



**ottobock.**

# Myo Plus pattern recognition in practice

Therapy and training brochure  
for fast and easy use

Quality for life

Information for qualified personnel





# Myo Plus pattern recognition

The new Myo Plus pattern recognition system detects, measures and displays the individual movement patterns of muscles in the forearm that can be used to control the prosthesis. Myo Plus control simplifies operation of the prosthesis and its multiple components, which streamlines the fitting process for patients, therapists, and O&P professionals.

The following training guide is designed to help qualified personnel learn how to use this new technology easily and efficiently.

# The Myo Plus System

## **Pattern recognition allows for easy, natural and customized control of the prosthesis**

Myoelectric prostheses generate movements of the hand via muscle activity in the residual limb. Unlike a conventional system, which uses only two specific myo sites for control, the Myo Plus system uses up to **eight pairs of electrodes that are positioned circumferentially in the socket**. This allows for the analysis of all forearm muscles working together, which results in the creation of individual patterns to control each specific function of the prosthesis. These patterns are generated by cueing the user to perform various movements with their phantom limb.

The movement patterns are then recorded via an app using a simple imaging process in which the desired phantom hand movement is assigned to a specific prosthetic function. The patient is given the freedom to determine which movements feel most natural to them, and which components the patterns created by these movements should be assigned to control.

## **What are the advantages?**

- Customized and intuitive control of the prosthesis
- Enhanced proportional control
- Ease of operation; no switching mechanisms required to change grips or components
- Direct access to grips results in faster operation
- Movements are easy to learn with visual feedback provided through the Myo Plus app
- Settings, feedback, and training are also provided through the app



# Myo Plus training

Training is easy with the Myo Cuff and Myo Plus app. The Myo Cuff contains all components necessary for identifying movement patterns that result from muscle activity in the residual limb. The app displays these patterns on a tablet or smartphone in a spiderplot graph, thus serving as a “window” into the control scheme of the prosthesis.

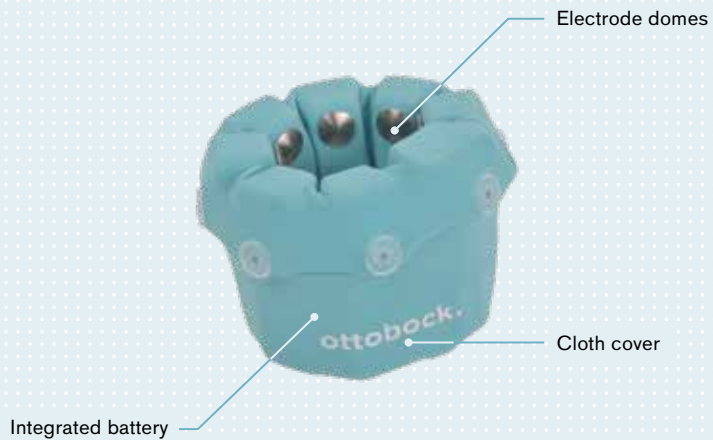
## What is required?

- Functional muscle movement in the residual limb
- An understanding of the new control system
- Tailored training to customize control of the prosthesis
- A Myo Cuff or finished prosthetic socket with integrated MyoPlus system
- A smartphone or tablet with the corresponding Myo Plus app\*\* (Android or iOS)

\* See Myo Plus technicians brochure

\*\* See Myo Plus App Quick guide

## Myo Cuff



## Myo Plus app



# A Myo Plus fitting – a simple process

## **Who is Myo Plus suitable for?**

- Transradial level myoelectric prostheses with active or passive wrist rotation
- Congenital or traumatic etiology
- Patients who have difficulty separating signals with conventional 2-site control
- Experienced or new myoelectric users

## **Which Ottobock prosthetic hands are compatible with Myo Plus?**

- bebionic
- Myo VariPlus Speed
- SensorHand Speed
- Greifer electric hook
- See IFU for all compatible terminal devices

## **What is the process?**

1. Initial session
2. Evaluating the phantom sensation
3. Evaluating the movement patterns with the Myo Cuff
4. Training and testing patterns
5. Creating the basic set
6. Prosthesis training





1 Initial session

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2 Evaluating the phantom sensation

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3 Evaluating the movement patterns with the Myo Cuff

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4 Training and testing patterns

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5 Creating the basic set

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6 Prosthesis training

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# Initial session

The initial session includes an assessment of the residual limb, and provides preliminary information about training with Myo Plus. Nerve damage and muscle degeneration or transfers can reduce the number of possible movement patterns.

## **Residual limb assessment:**

- Length
- Strength
- ROM
- Sensation/Nerve condition
- Skin condition
- Discover if phantom sensation is present



# Phantom hand movement

## Phantom hand movement

Before starting Myo Plus training, evaluation of phantom sensation must be completed. Unique and repeatable movements of the phantom hand create the necessary foundation for the Myo Plus system and make training easier for the patient. Enhanced perception and movement of the phantom hand leads to greater selection of possible movement patterns. In patients with congenital etiology, phantom sensation will not be present. Therefore, different types of cueing to elicit movement patterns will be required. For example, “show me the different ways you can move your limb”.

## Utilizing motor imagery, have the patient picture ...

- ... extending and flexing the wrist
- ... opening and closing the hand
- ... extending and flexing fingers II–V, together and individually
- ... thumb movements, including abduction, opposition, and flexion
- ... pronating and supinating the wrist

Find out to what extent each of these movements can be done. Try performing the movements in a slow and mild manner, then also fast and strong. Slight differentiations can be added to each phantom movement, such as during wrist pronation, leading more with the thumb.

To get a better idea of the patient's current perception of the phantom hand, have them show you (if possible) the extent to which they can perform the movements with the contralateral side.

If necessary, start training the phantom sensation before beginning the evaluation of the movement patterns. Mirror therapy is one way to do this.



Example: supination



Example: extending the fingers

# Evaluating the movement patterns with the Myo Cuff

Movement patterns are created by individual muscles working together in the residual limb, and are later used to control the prosthesis. They are recorded by the Myo Cuff and displayed via the app in the spiderplot graph.

The number of movement patterns required depends on the type of componentry used in the prosthesis. There are prosthetic hands that are limited to opening and closing the hand in one single grip pattern, which would require only 2 patterns (1 for open, 1 for close). Others offer multiple grips patterns which would require 1 for open, but multiple patterns for closing in various grip patterns. In addition, active rotation of the wrist can be integrated. Two more patterns would then be required, one for pronation, and another for supination.

The evaluation of the movement patterns can be started even if the details of the future prosthesis have not yet been determined.

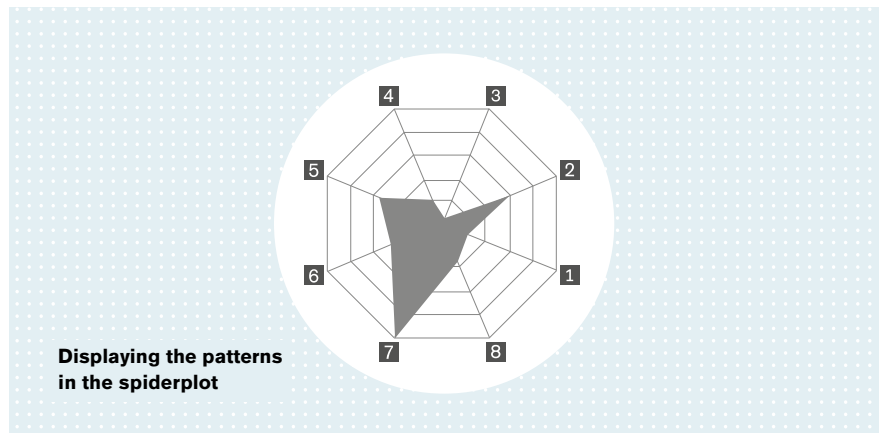
## Process

Please note the attending Certified Prosthetist who is qualified in Myo Plus needs to be present for the initial evaluation of movement patterns so the socket can be designed correctly, and the proper componentry can be selected.

Start with the [evaluation of patterns for “Open hand” and “Close hand”](#). Place the Myo Cuff on the patient’s residual limb. Ensure that the ulna is located between two pairs of electrodes (ideally #1 and #8) and that all electrode domes are placed against the skin. After connecting to the app ( see [Myo Plus app quick guide](#)), you can observe the movement patterns on the spiderplot graph.

1. Ask the patient to produce their [individual “Open hand” phantom movement](#). Have them demonstrate the movement (if possible) simultaneously with the contralateral side. Note positional details (e.g. wrist position, thumb position, degree of finger extension)

If your patient is already an experienced myo user, they may be inclined to use their **familiar pattern** of wrist extension to open the hand. Ask if they want to continue using that or switch to a more natural pattern (for example, finger extension as shown in this picture). Myo Plus aims to use intuitive, simple and repeatable movement patterns for control of the prosthesis in order to restore a more natural feel for operation. However, the patient is free to determine what patterns are most intuitive for them.



### Step 3 / Evaluating the movement patterns with the Myo Cuff

2. When you have agreed on a movement pattern, look at the [display of the pattern in the spiderplot](#) together with the patient to get an idea of which muscles/electrodes are relevant for this movement.\*
3. Use the same procedure for “[Close hand](#)”.
4. Now observe the movement patterns in the spiderplot while alternating between “[Open hand](#)” and “[Close hand](#)” and answer the following questions:
  - a. Do the two patterns have a different visual appearance? Are they pointing in different directions?
  - b. Does the pattern for “[Open hand](#)” (or “[Close hand](#)”) look the same when it is repeated?

If you can answer both [questions with “Yes”](#), continue with the remaining movements (for the wrist if applicable) in the same way.

If the answer to [question \(a.\)](#) is “No”, it is possible that the patterns are too similar to be clearly recognized. If you are unsure, create a test set to evaluate the patterns ( see page 19) and, if necessary, choose another phantom movement to create a different pattern.

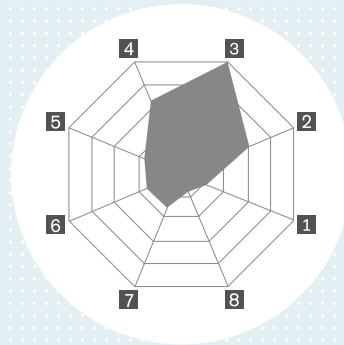
If you answered [question \(b.\)](#) with “No”, give the patient verbal guidance when making the movements or demonstrate the movement with your hand. It can also be easier for the patient to carry out the phantom movement with the contralateral hand as well.

\* The assignment of the pattern to the electrode numbers depends on the arrangement in which you applied the Myo Cuff.

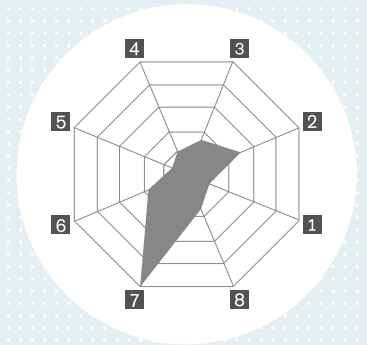




**Example of distinct movement patterns:**



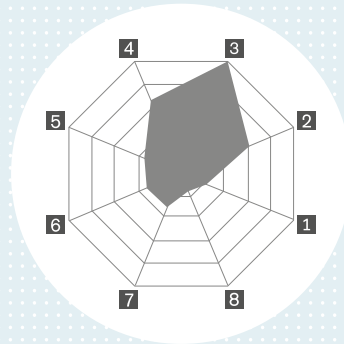
Movement pattern for  
"Open hand"



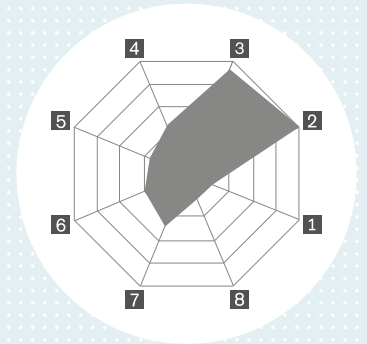
Movement pattern for  
"Palm down"



**Example of indistinct movement patterns:**



Movement pattern for  
"Open hand"



Movement pattern for  
"Palm up"

## Tips

- After an amputation, natural movements can oftentimes be easily imagined in the mind and carried out by the remaining muscles.
- If the amputation occurred a long time ago, some movements may be difficult to complete, or may be absent all together. Mirror therapy and motor imagery can assist in developing unique movement patterns, and promote repetition of these movements to improve consistency and repeatability.
- Some users who are experienced in using conventional two-channel control have become accustomed to the wrist extension and flexion patterns they have learned for controlling the prosthesis. Unless circumstances indicate otherwise, these two movement patterns can continue to be used for “Open hand” and “Close hand”.

5. Evaluate the movements “Open hand” and “Close hand” and if active rotation is used, also “Pronation” and “Supination”.\*

Visually evaluate all four movement patterns in the spiderplot for repeatability and distinctiveness.

6. If you want to evaluate **other movements**, e.g. pinch grip in a bionic hand, use the same procedure. Work together with the patient to decide on a phantom movement that produces an intuitive pattern for the chosen grip. Also compare this pattern with the previous ones in the spiderplot.

\* With mature amputations, oftentimes the rotational movements of the forearm are weaker, as the muscles controlling these movements have rarely been active. The intensity of movement patterns plays a small role in pattern recognition. However, it is important to establish two unique patterns for pronation and supination. Adjusting the intensity of the performed phantom movement may help keep these patterns unique. Adding a slightly different action to the pattern can also help, such as leading pronation with thumb adduction, and ending supination by increasing flexion of the 5th digit.

# Training and testing patterns

## Recording a Test Set

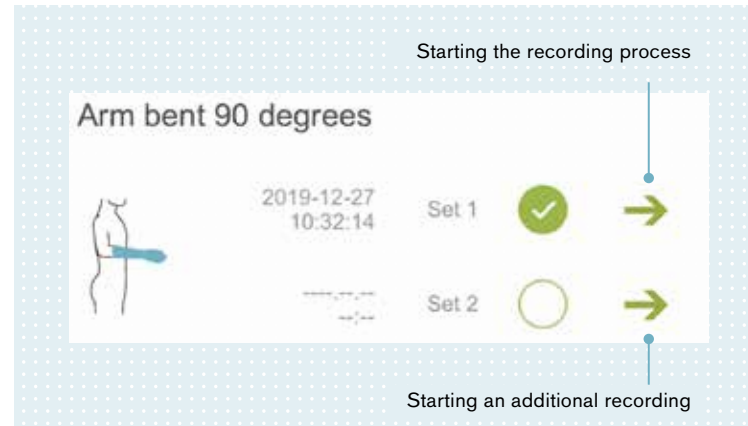
After evaluating the movement patterns, they are recorded twice and saved for testing. This is called a test set, and is done to make sure patterns are unique and reliable before performing all 6 recordings for the basic set. The test set is created under menu title “Basic Set”, while in Clinician Mode. Clinician mode can only be accessed by certified O&P professionals with the required username and password (please consult the attending Certified Prosthetist should the need arise to enter Clinician Mode).

Select the “90-degree flexion” arm position (see picture) and start the recording process by clicking on the green arrow in Set 1.


Each recording series consists of 5 movements in sequence:

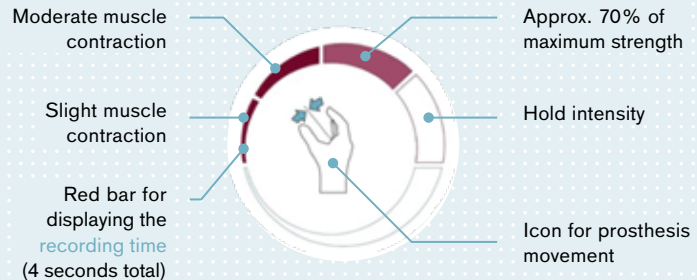
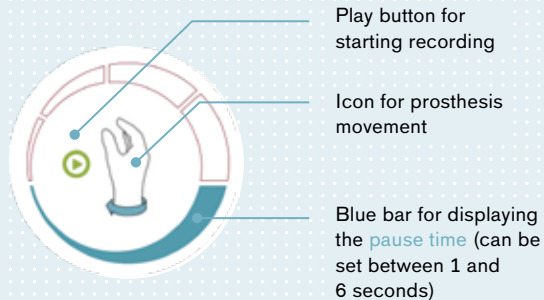
- Relaxed
- Open hand
- Close hand
- Palm Up (Supination)
- Palm Down (Pronation)

Record these movements a second time for Set 2 following the same process.



### Process for recording movement patterns

1. Ensure that the arm is in the desired “90-degree flexion” arm position.
2. Start the recording by clicking on the  icon. The pause time then starts running. Prepare the patient for the subsequent movement during this time. If necessary, mirror the corresponding pattern with your hands.
3. When the pause time is over, the movement pattern corresponding to the icon displayed for the prosthesis movement should be produced. The patient begins by contracting the muscles slightly and increases the intensity as the recording period progresses (see image at the right). After completing the recorded movement and all bars have filled with red, the blue pause time starts again in preparation for the next movement pattern.



## Tips for recording

- The patient sits (without resting the arm on the table) or stands with the arm flexed at 90 degrees. The muscles in the forearm are initially relaxed. This relaxed position is also recorded as a pattern (“Relax”).
- Have the patient carry out the movement patterns with both the phantom hand and contralateral hand in order to check the execution of the movement. If you see deviations in the movements from the previous evaluation, discuss this with the patient after finishing the recording series. If necessary, delete this recording or record over it by clicking again on the green arrow.
- Movement patterns can be evaluated in the spiderplot only after the test set is created.
- Ensure that the forearm muscles are relaxed during every pause session between the movement patterns.
- A recording series will not start until movement is detected in the limb, and ends automatically after the last recorded movement.
- The recording can be paused if necessary. This can be done during any pause session by clicking on the “Pause” icon. The current recording series can be cancelled at any time by clicking on “Cancel recording”. After two series have been successfully recorded, save the movements by scrolling down and clicking on **Creating a test set**

## Evaluating the test set

After the test set is created, the recorded patterns are saved in the Myo Cuff or prosthesis (until the next time it is switched off). The patient can now test the control in real time. View the movement patterns displayed in the spiderplot. They are outlined in colors that correspond to the colored hand movement boxes which are seen by scrolling below the spiderplot.

Assess the control of the prosthesis together with the patient:

- a. If **it is working adequately**, you can continue on to creating the basic set. Adequately means: The prosthesis generates the desired functions, and the patient has few or no problems carrying out the saved movement patterns. You can determine this in two different ways: using the spiderplot and/or the movement display (see pics on next page).

Ask the patient to carry out a certain movement:

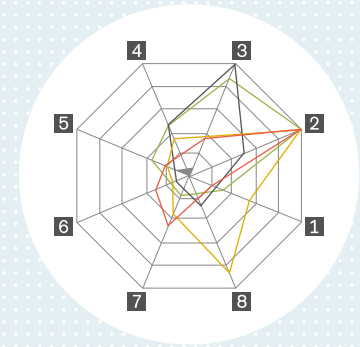
- Check if the pattern outlined on the spiderplot in the corresponding color fills with gray in a shape closely resembling the outline.
- You can also swipe left to see the movement display; check that the icon shown matches the desired movement. If the picture stays solid, the pattern is sufficient. If you see flickering of this icon between 2 different movements, there is overlap with these patterns and they should be reassessed.

Tips:

- Note the quality and speed of execution.
- Remember that this is a completely new feeling for the patient and requires a great deal of concentration.
- Take breaks as necessary to prevent muscle fatigue.
- Test all recorded movements in this manner.

b. If control of the prosthesis is not working adequately, there could be several causes:

- An incorrect pattern was produced during recording  
Remedy: Record the pattern again.
- The patient is unable to reproduce the recorded pattern or can only do so with difficulty.  
Remedy: Practice the patterns with the patient again and discuss the details of the patterns once more. Record the patterns again only after they have become consistent for the patient.
- The prosthesis responds with incorrect functions.  
Remedy: Practice the patterns with the patient again. If necessary, vary individual patterns.
- Patterns are too similar/not distinct enough.  
Remedy: Define other patterns for the respective movement.



Saved movement patterns in the spiderplot

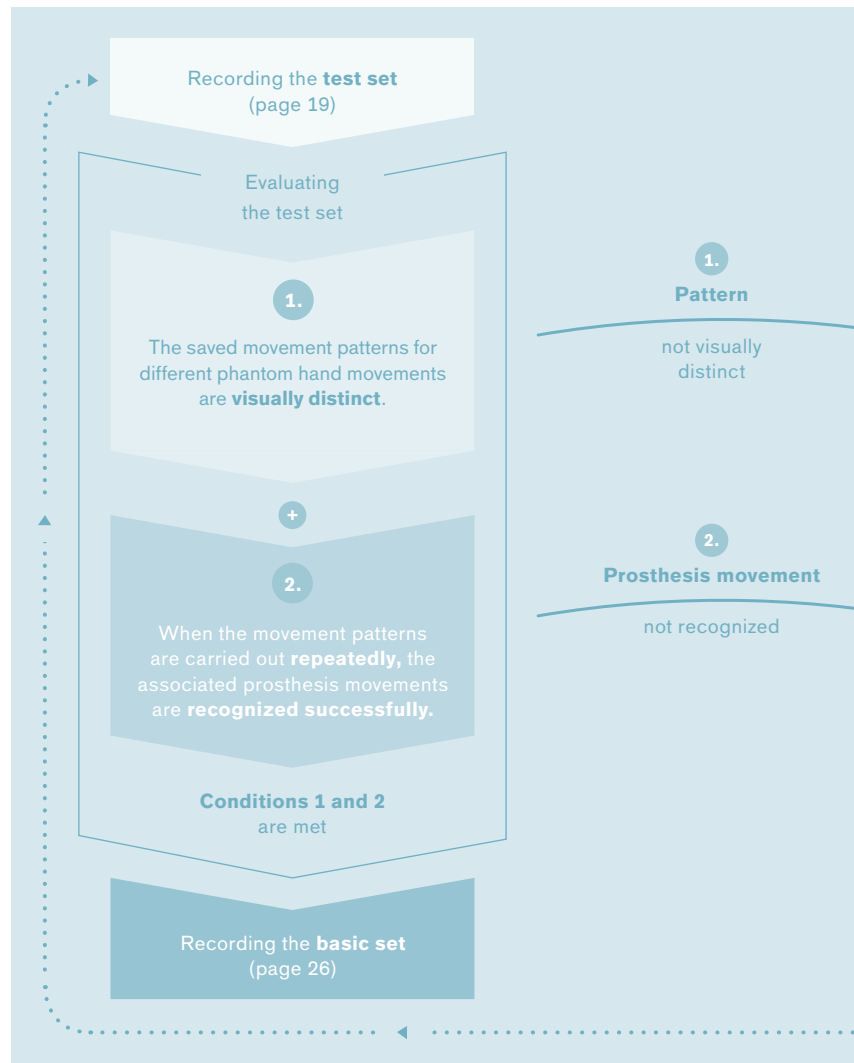


Movement Display

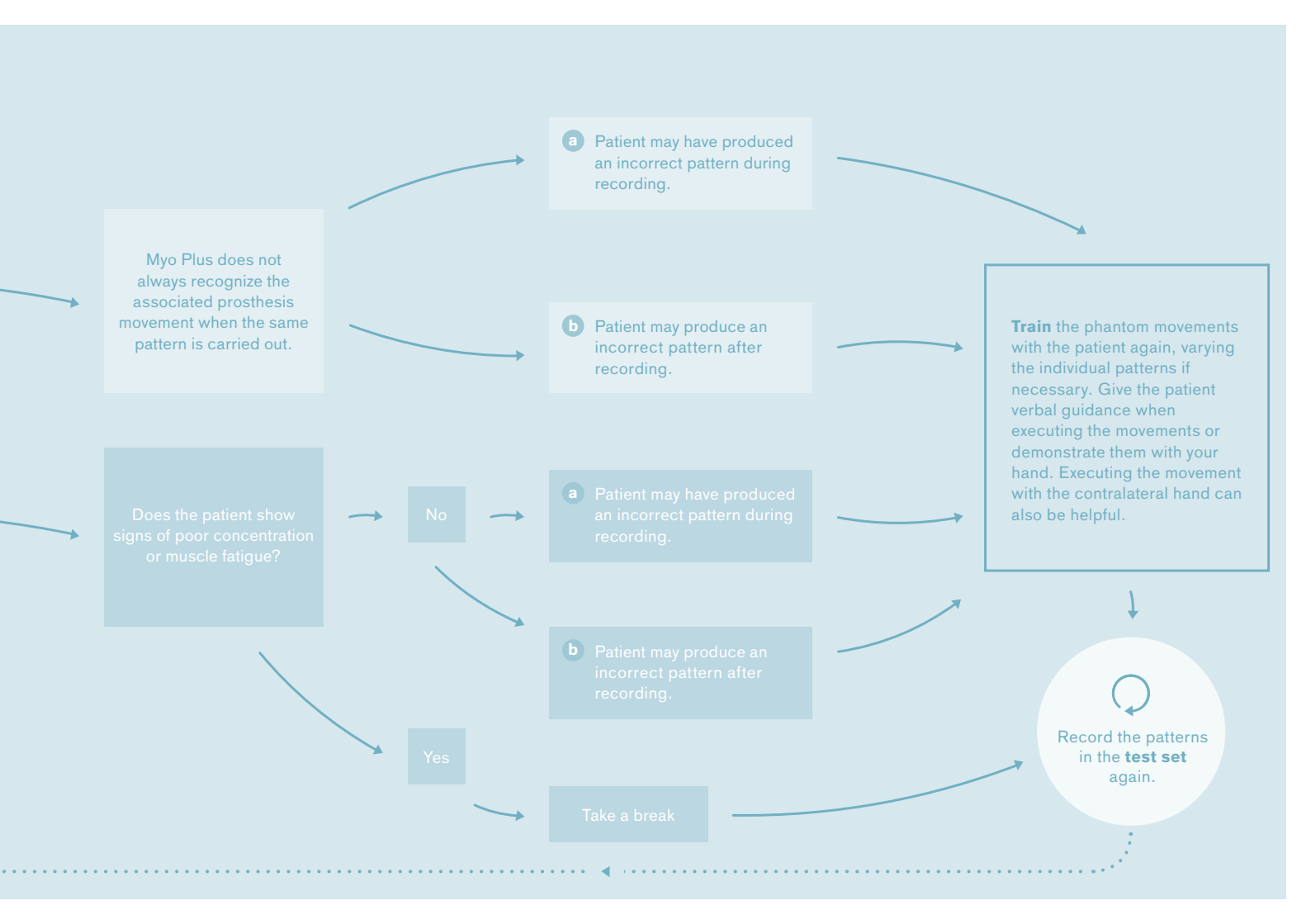
## Step 4 / Training and testing patterns (evaluating the test set)

### Evaluating the test set

Distinct and repeatable movement patterns form the basis for successful control of the prosthesis with Myo Plus. For this reason, it is important that the basic set (all 6 recordings) is not recorded too soon, and that sufficient time is scheduled for training the movement patterns. Creating and evaluating the test set should ensure that the patient can repeat the selected patterns distinctly. The adjacent [decision-making aid](#) supports therapists and O&P professionals in defining suitable movement patterns for control of the prosthesis together with the patient. The timeline required to complete this process will vary with each patient.







# Creating the basic set

## Creating the Myo Plus basic set

Once the patterns in the test set have been found to be unique and reliable, the remaining 4 recordings can be done to create the basic set. It is necessary to create and save the basic set in order to permanently save the patterns in the Myo Cuff or prosthesis. The basic set recordings also contain the “Relaxed arm position” and “Open hand” and “Close hand” movements, as well as “Supination” and “Pronation” if there is active wrist rotation, regardless of whether a bebionic hand or MyoBock hand is used.

The basic set can only be created and saved via Clinician Mode. Please note, the two recordings taken for the test set are included in the basic set (as long as check marks are still present in the status indicator).

The screenshot shows the 'Basic set' configuration screen in the Myo Plus app. At the top, there is a slider and the 'ottobock.' logo. Below, three arm positions are listed: 'Arm bent 90 degrees', 'Arm hanging', and 'Arm extended'. Each position has two recording sets (Set 1 and Set 2). Each set includes a status indicator (a circle with a checkmark) and a right-pointing arrow. Callouts on the left describe the recording requirements for each position, and callouts on the right describe the UI elements.

Two recordings each **with elbow flexed at 90 degrees**

Two recordings each **with the arm hanging down**

Two recordings each **with the arm extended**

Display of recording date

Recording sets

Status indicator

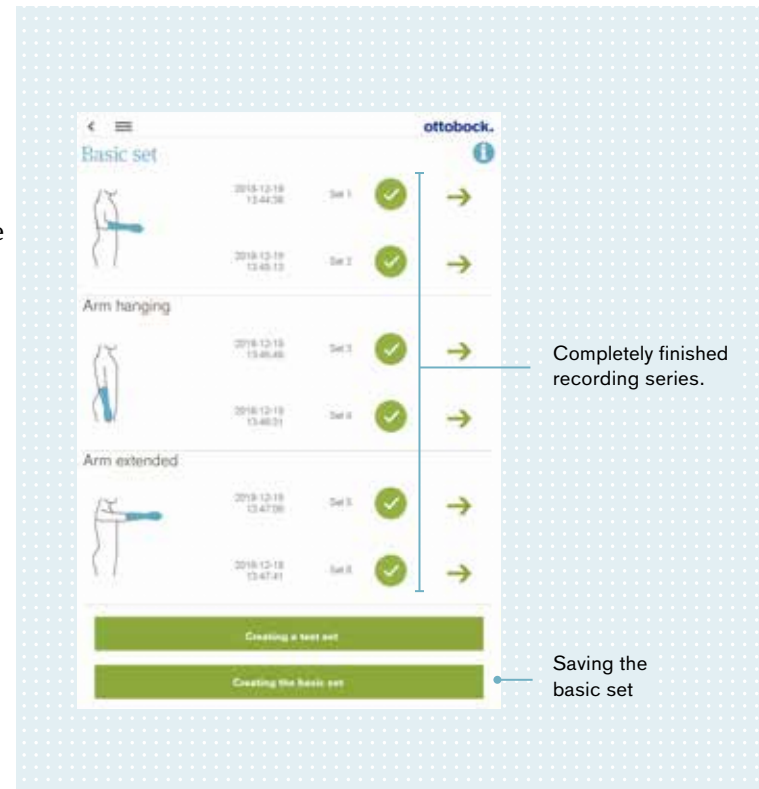
Continue to recording

The basic set can only be created when all six recordings have been completed. To save the basic set, click on **Create basic set**.

After a successful recording, the date and time of the recording are displayed in the respective line and a confirmation is indicated by the check mark symbol. A star symbol next to the checkbox indicates that this recording has been taken but not yet added to the basic set. After creating the basic set, evaluate the saved patterns. Proceed as you did with the “Test set”, utilizing the spiderplot and movement display. If you suspect that one or more sets were not adequately recorded, you can test this using a selection process:

**Please note:**

The date and time that are entered depend on the system time of the tablet/smartphone being used.



## Step 5 / Creating the basic set

Uncheck the patterns you suspect were not recorded correctly. Now, only the remaining recordings of the 6 total will be used for control. If you notice the control is now working better with these patterns unchecked, that is a clear indication that new recordings should be taken (either with more consistent phantom movements, or if necessary, a new phantom movement). To do this, click on the corresponding green arrow. Verify the patient is in the correct arm position and start the recording.

Creating the basic set establishes functional settings for controlling the prosthesis. The quality of the basic set is highly important for the patient to be able to utilize the prosthesis for everyday activities.

Additional recordings of the same or new prosthesis movements can be made (with or without qualified personnel) under the “Add pattern” menu (see page 30)

### Information:

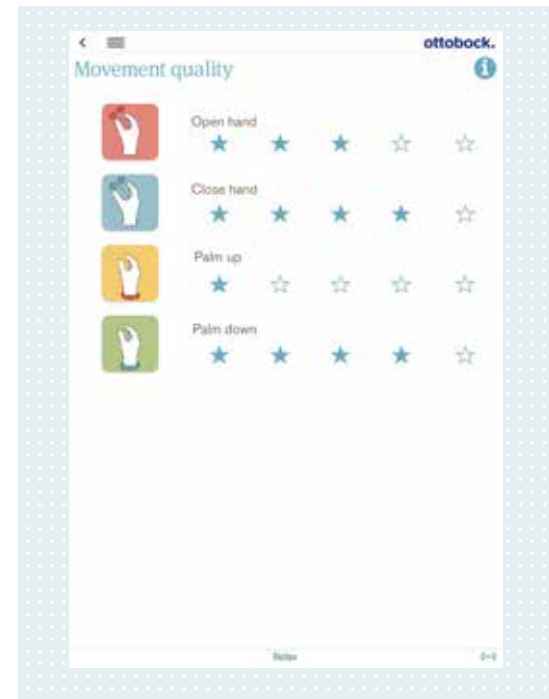
When a basic set is created in the Myo Cuff, these movement patterns are saved even after the Myo Cuff is switched off and on again. However, if the Myo Cuff is removed from the residual limb between different training sessions and then put on again, it is important to position the Myo Cuff exactly as it was when recording the basic set. It is not possible to transfer saved movement patterns from the cuff to the check socket or definitive prosthesis. The basic set is recorded again for the prosthesis after training with the Myo Cuff.

## Movement quality

Under the “[Movement quality](#)” menu, the quality of the movement patterns recorded is indicated using a simple evaluation system. Up to five stars can be awarded for each movement recorded. A movement with five stars can be clearly recognized by the system. Fewer stars indicate a pattern that may not be as unique or reliable. Looking at all movement qualities and comparing them provides information on the distinctiveness of the individual movements. Along with the practical execution of control, the movement quality can indicate whether movement patterns should be recorded again. However, please note it is not necessary to achieve 5 stars for each movement (3 is sufficient).

### Tip:

Evaluate control and movement patterns only after a longer break.



### **Adding patterns**

Patients can add additional recordings to the basic set on their own in order to make the system more reliable. This may be necessary when a movement is not adequately recognized in certain situations or arm positions, such as when the hand is above the head.

The reason why control is not working as desired should be evaluated before every new recording. This may initially be due to rapid muscle fatigue and higher demands on concentration. To prevent this, always ensure that a sufficient break was taken before recording.

It is not necessary to make additional recordings if control is stable and satisfactory.

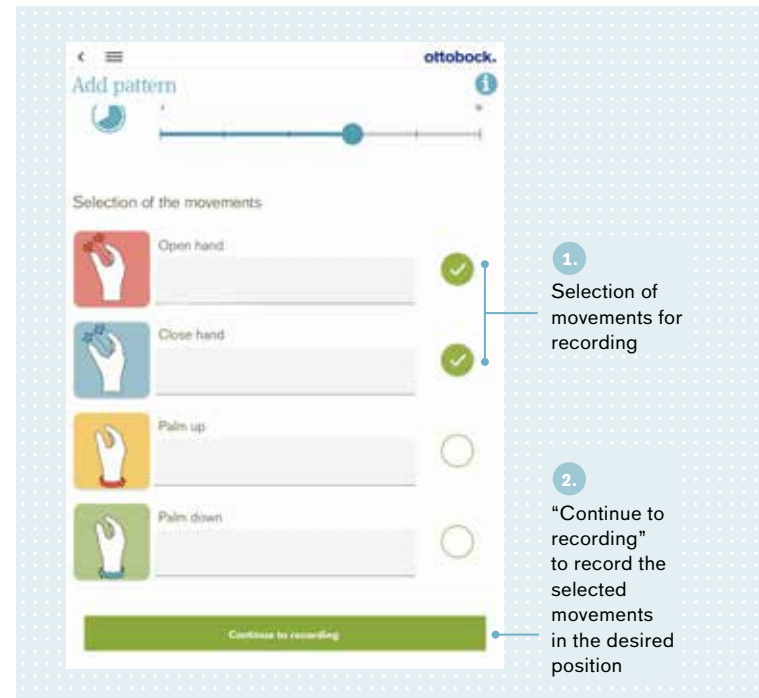
Added movement patterns cannot be deleted individually. However, the patient can always reset to the basic set.

## MyoBock Terminal Devices

The basic set for the MyoBock terminal devices already includes all possible prosthesis movements. For this reason, only the “Open hand” and “Close hand” movements are included under the “Add pattern” menu and, where there is active wrist rotation, pronation and supination.

If prosthesis movements do not work adequately in certain situations, the patient can add all movements in the desired arm position:

The movement patterns are automatically added to the existing patterns, and can be used immediately. Also please note, there is free text space by each prosthetic function where cues for patterns can be entered. This can help the user remember which movement pattern to perform.



## Step 5 / Creating the basic set

### bebionic hand

The basic set for the bebionic hand includes the four recorded movement patterns “Open hand” and “Close hand” and, where there is active wrist rotation, pronation and supination. The pattern for “Close hand” defaults to power grip when the thumb is in opposition, and key grip when the thumb is in the lateral position.

The patient can choose one of two control options when changing grips in the bebionic hand: movement patterns or conventional control using an “open/open” signal.

This is selected under the “Settings” menu under “Controlling the bebionic hand”.

#### Information:

A new “Close” movement pattern will be chosen for any additional grip patterns of the hand desired. Each pattern controls two grips, one for the opposed thumb position, the other for the lateral thumb position. These grip pairings are predefined, cannot be changed, and can be found under the menu “Add pattern”.

### Control of the bebionic hand

#### a. Conventional control using switching options

In this control mode, the “Open hand” and “Close hand” movements and, where there is active wrist rotation, pronation and supination, are created by movement patterns. However, switching to the various grips is done using an “Open/Open” signal or the program switch on the back of the hand. (see the bebionic therapy brochure).

If one of the four movement patterns does not function adequately in certain situations, the patient can improve individual or all movements by adding patterns as previously described.



### b. Intuitive control with movement patterns

When choosing movement patterns for control, switching grips via the program switch or an “Open/Open” muscle signal is completely eliminated. This makes control smoother and faster. The number of grips to be used depends on patient preference, and the number of unique movement patterns that they can generate.

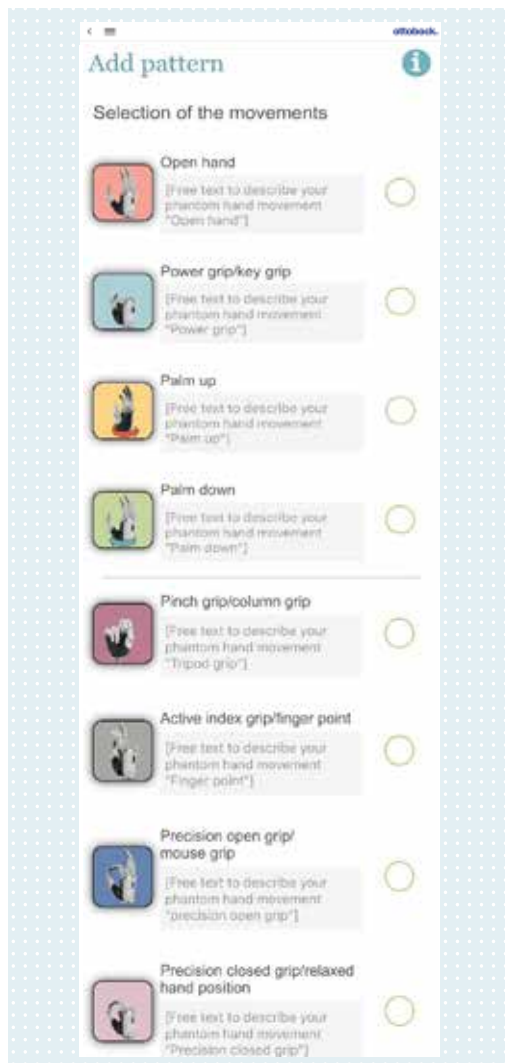
A total of eight different patterns would be required to use all functions of the bebionic hand (4 for open/close and pro/supinate + 4 for all available grip patterns). However, no more than five are needed to be able to handle everyday activities.

#### Variation 1:

The patient has **one** additional movement pattern that he can generate aside from “Open hand” and the wrist rotation movements. This pattern would be assigned to “Close hand”, for which the power grip and key grip are assigned by default. The patient can thus use a total of five prosthesis movements: Open hand, 2 grip options for close (depending on thumb position), and pro/supination.

#### Variation 2:

The patient has **two** additional movement patterns that he can generate aside from “Open hand” and the wrist rotation movements. One pattern would be assigned to “Close hand”, for which the power grip and key grip are assigned by default. The patient can then choose from four other pairs of grips for the second movement pattern. The patient can thus use a total of seven prosthesis movements: Open hand, 4 grip options for close (depending on thumb position) and pro/supination.



In the “Add pattern” menu, the patient can record new prosthesis movements with a new pattern in addition to the existing movements.

Before recording a new movement pattern, it should also be evaluated in the spiderplot. After recording added or new movement patterns, they can be controlled immediately.

### Activating/deactivating prosthesis movements

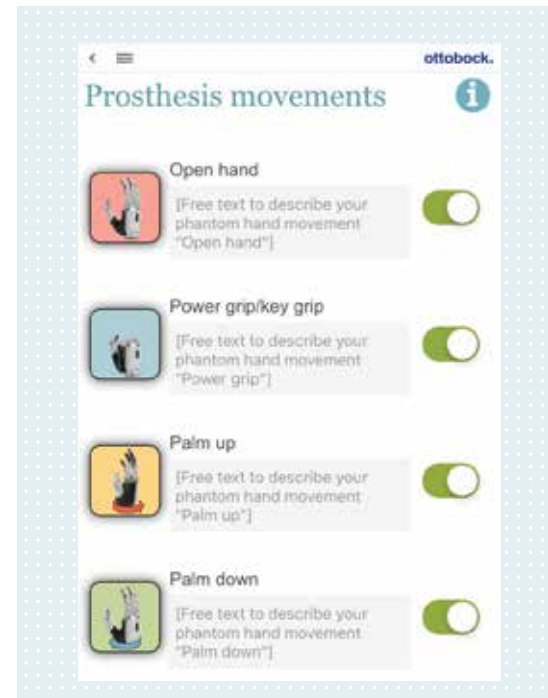
Slide the button by the corresponding movement icon to the left to temporarily deactivate one or more saved prosthesis movements. Slide the button to the right to activate it.

#### Example 1:

Pronation and supination are deactivated for activities in which the prosthesis must not rotate involuntarily.

#### Example 2:

Certain movements are deactivated in order to practice the others more effectively.



# Prosthesis training

Prosthetic training consists of 3 phases, and should begin with **controls training**. The structure of this phase depends on the prosthetic hand used and differs from conventional control especially with respect to activation. The goals of controls training include the user achieving the ability to:

- Follow explicit commands/mirror movements (10 reps, 30 min, 2-3 x day)
- Experience no random movements; only purposeful, consistent actions
- Produce unique movement patterns reliably
- Become more familiar with the prosthesis
- Learn control **without using objects** in all planes of motion
- Learn all passive and active functions available

If control of the Myo Plus system is not yet adequately working training should focus on distinguishing between movement patterns. Deactivate movements as needed to reduce the overall number that are being focused on, and proceed step by step until the desired number of movement patterns can be used reliably in everyday life. Once control is established, **repetitive drills** can begin. Activities should now be completed using all different shapes, sizes and durometers of objects. Exercises should be completed in reps of 10 for 1-3 hours per day. The goals of repetitive drills include:

- Drills can be completed with a minimum of 90% accuracy with all types of objects
- Objects are grasped with appropriate grip force, speed, and opening width of hand
- Objects can be grasped, held, and released using appropriate timing and wrist rotation
- Drills can be completed in varied planes of motion and starting positions
- Compensatory movements are minimized
- User presents with full understanding and internalization of prosthetic functions

And finally, the last phase of training focuses on **ADLs**. The user should choose 3-5 customized activities to work on at home once proper techniques are established. Adaptive strategies, assistive devices, and community reintegration can all be addressed. Goals of this phase include:

- Completion of bimanual functional activities using objects which are regularly used in daily life
- Determining how to use the prosthesis to its best advantage (active vs stabilizing use)
- Integration resulting in a full day's use of the prosthesis
- Achieving maximum autonomy & independence









Get all the details on the  
Myo Plus app here:

**[www.ottobock.com/en/apps/myoplusapp](http://www.ottobock.com/en/apps/myoplusapp)**



Discover the Ottobock  
professionals YouTube channel:

**[videoguides.ottobock.com/myoplus](http://videoguides.ottobock.com/myoplus)**

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