Armeo® Therapy Concept

Helping Patients to Grasp the Initiative and Reach Towards Recovery

We move you

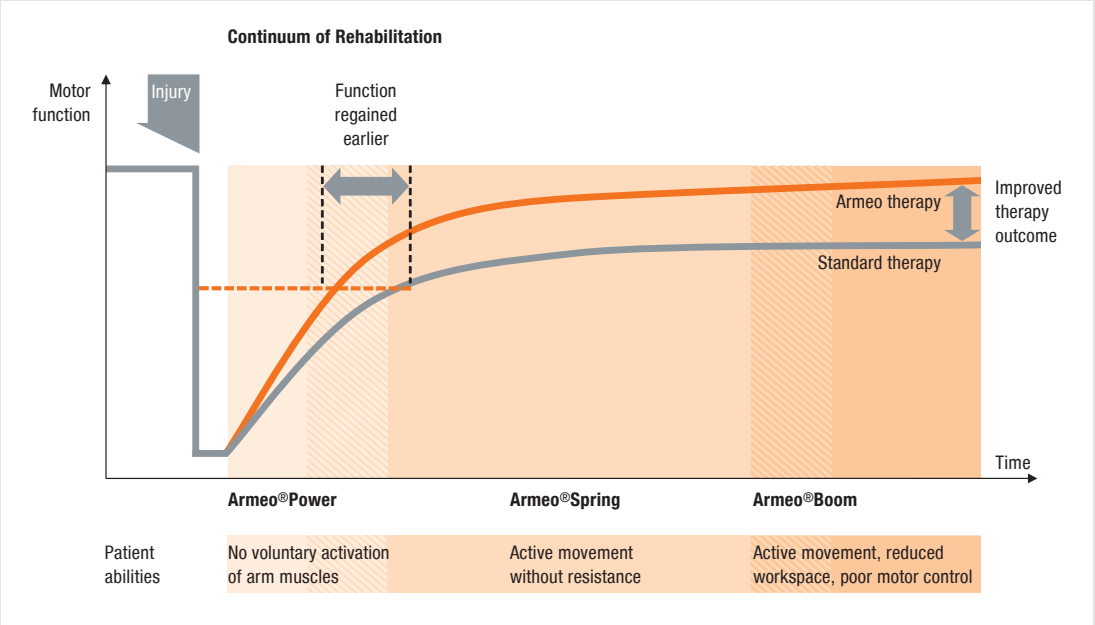
The Armeo® Therapy Concept

This is a sustainable and powerful therapy concept for individuals who have suffered strokes, traumatic brain injuries or neurological disorders resulting in hand and arm impairment.

Despite the patient's disorder, research suggests that the neural plasticity of the brain is retained and new connections can be made through intensive, repetitive, task-oriented movements. These exercises assist the gradual reorganization of the brain, which subsequently allows the restoration of movement and functionality to the affected parts.

Clinical trials also indicate that therapies are more effective if the patient initiates the exercise and remains motivated through the often lengthy rehabilitation process, a recovery period in which one-to-one therapist attention may not be economically viable.

Using this clinical evidence as a basis, the Armeo Therapy Concept has been developed. It comprises three features and a modular line of three Armeo products, all driven from a single software platform. The result is a comprehensive therapy concept which addresses different patient and therapeutic needs across the whole "Continuum of Rehabilitation", from the beginning of the rehabilitation process through to home therapy.



The Armeo Therapy Concept improves the efficiency of therapy treatments because the exercises are self-initiated, self-directed, functional and intense. Even severely impaired patients can practice independently, without the constant presence of a therapist, allowing patients to exploit their full potential for recovery.

The Augmented Performance Feedback provided by the shared software platform, encourages and motivates patients to achieve a higher number of repetitions, and this leads to better, faster results and improved long-term outcomes.

The software also provides automatic, ongoing assessment of motor functions and patients can readily track their progress, helping them to grasp the initiative and reach towards recovery.

Three innovative products, three key features

The rehabilitation, from immediate post-injury to long-term recovery, referred to here as the "Continuum of Rehabilitation", requires a range of therapies to address the changing needs of the recovering patient. The Armeo Therapy Concept includes three distinct products, Armeo®Power, Armeo®Spring and Armeo®Boom, each designed for a particular stage in the recovery process. However, the backbone of the Armeo Therapy Concept is the combination of three key features:

Arm Weight Support
Augmented Performance Feedback
Assessments Tools

Together, these features enable the patient to achieve a higher intensity of self-directed movement exercises, while remaining continuously motivated and capable of assessing and tracking the progress towards recovery.

The whole Armeo Therapy Concept is governed by the Armeocontrol software which is the basis of a shared user management system and database, providing therapy plans, assessment modalities, exercises and games across all three Armeo products.

1. Arm Weight Support

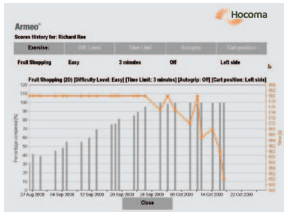
By providing support for the affected arm and hand, the Armeo Therapy Concept allows patients to reacquire and improve motor control. The support counteracts the effects of gravity and helps to:

- reveal any remaining motor functions
- facilitate self-initiated and intensive repetitive movements
- increase movements within a 3D workspace

2. Augmented Performance Feedback

Utilizing a wide range of self-initiated, functional and motivational exercises and games, which simulate regular activities of daily living, the shared software gives the patient Augmented Performance Feedback through:

- repeated tasks which are motivating and rewarding
- functional exercises with immediate performance feedback
- adjustable difficulty levels according to the patients' needs and progress
- adjustable workspace according to the patients' changing abilities



3. Assessment Tools

Included in the Armeocontrol software, these tools allow accurate monitoring of the patient's recovery progress through:

- an integrated database for the management of individual therapy plans
- documentation of progress as a basis for clinical decisions
- precise assessments of the individual patient's ability to move:
  - A-MOVE for active reaching distance, reaction time and movement velocity
  - A-GOAL for precise, goal oriented movements
  - A-COORD for inter-limb coordination during active movements
  - A-ROM for the range of motion during active and passive movements
  - A-FORCE for the isometric force generated in a static position
  - A-STIFF for the mechanical stiffness of joints while passively moving the arm in a specific pattern.

The Armeo® Therapy Concept

Armeo®Power
Robotic arm exoskeleton

Armeo®Spring
Exoskeleton with integrated spring mechanism

Armeo®Boom
Overhead sling suspension system

As shown in the table, the three Armeo products have been designed to offer different elements for each stage in the Continuum of Rehabilitation, from the beginning of the rehabilitation process through to home therapy.

Patients with no active movement of the arm muscles can begin their therapy using the ArmeoPower. They can then progress to using the ArmeoSpring as their active movement returns. Finally, the patient can use the ArmeoBoom to further increase active arm movements and improve motor control.

		Armeo®Power	Armeo®Spring	Armeo®Boom
Arm Weight Support	Arm Weight Support	●	●	●
	Exoskeleton for movement guidance	●	●	
	Active arm support	●		
Software Features	Augmented Performance Feedback	●	●	●
	Grasp and release exercises	●	●	
	Assist-as-needed support	●		
Assessment Tools*	A-MOVE	●	●	●
	A-GOAL	●	●	●
	A-COORD	●	●	
	A-ROM	●	●	
	A-FORCE	●		
	A-STIFF	●		
Therapeutic Goals	Increase active range of motion	●	●	●
	Increase strength and endurance	●	●	●
	Facilitate self-initiated movement	●	●	●
	Increase selective control	●	●	
	Mobilize patients	●		

*not yet all assessments available

"I can't over-emphasize how important it is that the effort in the Armeo therapy is self-initiated. In hands-on therapy, the initiation often comes from the therapist. With Armeo therapy, it's coming from the patient's own brain."

Louise Rutz-LaPitz
Director of Therapy and Training, Rheinburg-Klinik, Switzerland

Armeo®Power

The ArmeoPower has been specifically designed for patients with severe movement impairment who have no voluntary activation of their arm muscles yet.

Based on ARMin technology developed at the ETH Zurich and the University Hospital Balgrist under Prof. R. Riener and Prof. T. Nef.

The equipment combines adjustable, ergonomic guidance of the impaired arm with interactive therapy exercises, where motors assist the patient as much as needed.

Arm Weight Support

The ArmeoPower has a robotic arm exoskeleton, with an electric lifting column for comfortable height adjustment, allowing active arm support in a large 3D workspace. It can be used for both the left and right arm and hand, and is adjustable to different arm sizes and to the height of the patient. A positioning system correctly aligns the shoulder joint for ergonomic actuation and the product promotes movement in all relevant joints, assessing torques and angles for:

- Shoulder flexion / extension, horizontal abduction / adduction, internal / external rotation
- Elbow flexion / extension
- Forearm pro- / supination
- Wrist flexion / extension

Augmented Performance Feedback and Assessment Tools

The ArmeoPower will be equipped with the same Armeocontrol software as the rest of the Armeo products, with motivating exercises, games and simulations to provide self-initiated functional exercises, and a wide range of assessment options.

"The ARMin helped me to mobilize and guide my impaired arm, which would be far too strenuous and time consuming for my therapist. After repeatedly using the product, I can already lift my arm a little."

Patient in ARMin Study

Armeo®Spring

Fruit Shopping: The patient has to pick up apples and place them in the shopping cart.

The ArmeoSpring is specifically suited for patients who are beginning to regain active movement of the arm and hand, and has already proved to be successful in many clinics worldwide. Often becoming the preferred therapy choice of recovering patients, it is based on research and development conducted under Prof. D. Reinkensmeyer at the University of California, Irvine (UCI) and at the Rehabilitation Institute of Chicago (RIC).

Mounted on a trolley for quick and easy positioning, the ArmeoSpring offers various self-initiated repetitive therapies to increase the patient's range of motion and selective control. The self-directed exercises motivate the patient to exert intense levels of both concentration and coordination.

Arm Weight Support

The ergonomic and adjustable arm support is an exoskeleton with integrated springs. It embraces the whole arm, from shoulder to hand, and counterbalances the weight of the patient's arm, enhancing any residual function and neuromuscular control, and assisting active movement across a large 3D workspace.

The pressure sensitive handgrip is not only an input device for exercises but is also a computer interface for the software and computer games, and can be removed for functional training of real life tasks.

Augmented Performance Feedback

Armeocontrol for ArmeoSpring contains an extensive library of game-like movement exercises supported by a virtual-reality training environment that is both motivating and informative, clearly displaying the functional task along with immediate performance feedback. The motivating and self-initiated exercises include proximal and distal components, specifically related to:

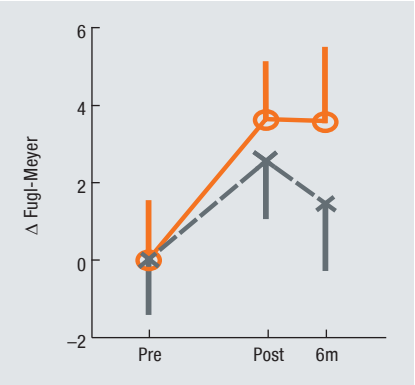
- grasp and release
- pro-/ supination
- wrist flexion / extension
- reach and retrieval function

The equipment detects even trace amounts of movement and function and facilitates intensive reach and grasp exercises at an early stage of therapy.

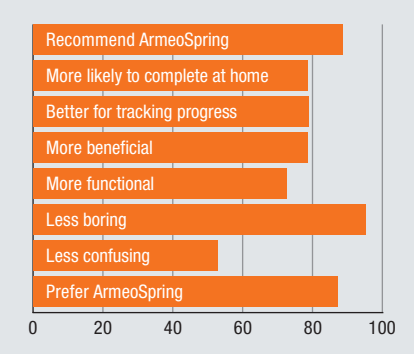
Assessment Tools

Besides functional exercises, the system contains exercises specifically designed to assess the motor ability and coordination of patients. Built-in sensors record the active arm movement at each joint during all therapy sessions and the performance data is stored in the computer, where it can be used to assess and document the patient's progress, to determine the next appropriate challenge and to promote the optimum therapy and best possible outcomes.

The Armeocontrol software supplies accurate assessments through the options A-MOVE, A-GOAL, A-COORD and A-ROM (please refer to page 3).



Control group
Armeo®Spring



Patients in favor of ArmeoSpring (in %)

Scientific results

Clinical evaluation of therapy utilizing ArmeoSpring was conducted at the Rehabilitation Institute of Chicago. The study compared Armeo therapy to conventional, self-directed therapy in 28 moderately to severely impaired chronic stroke patients and the following findings were reported (Housman et al., 2009):

- Better long term outcomes
- Significantly better outcome in motor ability (FuglMeyer) at 6 months follow up
- Increased motivation
- Patients were clearly in favor of Armeo therapy compared to conventional, self-directed therapy. It was described as “more beneficial” and “less boring” than conventional table-top therapy

Clinical benefits

- Reveals any remaining motor function
- Even moderately to severely impaired patients can practice independently and benefit from highly intensive, repetitive, self-initiated movement therapy
- The workspace is adjustable to the patients’ capabilities
- Patients with only trace motor function can integrate their remaining function into the intensive, engaging, functional exercises
- Optimum integration of arm, hand and wrist brings the whole movement chain into the therapy
- As a universal platform, the ArmeoSpring provides an interface to hand modules for patients with lower or higher functionality

“We are excited to see how upper extremity rehabilitation in stroke patients can be enhanced with this therapy. Our first clinical experiences are very positive.”

Sarah Housman
Occupational Therapist, Rehabilitation Institute of Chicago, USA

Armeo®Boom

Catching Fish: Using arm movements in the frontal plane, the patient has to catch the moving fish with the fishing net.

The ArmeoBoom is a product specifically designed for out-patient clinics and home settings. In these environments, it offers an optimal therapy solution for patients with mild to moderate movement impairments.

Like the other products in the Armeo Therapy Concept, the ArmeoBoom combines self-directed movement exercises with Augmented Performance Feedback and Assessment Tools driven by Armeocontrol software.

The product is based on research and development activities led under Prof. H. van der Kooij and Dr. A. Stienen at the University of Twente and Roessingh Research and Development in Enschede, the Netherlands.

Arm Weight Support

The ArmeoBoom has an overhead sling suspension system with low inertia to provide an adjustable amount of arm weight support and allow patients to perform self-directed, free movement exercises of the impaired arm in a large 3D workspace.

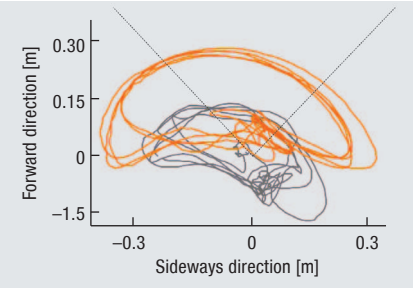
The system is lightweight and compact, easy to transport and to stow away, and quick and simple to set up.

Augmented Performance Feedback

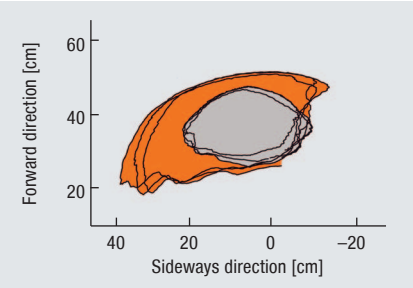
Once adjusted, the ArmeoBoom can be operated easily by the patient and the Armeocontrol software contains the same extensive library of game-like exercises utilized by the other products in the Armeo Therapy Concept. For the ArmeoBoom, the reach and retrieval exercises have an adjustable workspace and the patient can select horizontal or frontal movement planes or 3D movements.

Assessment Tools

The integrated Armeocontrol software supplies accurate assessments through the options A-MOVE and A-GOAL (please refer to page 3).



Without weight compensation
With weight compensation



Before training
After training

Active range of motion before and after 9 hours of training (6 weeks, 3 times 30 minutes) in the ArmeoBoom prototype. Stroke patient example, modified from Stienen, A. H. (2009)

Scientific results

Arm Weight Support facilitates active arm movement without impairing motor control or changing coordination patterns. It may therefore be a valuable way of increasing the intensity of training for mildly to moderately impaired patients.
(Prange et al., 2009).

Clinical benefits

Clinical evaluation of self-directed movement therapy in a group of chronic stroke patients, utilizing the ArmeoBoom with its overhead sling-based arm weight support, resulted in:

- significant improvement of the active range of motion
  (Stienen A. H., 2009)
- improved motor ability
  (Prange et al., 2009)

"I am convinced that a real limitation in rehabilitation could be overcome if we could encourage the active participation of the patients, and extend it over a prolonged rehabilitation period."

Prof. Dr. J.S. Rietman
Scientific Director Roessingh Research and Development, Enschede

The Armeo® Therapy Concept outlook

For optimum coverage of the needs of all patients across the Continuum of Rehabilitation, Hocoma is constantly working to improve and extend the Armeo Therapy Concept. We envision a modular toolbox with cross-platform compatibility and complementary solutions, including these future developments:

Grasping unit

For patients showing active hand opening and closing, this will be a fully passive system detecting the patient's voluntary hand movements. This grasping unit will also allow the integration of these active hand movements into the Augmented Performance Feedback.

FES module

For patients with increased flexor muscle tone and lack of voluntary grasping, this module will activate the muscles through electrical stimulation, supporting grasp/release exercises with Augmented Performance Feedback.

Robotic handle

For patients with a severely impaired grasping function, this will be an actuated hand module to support grasp and release exercises, and will be compatible with our ArmeoPower and ArmeoSpring products.

References

Housman S.J., Scott K.M. et al. (2009). "A Randomized Controlled Trial of Gravity-Supported, Computer-Enhanced Arm Exercise for Individuals With Severe Hemiparesis." Neurorehabil Neural Repair.

Prange G.B., Jannink M.J.A. et al. (2009). "Influence of Gravity Compensation on Muscle Activation Patterns During Different Temporal Phases of Arm Movements of Stroke Patients." Neurorehabil Neural Repair.

Stienen A.H. (2009). "Novel Devices for Upper-Extremity Rehabilitation." PhD Thesis, University of Twente, Enschede, The Netherlands.

Company profile

The leader in robotic rehabilitation therapy for neurological movement disorders

Hocoma is a medical technology company based near Zurich, Switzerland. The company develops innovative therapy solutions, working closely with leading clinics and research centers. Its product lines Lokomat®, Armeo® and Erigo® are all applied successfully in many renowned clinics and research institutes worldwide, improving the field of rehabilitation medicine.

Quality in all we do

Focused on improving functional rehabilitation therapy with innovative solutions, Hocoma develops its products in close collaboration with leading clinical and scientific partners. The company's experts work on high-level scientific advisory boards and within clinical networks to ensure optimum future developments and ongoing support. Hocoma is highly committed to both patients and clinicians in the field of robotic rehabilitation therapy. The company supports the field by offering clinical application workshops and trainings with certified instructors, and its products are supported by worldwide service and maintenance options.

Hocoma's complete product portfolio

The concept of "task-specific learning" based on neuroplasticity suggests that activities of daily living may be trained and improved through numerous repetitions and intensive training. At Hocoma, we are committed to support clinicians and patients in neuro-rehabilitation with innovative, high-quality therapy solutions. Our products are designed to optimize the quality and efficiency of the therapy and enhance the motivation of patients and medical staff.

Lokomat®

Functional locomotion therapy with Augmented Performance Feedback

Locomotion therapy supported by an automated gait orthosis on a treadmill has established itself as an effective therapy. The Lokomat is the first robotic gait orthosis that assists the walking movements of gait-impaired patients and is used to improve the mobility of individuals following stroke, spinal cord injury, traumatic brain injury, multiple sclerosis or other neurological diseases and injuries.

Armeo®

Therapy concept for the upper extremities

- ArmeoPower (end of 2011)
- ArmeoSpring
- ArmeoBoom

Erigo®

Patient mobilization and sensory stimulation in the early phase of rehabilitation

The Erigo is an innovative tilt table with integrated robotic stepping functions. It provides the opportunity for the patient to begin intensive movement therapy and physiological loading of the lower limbs at an early stage. It also offers the possibility of simultaneous up-righting of the patient.

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