# ottobock.

# The Michelangelo® Hand in Practice

Therapy and Rehabilitation





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# Training helps training to help

The AXON-Bus® prosthetic system in combination with the Michelangelo® Hand is an innovative development in upper limb prosthetics for transradial fittings. The Michelangelo® Hand offers entirely new gripping kinematics and a variety of new functions, which support the user in everyday activities.

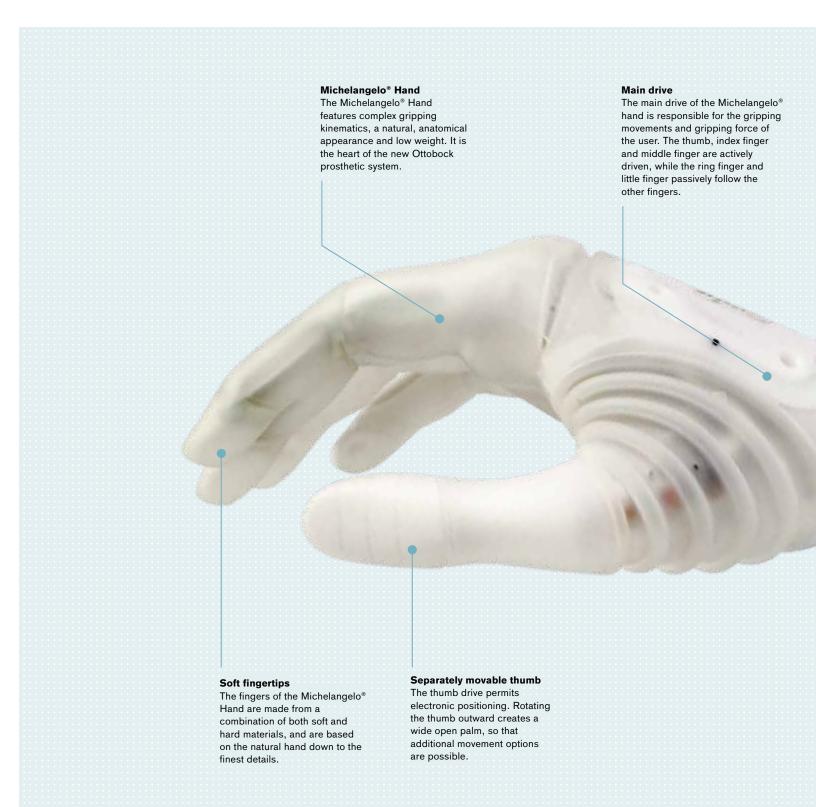
For user satisfaction and the success of the prosthetic fitting, it is crucial for the user to not only learn the fundamental operation but also the correct application of the new prosthesis. We're here to support you.

It's important that the exercises are performed in cooperation with a therapist (physical therapist/occupational therapist) and also be continued independently by the user at home. The more familiar the user is with the new prosthesis and its functions, the better he or she will be able to take advantage of all the new possibilities the Michelangelo® Hand offers.

This brochure serves as a guide for the therapist to set up and conduct the exercises with the user.

# Functional grips

# The Michelangelo® Hand—at a glance





natural. Flexion and extension

are based on the relaxed wrist

(flexible mode). Pronation and

supination can be passively performed by the user.

user can secure the wrist

joint in a desired position

it again.

(rigid mode) and/or unlock

### **Unique functionality**

Thanks to four movable fingers and a thumb that can be separately positioned using muscle signals, the Michelangelo® Hand offers innovative, never-before-seen gripping kinematics. In order to achieve a natural movement pattern, the hand is equipped with two drive units.

### **Extraordinary design**

In addition to the materials the fingers are made of, the Michelangelo® Hand features an innovative design. It won the 2011 German Design Prize, and was selected for a 2011 red dot product design award. A translucent glove even allows the user to show off the hand's fascinating design.

### A big plus



The Michelangelo® Hand constitutes a milestone in prosthetic fittings. Thanks to its special product characteristics, it offers fundamentally new application possibilities for the user, supporting incredible freedom of movement for everyday life. These new product characteristics are identified with a red "Plus" below.

Be sure to point out these new functions to the user and integrate them into the prosthesis training.





# Ease of use

# for multiple benefits

You will find basic information about the use of the Michelangelo® Hand in the sections that follow.

### Charging the battery

To charge the battery, the charging plug is connected to the charging receptacle with the help of an integrated magnet. The special contour of the receptacle and plug ensures that the two components are aligned quickly and easily. LEDs indicate the status of the charger and the current battery capacity.

### LED display for the current battery capacity

In order to display the battery capacity, briefly press the charging receptacle button (for less than one second): the LED display will light up and indicate the current battery capacity by color.

### Turning on and off

To turn on and off, press the charging receptacle for approximately one second. Two short audible signals will be emitted and the LED display will light up briefly to confirm that it has been turned on. An audible signal will confirm that it has been turned off.

### Activating the Bluetooth® function

When the prosthesis is turned off and the charging receptacle button is pressed for more than four seconds, the prosthesis Bluetooth® function will be activated: the LED display will flash blue.

### Opening the prosthesis in an emergency

To open the prosthesis in an emergency, press the charging receptacle for approximately seven seconds. The button should be pressed and held until the hand opens and the prosthesis turns off.

### Connecting/disconnecting the Michelangelo Hand from the socket

- Disconnecting the Michelangelo hand from the socket: turn off the prosthesis; push both release buttons on the wrist joint simultaneously.
- Connecting the Michelangelo hand to the socket: slide the Michelangelo hand onto the socket (locks automatically).

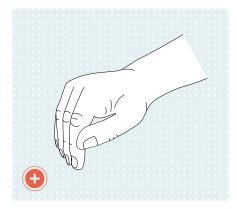
### **Care instructions**

- Cleaning the inner socket: Use DermaClean and a damp cloth.
- Care and cleaning of the glove: Regular cleaning with water and soap is usually sufficient to remove small amounts of dirt and keep the prosthetic glove clean. Heavier soiling can usually be removed with Ottobock Special Cleaner (640F12). (Further information: see the instructions for use).

### **Storage**

The user should ensure that the hand is always opened prior to storage.

### **Lateral Mode**



### **Lateral Pinch**

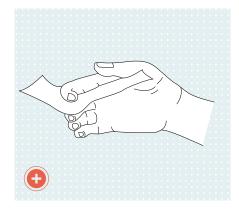
The thumb moves lateral to the index fingers so that the user can grip flat items from the side.



### **Lateral Power Grip**

The thumb moves laterally to the index finger: this allows the user to grip objects of medium size from the side.

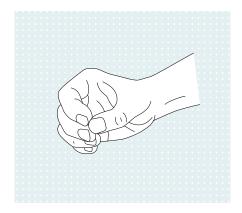
### **Lateral Mode+Opposition Mode**



### Finger Abduction/Adduction

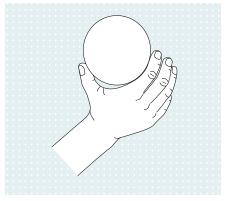
Finger adduction takes place when closing the hand. This allows the user to grasp flat objects between the fingers. Abduction takes place automatically when opening the hand.

### **Opposition Mode**



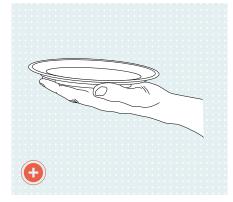
### **Tripod Pinch**

The thumb, middle finger and index finger form a three-point support - the user can hold small objects securely.



### **Opposition Power Grip**

The opening width allows the user to hold objects with a large diameter.



### Open Palm

In the open hand position, the thumb is at a far palmar location: the user achieves a flat hand position.

### **Neutral Mode**



### **Neutral Position**

Rest position with a natural, relaxed appearance.

# All around care with Michelangelo®

Ongoing support for the user is crucial for the successful use of the Michelangelo® Hand. Cooperation between all participants is vital: the doctor, therapist, prosthetist, the user, as well as the people he or she interacts with. Teamwork is the key!

The focus of this brochure is on rehabilitation. Successfully completing the preceding steps in the fitting process is a prerequisite.

The sequence and the specific steps for prosthesis training are described in greater detail below.



Therapy
Therapeutic measures
then follow with the
purpose of preparing
the user for a
prosthetic fitting.



Examination
A personal interview and thorough physical examination are carried out at the beginning of the fitting process.



Continuous control The fitting team maintains ongoing contact with the user.



Fitting recommendation

The user learns which prosthesis is most suitable for him or her, and what personal objectives can be pursued.



Measuring The prosthetist records the user's body measurements and takes a plaster cast.



### Production

In the next step, the custom prosthesis is fabricated for the user.



Trial fitting
During the trial fitting, the prosthetist adapts the prosthesis to the individual needs of the user.



Quality control
In the rehabilitation team,

the user discusses to what extent he or she is able to handle the prosthesis.



### Rehabilitation

Here the user learns how to correctly handle the prosthesis in daily life.

**Physical** Training







# Rehabilitation starts here

Harmonizing prosthesis training with the wishes, needs and personal situation of the user is absolutely essential for overall success. The following aspects play a crucial role:

Cause of the amputation, initial or subsequent fitting, unilateral or bilateral fitting, social environment, occupation, interests and hobbies—as well as motivation and physical condition at the outset—are all important factors for fitting success. In order to achieve the best possible fitting results, consult with the interdisciplinary team and—if possible—also involve family members. Before training actually begins, a detailed diagnosis is required; general and specific information about the affected side will be asked for and subsequently verified (case history and diagnosis).

### Case history and diagnosis

•	•
General information about the person	Body weight, body size, date of birth, handedness, occupation, recreational activities, environment, locomotion, etc.
Information on the affected side	Unilateral or bilateral, amputation level, residual limb length, etc.
General state of health	Heart disease, circulatory disorders, cancer, dizziness, allergies, pain and other complaints, other diseases, limitations of functionality, devices, medications, etc.
Information on the affected side	Amputation or congenital deformities (dysmelia), pain, phantom pain, residual limb load bearing capacity, sensitivity, soft tissue coverage, scarring, joint diagnosis, contractures, muscle status, volume, etc.
Abnormalities of the contralateral side	Pain, sensory disturbances, skin condition, joint diagnosis, muscle status, etc.



# Professional prosthesis training

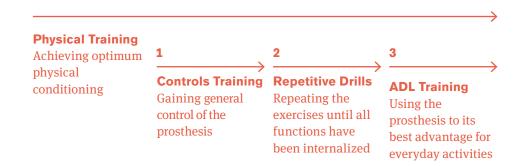
# in three phases for success

The therapy and rehabilitation concept for the Michelangelo<sup>®</sup> Hand has been designed by the following external and internal experts: Eli Færevaag Jacobsen (Norway), Liselotte Norling Hermansson (Sweden), Shawn Swanson Johnson (USA); and Daniela Wüstefeld, Annette aus der Fünten, and Dr. Andreas Kannenberg (Germany).

> For optimum results, prosthesis training is divided into three phases that build on each other. In each phase, you should practice with the prosthesis user and motivate him or her to train independently until he or she feels confident and is able to use the Michelangelo® Hand reliably.

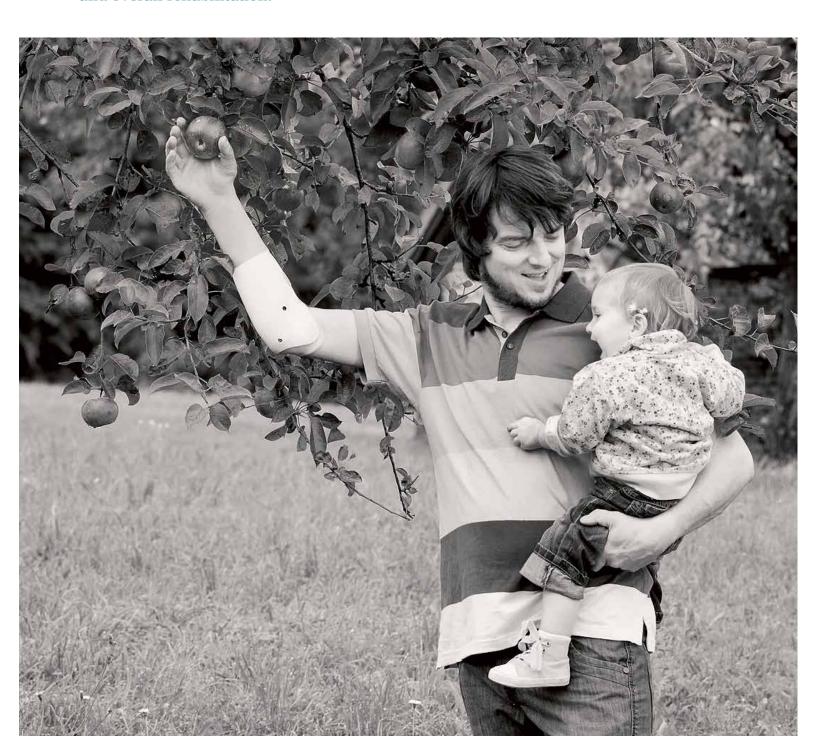
> It is important to begin the training units with simple exercises, only transferring the applications to everyday life gradually. Focus on experiencing success! This prevents the user from demanding too much of him or herself and getting frustrated.

Physical training should take place before, during and after the prosthetic fitting.



# Finding the right way training principles

Optimum mental and physical conditioning is an important prerequisite for prosthesis training. Incorporating work, hobbies and personal interests is helpful in order to tailor prosthesis training to the needs of the user—for the successful use of the Michelangelo® Hand and overall rehabilitation.



### **Training duration**

Prosthesis training must be adapted to the needs of the user. Important factors for initial as well as subsequent fittings include: experience, physical conditioning, individual wishes and the personal pace of learning.

### **Training success**

It is important to repeat the exercises in each phase until the user has achieved the learning objective to at least 90 percent (and ideally 100 percent) in terms of accuracy and consistency. Should the user plateau at a low level in any phase, discussing the matter in the interdisciplinary team is recommended. This allows the current situation to be jointly evaluated—and to determine which steps should be recommended to the user.

### **Training focus**

The overall body posture and mental state of the user should be observed throughout the course of training: is the user relaxed and able to concentrate during the exercises, or overtaxed? Does the user tend to assume positions that may become painful? Does the user require more encouragement, or should he or she slow down until all movements are familiar?

### **Training variations**

Different training variations are available to systematically practice the controlled and precise application of the prosthesis with the user. This prevents the user from losing confidence or triggering unintentional movements.

### Initial positions

It is best to begin the exercises in a sitting position. To increase the level of difficulty, have the user perform the exercises in a standing position, then while walking, and finally while walking on uneven surfaces.

### Support

The user can initially support the prosthetic arm on a table or in his or her lap.

### · Axes and planes

Get the user to complete the exercises in various axes and planes: for example close to the body and far away from the body, with or without crossing the center of the body and at various heights—overhead, at the sides of the body or close to the ground.

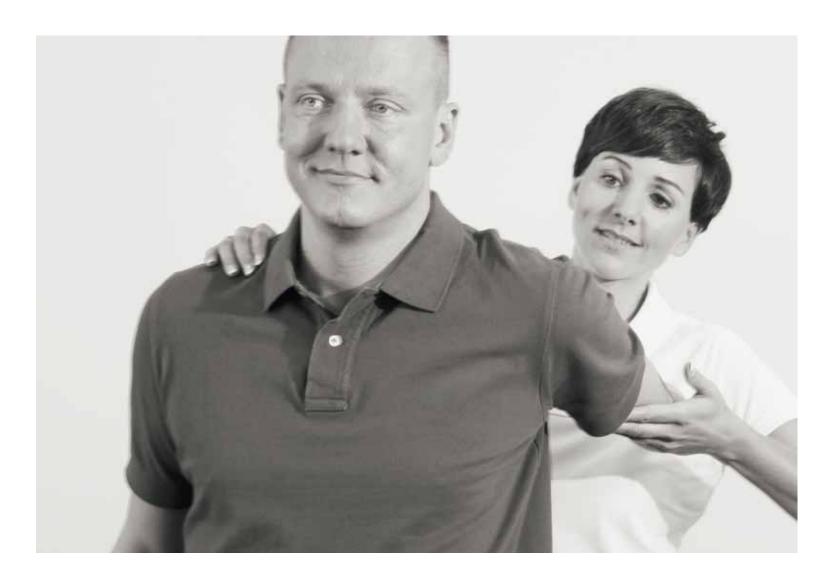
### Visual verification

At first the user completes the exercises with visual verification (by looking at the prosthetic hand). Let the user know that the training goal is to complete the exercises with as little visual verification as possible ("automatic" gripping and releasing without looking).

### · Gripping force and gripping speed

As training progresses, encourage the user to complete familiar exercises with a grip force and speed adapted to the respective situation and object.

# **Physical Training**







### **Establishing a foundation**

Trunk stability is a key factor for prosthesis control. Physical training before, during and after the prosthetic fitting prevents secondary problems, boosts self-confidence and improves the user's perception of his or her body. Physical training should begin even before the prosthetic fitting, as

preparation, and should then continue with the prosthesis after the fitting. Always focus on the following factors during physical training:

- User posture
- Coordination and balance
- Strengthening the muscles

### **User posture**

Assist the user in avoiding compensatory movements. Work with the user during all exercises in order to consistently maintain a physiological body posture (which is also the most relaxed).

Instruct the user to check his or her own posture as often as possible with the help of this information—as well as with a mirror. Over time the user will increasingly get a better feel for this and heighten his or her self-awareness. This helps the user more easily achieve a relaxed, comfortable body posture so it gradually becomes a matter of course. Questions to consider:

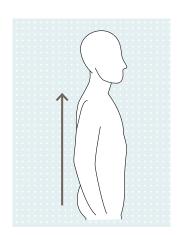
- a) Is the body posture upright?
- b) Is the body weight distributed evenly between both legs?
- c) Is the spine rotated as little as possible or not at all?
- d) Are both shoulders at the same height?

### Coordination and balance

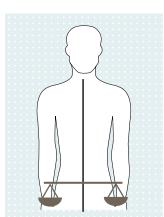
The human body attempts to compensate for the missing weight of an amputated arm. As a therapist you know that wearing a prosthesis changes the body pattern again, and this can also affect balance. The user's physical balance is improved through coordination exercises, during which you support the user. Exercises on uneven surfaces and training with the balance board are particularly well suited for this purpose.

### Strengthening the muscles

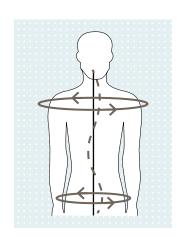
Exercises to strengthen the trunk muscles can, for example, be completed with a flexible strap (Theraband). Regular and long-term training is very important in all cases in order to achieve sustained success. Motivate the user to build up endurance with the exercises—and to participate in sports as well.



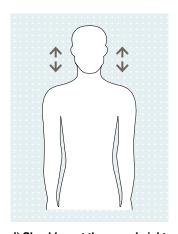
a) Upright, straight posture



b) Balanced stance



c) Avoid rotation of the upper body and spine



d) Shoulders at the same height (avoid raising)

# 1. Controls Training





### **Gaining control**

In Controls Training, you first familiarize the user with the passive functions and Neutral Mode. Then you help the user in learning the active modes and their functions (through instructions, without objects at this point).

You can also begin this training unit with the AxonSoft software. The goal of Controls Training is for the user to learn how to precisely control and efficiently use the Michelangelo® Hand (this means that the user gains "control" of the prosthesis).

### **Training prerequisites**

Before the actual start of training, you should provide the user with basic information about the new prosthesis. Familiarize the user with donning and doffing the prosthesis, turning the system on and off, the energy supply and the charging process. The myo-test to evaluate the EMG signals on the residual limb is a fundamental prerequisite to individually tailor the hand program and switching mode to the respective user.

### 1.1 Training the passive functions

### Flexion and extension



The wrist joint offers mechanical flexion/extension and unlimited rotation. Starting from the neutral position, the joint can be flexed approximately 75 degrees with five ratchet positions, while extension is approximately 45 degrees with three ratchet positions.

### Flexible mode of the wrist joint



Flexible mode simulates the natural movement characteristics of a relaxed wrist joint. This mode is selected by pushing and holding the lock button until it engages. Now the joint can be moved without engaging at the ratchet positions. Pushing the button again terminates flexible mode and the wrist joint engages at the next available ratchet position in rigid mode.

### Rigid mode of the wrist joint



If the lock button is only pressed lightly and not to the stop, the user can bring the wrist joint to the desired locking position. Upon releasing the lock button, the wrist joint engages at the next available position. The most important training goal is for the user to be able to use the flexible and rigid modes of the Michelangelo® Hand depending to the situation—in other words, to have no problems using the flexible wrist joint and the locking mechanism of the wrist joint for everyday tasks.

### Rotation

The Michelangelo® Hand can also be rotated manually 360 degrees—with no limitations. For rotation, the user can select from and switch between 24 ratchet positions spaced every 15 degrees.

### Objective

Gaining general controlthrough exercises without objects

### Recommendation

### **Position**

Begin exercises in a sitting position, then continue while standing.

### Methods

The user copies the movements of the therapist.

### Check

Avoid compensating movements and mechanisms.

### Duration

From 30 minutes per therapy unit, up to several units per day.

# 1.2 Training the active functions

# 1.2.1 Training Lateral Mode

10 repetitions each

### Recommendation

Start training in Lateral Mode, followed by Opposition Mode (especially important for experienced users).

### Tip

Deactivate Neutral Mode in AxonSoft at the outset.



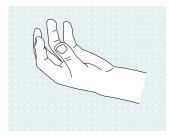


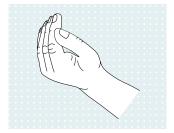
Fully opening and fully closing the hand at maximum speed





Half opening the hand, then fully opening the hand, at low speed





Half closing the hand, then fully closing the hand, at low speed

This is followed by combinations of various tasks.

# 1.2.2 Training Opposition Mode

### Recommendation

It is possible to switch modes in the software with a click of the mouse - without the user having to actively do so.

### Tasks (same as for Lateral Mode)

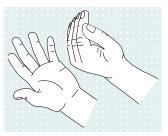
10 repetitions each

## 1.2.3 Training switching between modes

Between Lateral Mode and Opposition Mode

### **Tasks and situations**

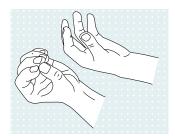
In Lateral Mode, switching to Opposition Mode



Opening and closing in Lateral Mode



Switching modes



Opening and closing in Opposition Mode

This is followed by various combinations of the mode, initial position and speed.

## 1.2.4 Training Neutral Mode

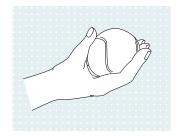
Neutral Mode has to be activated in the software



Shaking hands, waving, patting on the back, etc.



Clapping the hands



Offering something held in the opened

### ▶ Has the goal been reached?

- 90-100% control over the prosthesis achieved?
- Compensating movements and mechanisms minimized?

# 2. Repetitive Drills





### **Gaining confidence**

In this phase, the user practices gripping and releasing various objects in different planes and axes. The hand positions in Lateral Mode constitute entirely new functions and should be selected as the standard mode. When choosing the objects, be sure to select

the greatest possible variety in terms of size, shape, surface characteristics and resistance. The user has to practice and repeat the exercises many times in order to internalize the functions and control of the Michelangelo® Hand.

# 2.1 Training the various modes and hand positions

### Objective

Frequently repeating the exercises with objects

objects (no adjustment of gripping force required), then switch to

### Check

movements and mechanisms!

### Hand positions

The Lateral Power Grip and Lateral Pinch offer the greatest benefits for

### **Variations**

order to prevent compensating movements.

### **Duration**

From 1 to several hours/day.

Functional games that require the frequent repetition of certain movement patterns, e.g. solitaire or memory.

### Recommendation

### Objects/materials

Start with heavy, large, solid smaller, lighter, softer objects.

Watch for compensating

the user!

Incorporate extension, flexion and especially the flexible wrist joint in

### ▶ Has the goal been reached?

- · Does the user understand the functions of the Michelangelo® Hand, and is the user able to execute them 90-100 %?
- Compensating movements and mechanisms minimized?

### **Tasks**

Gripping and releasing various objects in different modes and hand positions



**Building blocks** 

various shapes and sizes



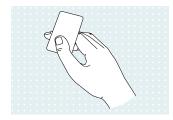
Full water bottle

gripping a solid object with a larger diameter > controlled gripping force



Pencils and pens

small diameter, smooth surface > precise gripping



Card game, credit cards

flat object with smooth surface > precise gripping

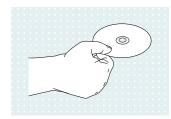


Soft ball

yielding object > adjustment of gripping force

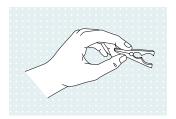


delicate material > adjustment of gripping force



**CDs** 

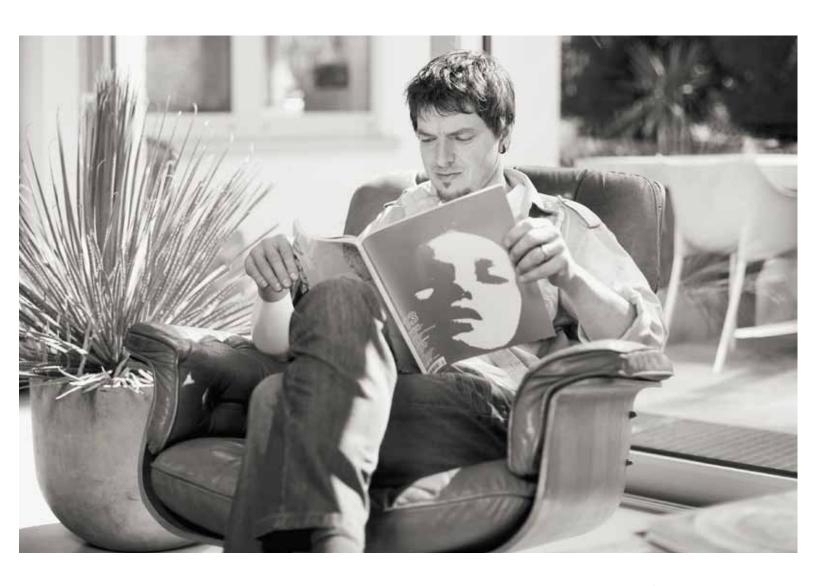
flat object > precise gripping



### Clothes pins

Tip: therapy clips with different spring force (manufacturer from the USA)

# 3. ADL Training: Activities of Daily Living





### Learning for everyday life

ADL stands for "Activities of Daily Living." In the course of ADL training, the therapist and the user should discuss which activities and exercises are most important to the user in

his or her private and work environments. Be sure to take the wishes and needs of the user into account when establishing the training program. Begin with three to five activities.

### Objective

The user is able to use the prosthesis confidently and to its best advantage in everyday life. He or she achieves maximum autonomy and independence.

### Recommendation

### **Objects and materials**

Choose training objects according to the individual work and home situation of the user.

### Three new tasks/training units

The exercises should be repeated at home. Increase the daily duration of use for the prosthesis up to full integration in everyday life.

### **Motivation counts**

Motivate the user to repeat the exercises independently as "homework"—with objects used in daily life. Build on this foundation with the next exercises in the subsequent therapy session. Add another three activities to the program.

The personal motivation of the user and the corresponding experiences of success play a crucial role in the training progress. Always ensure that the exercises meet the needs of the user and his or her personal situation—during leisure activities and sports (social component), too. There is no single right solution for training and implementing the exercises. The user can always choose from several options. He or she can decide which mode and which hand position are best suited for the respective situation. Select unilateral as well as bilateral exercises in order to develop the coordination of both hands.

### Sequence of the exercises

For easier orientation, the ADL training exercises in this brochure are grouped by the various modes and hand positions offered by the Michelangelo® Hand. In the course of training with the user, you can combine the exercises in any desired sequence. Ideally the user will assign them to the everyday situations and activities that are relevant for him or her (dressing and undressing, eating and drinking, workplace activities, leisure time, personal hygiene, etc.). The degree of difficulty should be increased from simple exercises (such as folding a towel) to more demanding tasks (such as preparing meals).

## 3.1 Lateral Mode

Lateral Power Grip, Lateral Pinch and Finger Abduction/Adduction

### **Lateral Power Grip**

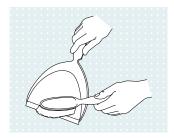


The thumb moves laterally to the index finger so that objects of moderate size are gripped sideways.









Holding toothpaste

Ironing clothes

Using a hand broom and dustpan

### **Lateral Pinch**

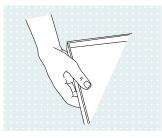


The thumb moves laterally to the index finger so that flat items are gripped from the side.









Holding a wallet

Reading a newspaper

Holding and carrying a tray

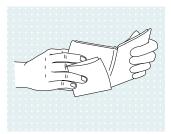
Finger abduction/adduction is also possible in Opposition Mode!

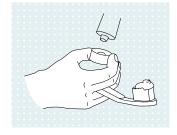
### Finger Abduction/Adduction



Spreading the fingers allows several flat, thin objects to be held between the fingers.







Holding banknotes

Using a credit or business card

Holding a toothbrush and toothpaste

## 3.2 Opposition Mode

Opposition Power Grip, Tripod Pinch, Open Palm and Finger Abduction/Adduction

### Recommendation

The prosthetic hand is almost always used to secure the object.

### **Opposition Power Grip**

The opening width allows the user to hold objects with a large diameter.





Opening a bottle and holding a glass



Grasping and holding a tennis



Opening and holding a cream container

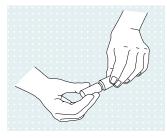
### **Tripod Pinch**

The thumb, middle finger and index finger form a three-point support to hold small objects securely.





Opening a cereal bar



Using lip balm



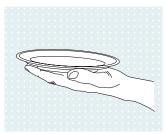
Lifting the lid off a pot

### **Open Palm**



In the open hand position, the thumb is spread away from the palm so that a flat hand position is achieved.

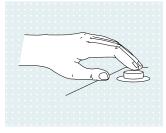




Carrying a plate



Holding a large ball with both hands Pressing a button



### 3.3 Neutral Mode

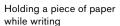
### **Neutral Position**

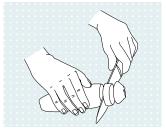


Natural, physiological appearance in the rest position.









Holding bread or vegetables while cutting



Putting on clothes

### **New freedom of movement**

Is the user successfull in doing all ADL exercises? Keep motivating the user to gradually integrate the training units into everyday situations: at work, at home and during leisure activities. Your support and motivation count! It is important that the user becomes acquainted with all of the ADL exercises—and thus all the movement possibilities of the Michelangelo® Hand. This allows the user to decide which movements are most important for his or her daily life, which in turn will determine which exercises and training units will be used most.

Always allow the user to practice the ADL exercises as long and intensively as is beneficial—so that the user is motivated to also continue training on their own. Experiencing success is important! Through this process, the "exercises" soon become entirely natural movement patterns that get progressively easier for the user. With your help, the user will become more independent and gain new freedom of movement with the Michelangelo® Hand.



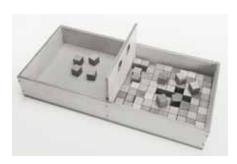
- · Are all of the benefits of the prosthesis being utilized during activities of daily living?
- Has the user achieved maximum autonomy and independence?



# Measuring results,

# enjoying success

Various standard tests can be used at any time in order to document training progress and the successes achieved by the user. Such documentation rewards the user and encourages him or her to continue training consistently. Examples of such standard tests:



### **Box and Blocks Test**

A motor function test for the upper limbs: the test task for the user is to move as many blocks as possible from one compartment in the box to the other compartment in 60 seconds.



### **Clothespin Relocation Test**

For the clothespin test, you need the "Rolyan Graded Pinch Exerciser": How quickly does the user move three therapy clips from the horizontal to the vertical rod?



### **SHAP Test**

For the "Southampton Hand Assessment Procedure" (SHAP), you need the SHAP kit equipped with eight abstract objects and 14 objects for ADLs (Activities of Daily Living). How long does it take the user to complete certain exercises? This measures the user's efficiency in using the prosthesis.

Another standardized clinical assessment is the Assessment of Capacity for Myoelectric Control (ACMC) designed by Liselotte Norling Hermansson and Helen Lindner. The assessment is based on the video-observation of a person's ability to operate a myoelectrical hand while performing an ADL (www.acmc.se).

### Follow up regularly

Stay in touch with the user. Follow up regularly, check the prosthesis settings and conduct tests to measure the user's successes over the long term and to ensure that he or she is satisfied.



### Transition to daily life

The Michelangelo® Hand features a wide range of functionality. However, the most important thing is that the user feels safe while using it and learns to use the hand positions and movement patterns to the best possible advantage. Once they have reached a certain level of proficiency, users can practice independently at home. By doing so, they quickly gain even more confidence in using the Michelangelo® Hand. In addition to therapeutic support in the training units, practical exercises are also available on DVD. This can accelerate the user's ability to participate in life more actively and naturally.



For further information, please visit the Michelangelo® microsite:

www.living-with-michelangelo.com