Fear of falling in multiple sclerosis
A sequential treatment with Virtual Reality and Interactive Games

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Fear of falling in neurological diseases as a paradigm (combined anxiety)

Fear of falling (FOF) is a frequent phobia
- older adults
- patients with neurological impairments
  multiple sclerosis (MS)
FOF in MS is
  a “rational” emotion (congruent with imbalance and motor symptoms)
  and sometimes a pathological fear (uncongruent with neurological symptoms)
Motor and Postural disability

Legitimate adaptive Behaviour « CONGRUENT »

Anxiety « INCONGRUENT »

FEAR OF FALLING

Motor and Postural disability

Legitimate adaptive Behaviour

Fatigue

Self confidence impairment

anxiety

FEAR OF FALLING

Agoraphobia-like behavior
The hierarchical integration

Perception and regulation of gait
- low levels of integration
  - vestibular (balance, …)
  - proprioceptive
  - visual ++ (sensorial conflicts,..)
- high levels
  - cognitive
  - emotional

Design

FOF and associated agoraphobia must be addressed
For treatment, combined patterns have to be disentangled.
Planning two sequential mechanisms of action in treatment
- Top-down high level of integration
  - Non related with motor symptoms (beliefs)
- Bottom up level
  - Related with postural imbalance
PILOT OPEN STUDY

Population

To be eligible for the study patients have to be
- able to walk independently or with assistance
- without relevant cognitive impairments
- Mild to moderate MS

11 patients are recruited so far

<table>
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<tr>
<th>Patients</th>
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<th>Sex</th>
<th>EDSS</th>
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<tr>
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Design of the study

One session per week during 10 weeks:
For each session, a sequential treatment

- 1“Pure Mental recalibration “: Virtual navigation (15-20min) without real exposition to inbalance deficit .
(5 different environments)

- 2 Transfert: virtual and real exposition
Interactive multimedia exercises (25-30min)
(Eye Toy & Dance mat)

RATINGS
before & after intervention

Fear of falling (Velzo & Peterson, 2001)
Quality of life (Marks, 1993)
Handicap linked to the phobia (Sheehan, 1983)
Expanded Disability Status Scale (EDSS) (Kurtzke, 1983)
Clinical Global Impression (CGI)
Video films
VR navigation: phase 1

**Pure Mental simulation** of walking: patients seated during navigation (to avoid “bottom-up reinforcement factors" of fear)

**Visual Training** of the perception of fluid walk

Possibility to practice *virtually* complex motor exercises (go up/down stairs)

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**Virtual reality display**

[Diagram of virtual reality setup with head movement sensor and head mounted display]
During this first step, patients seated in order to optimize pure mental recalibration, without postural implication.
Phase 2A: The perception-action recalibration

Dance mat (gait and balance)

- Lower limbs movements according to the task visually suggested on the screen
- Visual-motor coordination reinforcement
- First Ecological reintegration of previous virtual recalibration
Phase 2B: The perception-action recalibration: mirror play, self and agency integration

- Upper & lower limbs movements according to the auditory-visual context presented in the exercise
- Visual representation of the body of the patient allows real-time monitoring of action
- Self-seing (movements and translations) increases agency integration (knowing of self attribution of action)

Results (1)

<table>
<thead>
<tr>
<th>Measures</th>
<th>Number of patient improved /10</th>
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<tbody>
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<td>FOF (FFM)</td>
<td>9/10</td>
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<tr>
<td>Global state CGI</td>
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<tr>
<td>Quality of life</td>
<td>8/10</td>
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<tr>
<td>Handicap linked to phobia</td>
<td>8/10</td>
</tr>
<tr>
<td>EDSS (motor)</td>
<td>4/10</td>
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</table>
Results (2)

- MS Patients are more frequently improved on FOF than on motor impairment.
- Both effects are not closely related (except for 3 of 10).

Conclusion & Perspectives I

- It is a pilot open study, unable to strongly establish the interest of this design.
- VR + IME allow the management of Cognitive & Emotional component in MS patients with FOF through the involvement of the body.
- However, several patients described a global, large cognitive as well as emotional effect.
After treatment

Patient's comments:

"when I felt I was afraid to move, I mentally visualized the arrows and it helped me to make the first step, then I could continue my way"

“When walking became difficult, I remember the virtual walking and all what I was able to do…”

“…now I can cross roads without panic”

Conclusion & Perspectives II

Need for theories …
- physiopathology
  - sharing of neural mechanisms between sensorimotor processes and higher level cognitive processes
  - early processes of reactivation of fear
- implicit mechanisms of therapeutic effect
  - “de-embodiment of fear”? 