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Intensive and play-based rehabilitation for toddlers

OUR RESEARCH THEME FOR 2019-2022

CEREBRAL PALSY
RESEARCH LETTER

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Pr Olivier Baud

Professor of Pediatrics
President of the
Scientific Board

Dr Alain Chatelin

President

The Fondation Paralysie Cerebrale has decided to grant exceptional funding for the CAP' research project «Changes induced by HABIT-ILE* therapy in preschool-age children with cerebral palsy».

For over ten years, our foundation has supported progress in knowledge on cerebral palsy and the emergence of new research teams through multiple projects (more than 75 to this day). We have now decided to extend the challenge and launch even more ambitious projects with researchers. To that aim, we have committed to raise unprecedented funds for major development.

The program we are asking you to support for four years was chosen amongst eight different projects, each of which were fully evaluated by six international experts. It was unanimously selected by the foundation's European scientific council for both its rigour and ambition, bringing together multidisciplinary research teams from five countries.

This project can make a big impact for cerebral palsy. It is possible, through a new intensive and play-based rehabilitation treatment, to change prognosis for children when their brain is the most receptive, between one and four years old.

If the expected results are confirmed, we will be able to propose real transformation in the organization of rehabilitation therapies for toddlers with cerebral palsy. We will then be ready to spread these new techniques as widely and quickly as possible so many children can benefit from them.

It is a huge challenge that can change lives of thousands of children. For that, more than ever, we need everyone's support. It is your generosity that carries these hopes.

Thank you!

1.5 million euros in four years: the most important budget granted in France for a project on cerebral palsy

A European consortium of seven research teams

*HABIT-ILE: Hand and Arm Bimanual Intensive Therapy Including Lower Extremities (an intensive and play-based rehabilitation for autonomy)

How is the CAP' project important and new?

Why is this study important?

Cerebral palsy, or CP, is by definition a motor trouble that impacts common daily activities: walking, moving, but also grabbing objects, or just articulating or swallowing. Motor rehabilitation is thus a key player in care, with strong expectations regarding patients' autonomy, participation and quality of life. Researchers are constantly looking for effective and validated new motor therapies that really make a difference for many.

What is the starting point of this study?

We have known since 2014, thanks to a first study led by Pr Yannick Bleyenheuft in Brussels, that intensive rehabilitation in children over the age of six with hemiplegia (HABIT-ILE Method) is more effective than conventional rehabilitation. In 2017, a multicenter study carried out between Brussels and Columbia showed major changes induced by HABIT-ILE also in children with bilateral CP.

In parallel, experimental research on brain development and plasticity after brain injury incites to practice early interventions in children, before they are six years old for sure, and most likely before they are two years old. That is why, after clinical validation in children over the age of six executed by the team from UC Louvain, we decided to test HABIT-ILE in 1-to-4-year-olds with CP. Our hypothesis is that this treatment will be more effective on their motor development than conventional rehabilitation at this age. We also hope for more important effects than in older children (over the age of six).

How is the CAP' Project original ?

It is an European project involving research centers from France, Belgium, Switzerland, Italy and Spain, and gathering researchers from many disciplines: physiotherapy, physical medicine and rehabilitation, neuropediatry, medical imaging, biomechanics etc.

Pr Sylvain Brochard

Coordinator, Physical Medicine and Rehabilitation

Brest CHU, France

This project is also particularly original because it aims at clinically validating and understanding in detail the effects of therapy, and the origins of these effects. The understanding of functional, cerebral and movement changes combined with the identification of key ingredients in therapy with experimental models thus guarantee serious validation and controlled therapy in 1-to-4-year-olds.

It is this science necessary to every therapy, and even more in young children, that is supported through the CAP' Project. If its efficiency is validated, it will be the first step towards radical changes in early motor rehabilitation practices in France, Europe and probably beyond.

How will the study be organized?

Where will the study be conducted?

It is an European study and the children will be followed on four sites across three countries:

- in Belgium, at UC Louvain
- in France, on two sites in Brest (CHRU and Ildys Foundation) and in Angers (CHRU and Les Capucins)
- in Italy, in Pisa.

These are all centers where children with cerebral palsy are taken care of and where intensive rehabilitation according to HABIT-ILE Method is already practiced, or will give rise to specific training for therapists.

How many children are concerned?

100 children age 1-4 will be part of the study, all with CP: 50 suffering from a unilateral form and 50 from a bilateral one. In each group, half of the children will be in the 1-2 year-old age range, the other half in the 3-4 year old range. The purpose is to allow us to determine the best window of opportunity to set up intensive rehabilitation.

How will it take place?

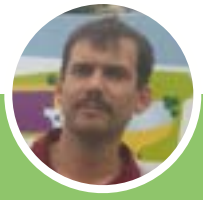
The different categories of children will be split by draw (randomized trial) in two groups:

- a «control» group undergoing conventional rehabilitation during two weeks
- a «therapy» group undergoing HABIT-ILE rehabilitation during the same period, which represents 50 hours over two weeks.

It can seem like a short period of time, but 50 hours of rehabilitation with a therapist working with patients individually is huge compared to conventional rehabilitation.

The evaluation of this rehabilitation according to criteria defined in the study will take place after three months. To motivate children in the control group, they will benefit from HABIT-ILE Therapy at the end of the study, once the evaluation achieved in both groups.

With this study, we hope not only to prove the efficiency of the intensive method, but also to evaluate the medico-economic cost of this type of care.



Pr Mickaël Dinomais

Physical Medicine and Rehabilitation

CHRU Les Capucins, Angers, France

What is the HABIT-ILE method?

What is exactly the HABIT-ILE rehabilitation method and how is it innovative?

HABIT-ILE, or Hand and Arm Bimanual Intensive Therapy – Including Lower Extremities, is an intensive rehabilitation method that shares with other validated methods, like constraint-induced therapy or intensive bimanual rehabilitation, the following components:

- an important dosage (several hours per day during two weeks in the frame of a mini-training)
- a period of motor commitment, which means the child active in useful tasks, of more than 80%
- functional therapeutic objectives set on the basis of demands from the children and their parents
- exclusively voluntary movements (no guidance nor movement facilitation)
- progressiveness in tasks and movements' difficulty to induce motor and neuroplastic changes
- a playful context to maintain children's motivation.

But compared with former intensive therapies, targeted uniquely on the upper limb, HABIT-ILE presents two major originalities:

1. It stimulates constantly, at the same time, the bimanual coordination of the lower limbs and the postural tone, thus inducing important functional and motor changes at the level of upper and lower limbs both.
2. Given its impact on upper and lower limbs, it can be proposed to children presenting bilateral cerebral palsy, which is a first. Changes observed in these children exceed those observed initially in children with unilateral damage.

What is its origin and how widespread is it?

I developed HABIT-ILE in 2011 with my research team in Brussels on the basis of the HABIT method (limited to the upper limb) that was used in Columbia (NY). At the moment, HABIT-ILE is used in an experimental context in my research laboratory in Brussels, at the Center for Cerebral Palsy Research of Columbia, and in a large Australian multicenter study, to which I am also committed. In a context of routine care, it is proposed by CP Alliance in Australia by teams benefiting from a transfer of knowledge after their visit in Belgium; in the Netherlands, where intensive treatments are part of clinical routine and are reimbursed ; and in Brest, in the team led by Sylvain Brochard, which already followed two intensive trainings with the help of my team.

Pr Yannick Bleyenheuft
Neurosciences
UC Louvain Brussels, Belgium

What types of children have benefited from it until now, and how is this study new ?

Until now, HABIT-ILE was used with children over the age of six with unilateral or bimanual damages. This project will allow us to conduct for the first time a large randomized controlled trial on HABIT-ILE's effects on preschool-aged (1-to-4-year-old) children. At this age, although cortical plasticity is theorically maximal, no study to this day has attempted to stimulate upper and lower limbs at the same time in an intensive process.

The playful aspect of the exercises is crucial to maintain children's motivation.

Photos MSL-IN lab.

How will the evaluations of the study take place?

The main evaluation of HABIT-ILE therapy's efficiency will rest on two types of measurements:

- measurement of bimanual performance, in the 50 children with unilateral CP. In 18 months-to-4-year-old children, we will use the AHA (Assisting Hand Assessment) Test, and in toddlers (aged 12-to-18-months), the mini-AHA Test. They both explore the functioning of the affected hand during games necessitating the use of two hands ;
- measurement of general motricity in the 50 children with bilateral CP. To that aim, we will use the GMFM (Gross Motor Function Measure) Test, which explores five dimensions of the motor functions.

These measurements will be made at the beginning of the study, after the 15 days of therapy (conventional or HABIT-ILE as appropriate) and after three months.

Moreover, we will perform different tests on motor function and cognitive functions.

And finally, we will evaluate biomechanical changes, which will give us information on the effects of intensive rehabilitation on the movement's configuration and quality.

How will these last measurements be performed?

We will study spatio-temporal parameters, kinematics and muscle activation in functional tasks (walking, grasping...) for lower and upper extremities.

To that aim, we will use an optoelectronic capture motion system coupled to an electromyogram. In clear, children will be equipped with optic markers along with small electrodes, on limbs whose motion we want to study. We will collect 3D data that will allow us to analyse finely the quality of their movements.

Dr Christopher Newman
Pediatric Neurorehabilitation.
CHUV Lausanne, Switzerland

Child equipped with sensors for walking 3D analysis

You will also evaluate children's general activity. Can you explain what this method is, and how it is interesting?

Our team in Lausanne showed that portative acceleration sensors allowed to measure with precision spatio-temporal parameters of walking in children with cerebral palsy as well as upper limbs functions, this on full days and in their usual environment.

We will thus be able to measure, in the study, children's physical activity during several successive days – rest and activity states, intensity, posture, moving periods – by putting a sensor on each wrist (like a watch). From these measurements, we will be able to calculate what percentage of time was spent in motion, whether that is crawling, walking and running. Several other parameters as the number of elevations of the arms or wrist movements will be also collected for both arms.

Evaluation of cognitive functions session

What is the purpose of MRI's performed on children?

Why will MRIs be performed on children who are part of the study ?

The main goal of HABIT-ILE Method is to improve motor functions, and thus the patients' activity, participation and quality of life.

These effects are produced through specific changes in the cerebral structure and functions, themselves induced by this therapy. Knowing these modifications in the brain is very important to understand the underlying mechanisms, interpret the different levels of response and identify the subgroups of patients presenting homogeneous therapeutic needs.

This will allow us to refine the different aspects of the therapy according to children's individual needs.

Pr Andrea Guzzeta

Child Neuropsychiatry

Stella Maris Scientific Institute, Pisa University, Italy

How will it be carried out?

The data collection from the MRIs protocol will obey established clinical practices making it reliable, feasible and effective. Children will have to be asleep so we can be sure they will stay totally still, which will allow us to collect high-quality data. Time for the scan won't exceed 45 minutes.

All the MRI protocol will be explained in detail to the parents when collecting their consent for the study, and again before the scan. From our experience, we can expect to collect neuroimaging data from 90% to 95% of the participants.

What should these MRIs show?

We hope to be able to detect the slightest structural change in connection with this therapy by using the most advanced methods of brain imaging, which capture at the same time changes in brain's functional activity and structural changes connected to it in terms of connectivity and cerebral volumes.

What is the use of the experimental study led in laboratory?

In parallel to this study in toddlers, an experimental study will also be led. What is it?

We will conduct in a laboratory a study comparable to the one led with children, which will allow us to investigate in detail neuroplastic brain changes induced by rehabilitation. Young rats with cerebral palsy will undergo at different moments of their brain development a therapy of the type of HABIT-ILE, in the form of sensorimotor enrichment, along with periods of motor training. Following this rehabilitation, we will analyse by different imaging techniques the cerebral structure and function, as well as biological function.

What will it bring?

The translational study we propose will allow to evaluate the treatment's efficiency according to the earliness of its application in relation to brain development, as well as the brain capacity to remodel itself through treatment. Indeed an early intervention has the theoretical advantage to better remodel the brain for a better functionality next. The repetition of the treatment will also be evaluated to know if it reinforces rehabilitation compared to a one-session treatment. Beside the functional aspect, we will be able to study in a precise way how the brain reorganizes itself by using imaging approaches that could be correlated with the neuropathology of brain tissue. Biological parameters induced by rehabilitation will also be studied, allowing to better understand how brain reorganization takes place and maybe to pave the way for treatments that will add to HABIT-ILE rehabilitation and reinforce its effects.

Pr Stéphane Sizonenko

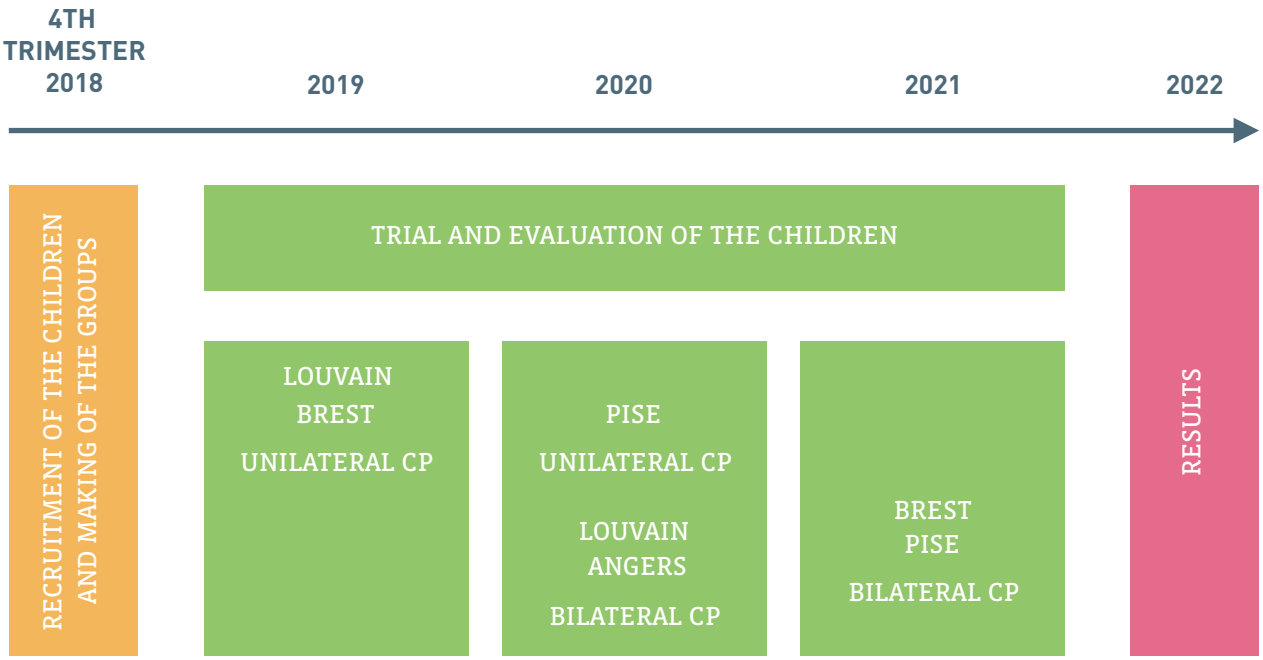
Development and Growth

Geneva University Hospitals, Switzerland

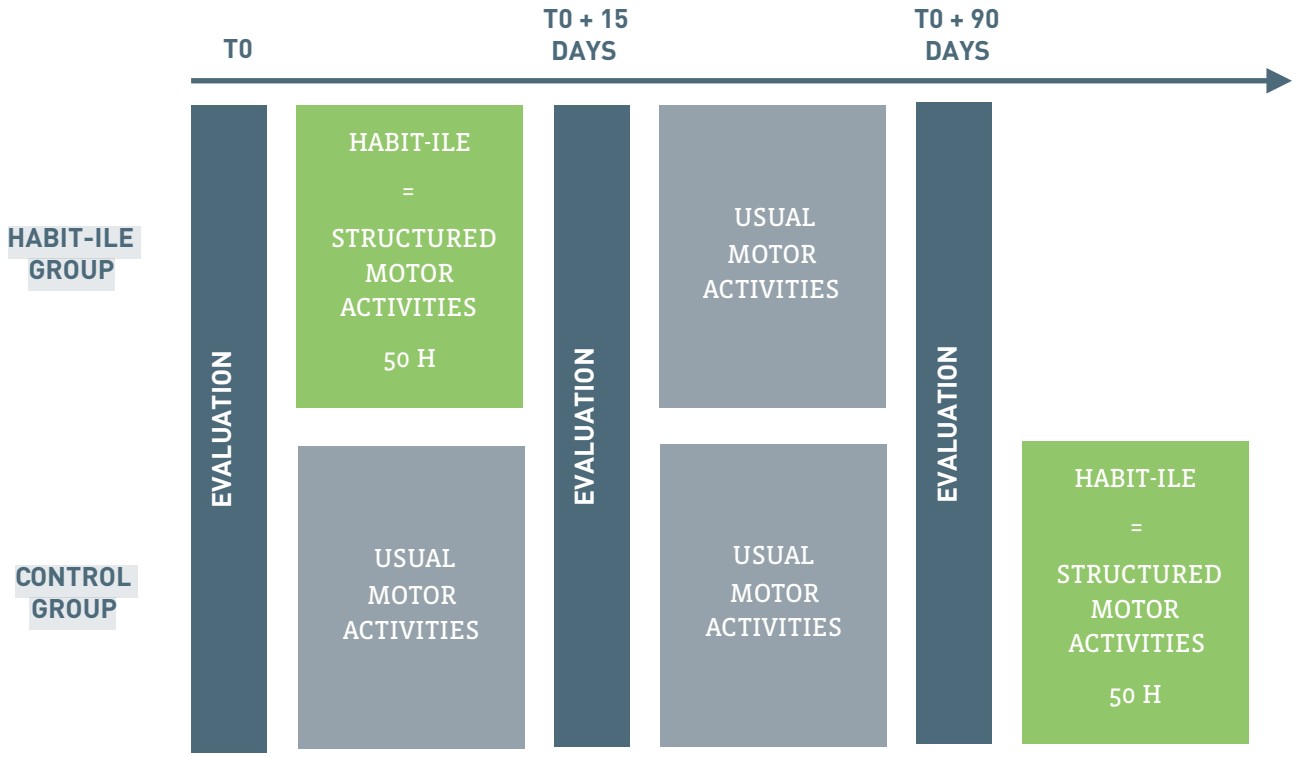
How will its results be integrated to those of the study conducted in children?

During the implementation of the project, it was very important that data obtained by this experimental part were easily comparable to data from the clinical part. For that reason, brain analysis methods are the same that in the study with children: MRI imaging, functional imaging, motion study etc. These translational methods will monitor the same thing in children and in young rats, with the advantage of the latter being that we can go further with neuropathological analysis and biological events favoring brain reorganization. Moreover, we will test two different ages for intervention, as well as its repetition, which will allow to implement the most adapted and the most effective intervention program for the child in the future.

CAP' project timeline



ORGANIZATION OF EACH SESSION OF THE STUDY



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