over a longer period to observe trends and overall improvements.

Importance of Individualization

Each patient is unique, and the evaluation should be tailored to their specific needs. Consider individual goals, overall health status, and personal responses to treatment.

8. Clinical Cases

1. Granny Georgette: 80 years old, femoral neck fracture, underwent total hip replacement surgery. Comorbidities include diabetes, obesity, 15 days in a Rehabilitation and Recovery Medicine (MSR). Loss of axial tonicity and difficulty walking.

- Pre-Therapeutic Evaluation

A patient who was autonomous at home, underwent total hip replacement for a femoral neck fracture, was hospitalized for 10 days, and received a transfusion. Hospitalized in MSR, bedridden, lost upper limb tonicity, has difficulty sitting, and takes a few steps with a walker within a limited perimeter. The goal is to restore functional locomotor autonomy and enable her to regain the necessary praxic functions to return home independently. The patient is particularly willing, uses a mobile phone, and agrees to use a rehabilitation method.

- Strategy Determination

Protocol 4.b.ii - Patient with loss of locomotor autonomy in global exercises
Protocol 5.b.v - Patient with hip pathology in device-specific exercises

- Implementation

Exercises will begin seated to allow for the toning of the shoulder girdles and recovery of axial bracing. As soon as the patient recovers axial tonicity, exercises for the lower limb will begin: Protocol 5.b.v. The exercises should not be

approached with a sense of competition, focusing on the patient accepting the slowness and proper execution of exercises rather than the number of repetitions.

- Evaluations and Adaptations

The introduction of exercises depends on the progression of verticalization. Evaluation will be done between sessions on clinical progress, score progression on each exercise, and analysis of patient satisfaction. The first sessions must be fully monitored by the therapist to set a slow pace and ensure the proper execution of exercises.

- Assessment

Based on a comprehensive analysis of care, encountered difficulties, and the level of recovery at consolidation.

2. Georges: 23 years old, excellent general condition, anterior cruciate ligament rupture during rugby, stabilization with hamstring graft, 3 weeks of outpatient rehabilitation.

- Pre-Therapeutic Evaluation

Walks with a limp due to a 10-degree flexion contracture, active flexion to 120 degrees, complete extension when lying down with relaxed posterior muscles, loss of thigh circumference of 4cm to 10cm from the patella, knee slightly swollen, healthy scar.

- Strategy Determination

Protocol 5.b.vi.3 - Deafferented Knees
Protocol 5.b.vi.1 - Anterior Knee Pain

- Implementation

The goal is to divert the brain's attention from the often painful surgical context directly related to the trauma and focus it on function, through play. The therapist must avoid introducing the notion of competition in the first sessions, restraining the patient to avoid nociceptive reflexes related to pain. If anterior pain syndrome appears, protocol 5.b.vi.1 should be implemented to relieve the femoropatellar compartment.

- Evaluations and Adaptations

Mechanical work to recover flexion, deep massage, and palpate-rolling should be implemented after the session or alternately.

- Assessment

Functional evaluation should be carried out at least weekly to detect early cases of mechanical stiffness due to surgery or algodystrophy. The final assessment will consider the return to sports autonomy after physical preparation, the necessity for isokinetic sessions. This type of patient must wait 6 months before, in the best case, receiving authorization to play contact rugby.

3. Georges-Henri: 30 years old, history of Covid a year ago with ICU stay. Chronic respiratory failure. Exercise intolerance, outpatient care.

- Pre-Therapeutic Evaluation

An overweight patient, not athletic before covid, former smoker, senior executive. He has decreased vital capacity and becomes dyspneic with moderate effort.

- Strategy Determination

Protocol 6.b - Respiratory Physiotherapy

- Implementation

The first sessions must be evaluated to not exceed respiratory capacities, and the pace of exercise repetitions must be adapted to the patient's clinical status. However, completing the entire session is essential for favorable evolution. The therapist must emphasize the respiratory rhythm that should favor expiration over inhalation.

- Evaluations and Adaptations

The patient's motivation and commitment must be sought as sessions can be tedious. The therapist should emphasize score progression.

- Assessment

Recovery of autonomy at effort.

4. Georgelin: 50 years old, long-term illness for ankylosing spondylitis, stiffness of the cervical spine, outpatient care.

- Pre-Therapeutic Evaluation

A comprehensive functional assessment with angular measurement, rotation, inclination, extension of the cervical spine, dorsolumbar spine, and particularly the lumbosacral hinge. It is necessary to evaluate the pain level at rest of the spine. This patient struggles to look above the horizon. He has no hip stiffness but presents a flexion contracture of both knees.

- Strategy Determination

Protocol 5.b.ii - Cervical Spine
Protocol 5.b.vi.2 - Painful and Stiff Knee

- Implementation

The therapist must ensure complete adherence to the project. Indeed, this patient requires long-term care. The rehabilitation aims to provide comfort but does not stop the natural progression of the disease. It is essential to explain the process well and to combine different care techniques. The ILR method should be one of the usable methods in this case.

- Evaluations and Adaptations

Evaluation will be done after and during each session by asking the patient about their feelings. The therapist should comment on the feelings and encourage the patient to continue with a new session by reinforcing motivation positively. If there is a painful phase, the exercise can be performed seated. The protocol concerning the knees can be introduced at any time, added to the cervical spine protocol, or replace it. The patient's tolerance and feelings will guide the therapist's care.

- Assessment

It must be regular to follow the long-term progression of the disease.

5. Paul-Georges: 28 years old, excellent general condition, recurrent shoulder dislocation after a skiing accident, arthroscopic stabilization with a buttress at two months, outpatient care.

- Pre-Therapeutic Evaluation

Measurement of joint amplitudes lying down and sitting, the scar is healthy, the shoulder is stiff in external rotation and abduction, little painful at rest, loss of deltoid volume, and no sensory disturbance.

- Strategy Determination

Protocol 5.b.iii - Shoulder

- Implementation

The session should be preceded by preparatory work in passive and lying positions to seek increased amplitudes while respecting the pain threshold. The method allows for strengthening the scapula stabilizers before stimulating the joint chains of the upper limb.

- Evaluations and Adaptations

Regular progress tracking is essential to detect early scapulohumeral dyskinesia or capsulitis. The progression should be regular, monitored by score increases.

- Assessment

It will be clinical and radiographic. A 3-month radiography is necessary to ensure the proper fusion of the buttress on the glenoid. The goal is to enable this patient to resume contact sports activity after 6 months.

6. Giorgio: 68 years old, Italian mason, operated for knee osteoarthritis on a 15-degree genu varum with a total knee replacement with a mobile bearing. Retired, treated for GERD, in excellent general condition, hunter, fisherman, handyman. Significant functional demand. In SMR.

- Pre-Therapeutic Evaluation

Clinical examination of the knee, swelling, complete extension, flexion limited to 100 degrees, quadriceps deficit, hypertonicity of the hamstrings. Good venous return. Healthy scar.

- Strategy Determination

Protocol 5.b.vi.2 - Painful and Stiff Knee
Protocol 5.b.vi.3 - Deafferented Knee

- Implementation

The two protocols can be alternately used depending on the predominance of stiffness or muscle loss. Active manual work for drainage, deep massage, and palpate-rolling should be undertaken quickly, either in place of the session or in addition to it. It's the therapist's job to convince the patient to flirt with the pain threshold to perform the exercise in its entirety. Emphasis on progression, even if it seems minimal, is crucial because the satisfaction system in this case is predominant.

- Evaluations and Adaptations

The therapist must be careful as this highly motivated patient aims to exceed the exercise request. The risk is to trigger an algodystrophy generating painful stiffness. It's the therapist's responsibility to determine the limit between acceptable positive pain and harmful nociceptive reflex.

- Assessment

Progression must be regularly appreciated to avoid the appearance of mechanical stiffness or algodystrophy. The final result should allow this patient to regain full autonomy.

9. Conclusion

The ILR method combines specific pathologies and alterations in the general state with care in augmented reality and virtual reality. It is a comprehensive method made available to the therapist as a working tool in addition to their own practice. To our knowledge, this method is pioneering.

Technology evolves rapidly, directly influencing practice. C2Care closely follows technological advancements and will do everything within its power to integrate them and make them available through software updates. C2Care thus invites you

to collaborate in this improvement by collecting your opinions and proposals, and to advance research.

"One need not hope in order to undertake, nor succeed in order to persevere" - William I of Orange Nassau

10. Bibliography

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C2Care Cross-Reference Table of Indications-Applications

	Standing Praxis	Seated Praxis	Locomotion	Shoulder	Elbow	Hip	Knee	Ankle	Spine	Neuro	Respiratory Physiotherapy
Archery	x	x		x	x					x	
Basketball	x	x		x	x					x	x
Tennis	x	x	x	x	x	x	x	x			
Soccer hand	x	x	x	x	x	x	x	x			
Soccer feet	x		x			x	x	x			
Horizontal Pins				x					x		
Vertical Pins				x					x		
Squat						x	x	x	x		x
Visual Pursuit				x					x		
Dance			x			x	x	x	x		x
Sword	x	x		x	x						
Crossbow	x	x		x	x				x		
Item Entry	x	x		x	x					x	
Personal Movement				x	x						