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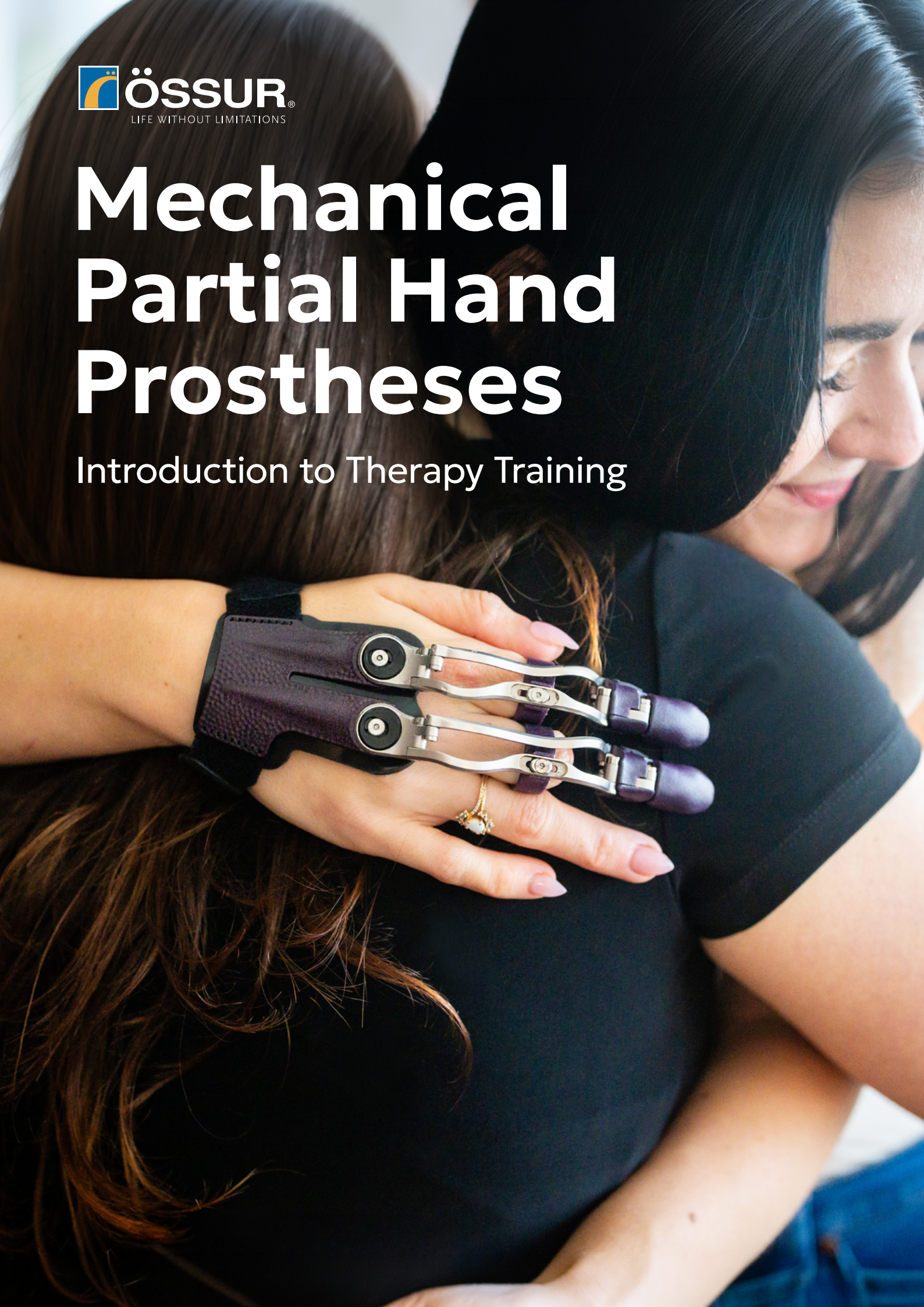
LIFE WITHOUT LIMITATIONS

Mechanical Partial Hand Prostheses

Introduction to Therapy Training



Contents

Why is Therapy important?

Multi-disciplinary intervention, combining the expertise of surgeons, therapists and prosthetists, is the optimal system of care for persons with traumatic partial-hand amputation. [1, 2, 3]

The role of the therapist is key to support the user and help them to navigate their new situation. Understanding their specific circumstances in relation to their lifestyle, needs, goals and abilities.

The therapist is focused on function, helping to prepare the user for their new prosthesis and the optimum way to integrate it into their daily life.

It is important for therapy training to be person-centric. Supporting each individual to fulfil their own potential and optimise functional outcomes with their prosthesis.

Hand Function

The Human Hand

Our hands are remarkable. They consist of 27 bones, 27 joints, 34 muscles and over 100 ligaments and tendons.

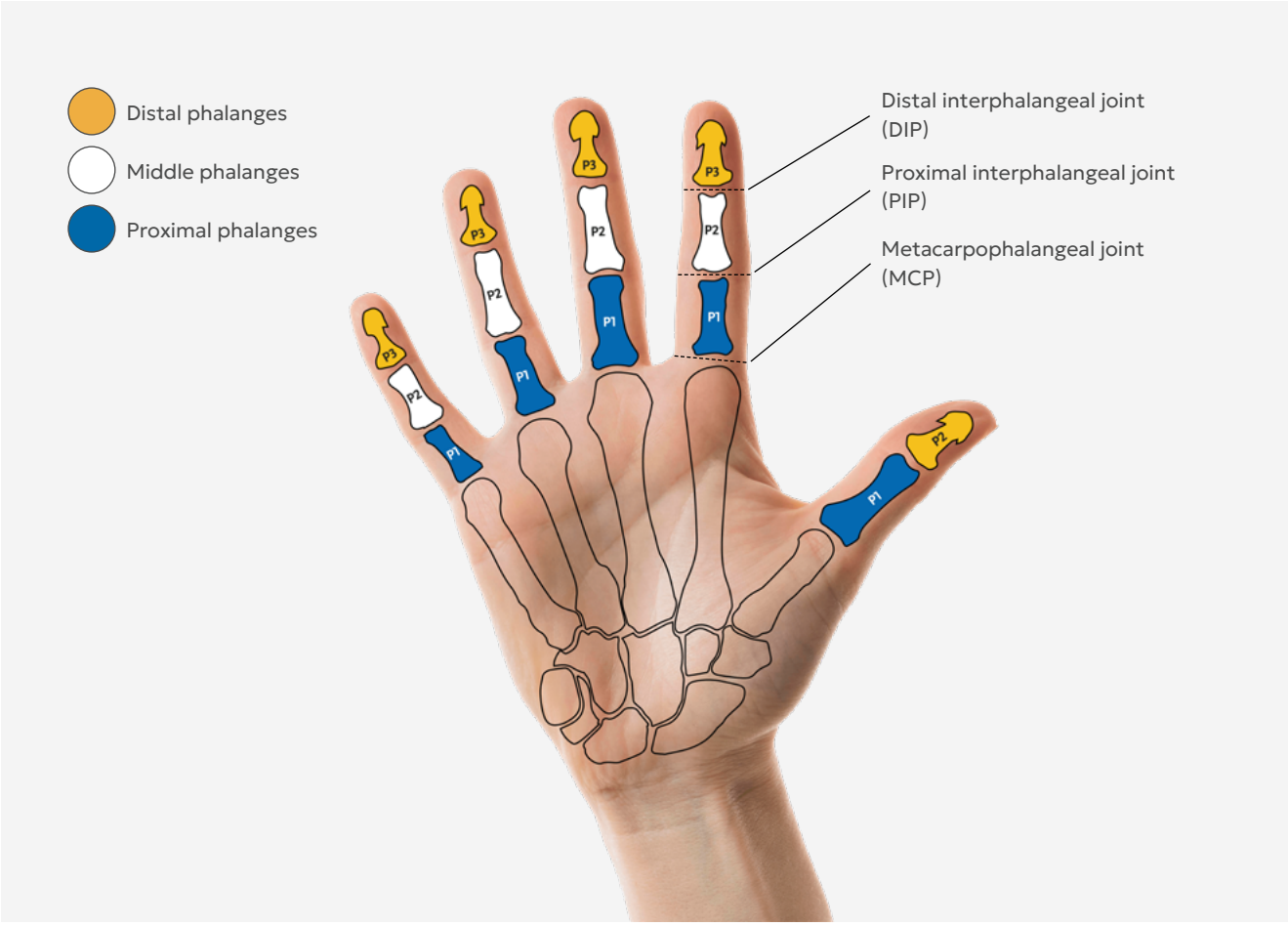
With over 3,000 touch receptors in each fingertip.

Our hands can perform a huge range of activities with wide ranging functions. Vegera (2014) estimated that we use our hands for 5 hours per day, excluding time spent doing work and sports. With feeding relating to one hour per day of hand use.[5]

Our hands can be delicate in precision tasks such as writing, or powerful when carrying a suitcase or digging the garden.

They provide feedback through sensation, with the ability to identify between rough or smooth, hot or cold and sharp or dull.

“Our hands help us talk, think, and remember, sometimes revealing unique knowledge that cannot yet be verbalised,” said Goldin-Meadow back in 1993.[4]



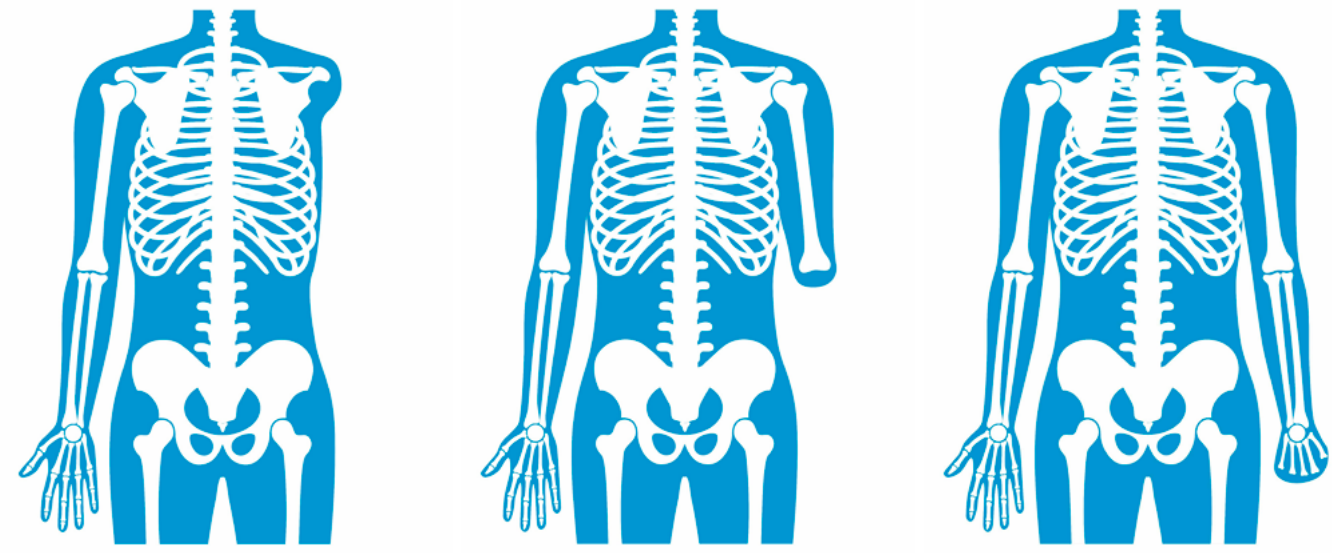
Partial Hand Absence

In 2005, 1.6 million Americans were living with limb loss, with 35% of cases involving the upper limbs.

Although lower-limb loss is heavily associated with dysvascular disease, upper-limb loss is most commonly secondary to trauma.[6]

It is estimated in the US, that 45,000 people suffer traumatic finger amputation every year, a third of which are work related.[7]

Often individuals undergo surgery, but they are not referred for prosthetic assessment as the impact of their loss can be underestimated.



AMA 'Guides to Evaluation of Permanent Impairment'

The American Medical Association Guides to the Evaluation of Permanent Impairment[8], can be beneficial in quantifying the level of impairment.

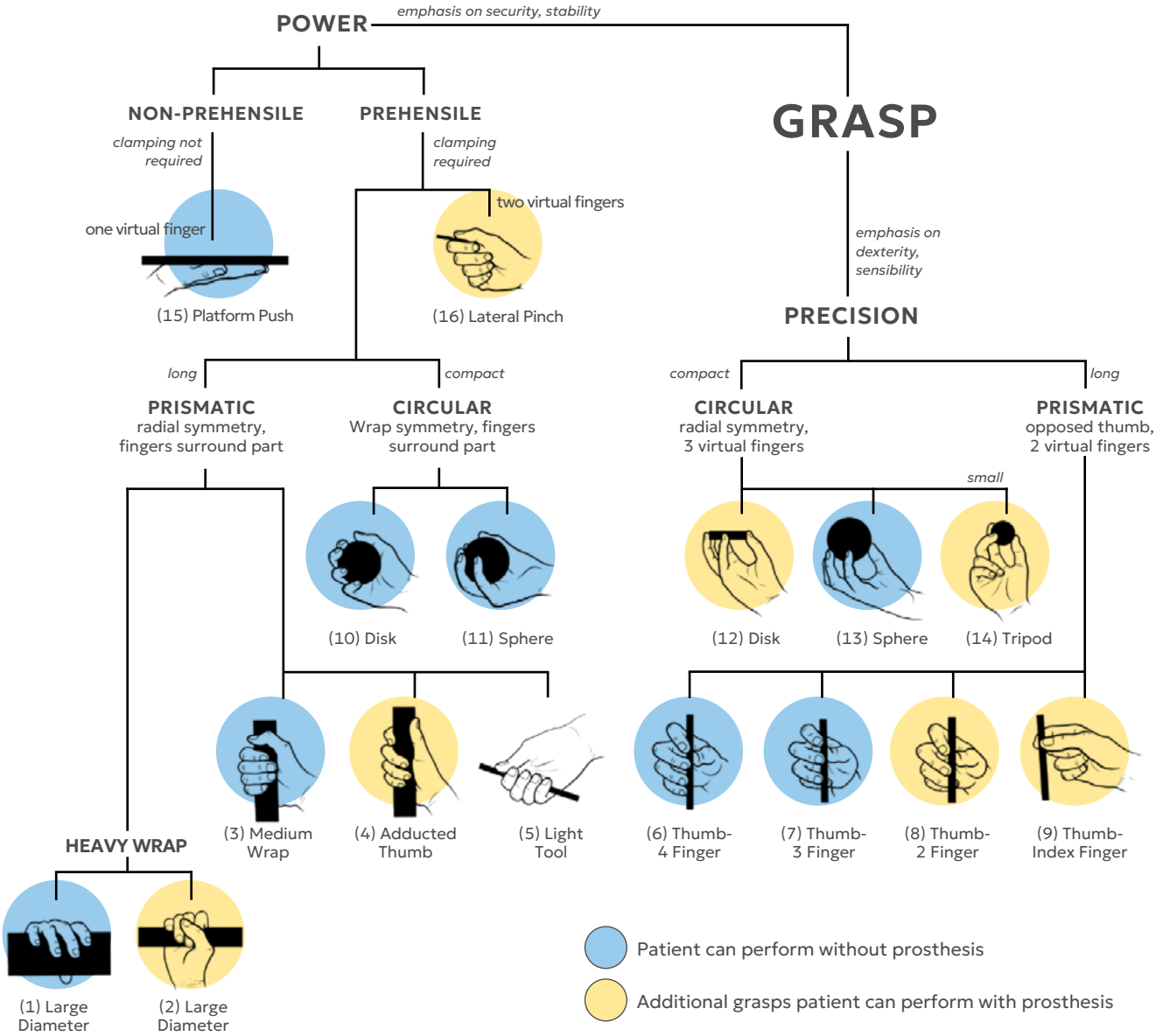
We know that the thumb relates to 40% function of the hand. The index and middle fingers are 20% and the ring and little fingers are 10% each. When assessing the hand for current function, these percentages help us to understand the overall impact of loss.

The majority of hand function is from the thumb, index and middle fingers. They are involved in most grip patterns. The functional power grips rely on the ring and small fingers.

The current function of the hands should be examined in detail, with each grip type assessed for functional ability and strength. Even a relatively small partial amputation of a digit results in both psychological and functional loss, such as lower pinch and grip force and difficulty with everyday tasks.[9]

Current Function

This chart, by Cutkosky[10], can be used to structure the grip assessment process. It was originally designed for robotics but has also been found to be clinically useful.



Each grip type should be trialed in turn, if the patient is able to achieve it then it should be circled on the chart. At the end of the assessment, the grips that are not circled are those that are not possible for the patient.

The absent grips can then be considered in relation to the functional possibilities or limitations of the prosthesis; to outline the benefit the prosthesis can offer to the patient.

The assessment can be completed again after fitting with a prosthesis to highlight what specific grip functions have been added by using a prosthesis.

This process looks at the specific grips, but in addition observation of how the patient currently completes tasks should be carried out to highlight their functional challenges in daily life, aiding goal setting and alignment of expectations.

Prosthetic Assessment

Physical presentation must be assessed to see what type of prosthesis the patient is a candidate for. Some important considerations are the number of digits affected, skin condition, length of digit remaining and the active range of motion. Including whether both hands are affected or just one. The length and integrity of their residuum must be sufficient to suspend the prosthesis ring and to provide power for the prosthesis movement.

As the body driven devices are powered by the movement and strength of the residual digit, there must be an active range of movement. This means that the patient must be able to move their residual digit. The movement of their residuum directly relates to the amount of movement which can be achieved with the prosthesis. Any limitation in motion of the residual digit may impact on the functional output possibilities of the prosthesis.

If the patient has scarring, tight or sensitive skin this should be assessed for location and mobility to ensure fitting a prosthesis will not excessively pull on the tissue. This is particularly important if located within the webspace or on the distal residual digit.

If multiple digits are affected, the patient may be suitable for multiple devices. Therefore, the suitability of each residual digit must be considered individually, and also in combination to understand how multiple prostheses will function together. For affected digits side by side, such as in the image shown, consideration should be given to the fitting and comfort. Length discrepancies between the residual digits may result in overall discrepancies between the prosthetic digit lengths. To achieve optimum function, it may not always be necessary to fit all affected digits.

Functional Requirements and Expectations

Every individual has their own unique requirements and lifestyle. What is important to one person, may be completely irrelevant to another. Therefore, exploring through open **discussion each potential user's hobbies, interests, work and environment** can aid identifying the areas in which a prosthesis could assist them.

Discussion should include what the user thinks the prosthesis will do for them, how it will move and how it will assist them in their day-to-day life.

Successful outcomes with any prosthesis are built upon a foundation of matching the **patient's expectations and goals** with what is possible to be achieved with a prosthesis.

Supported by Jones et al[11] in their 2021 research when they started '**The functional performance of a prosthesis can be influenced by the expectation and the experience of a user**.'

Any misalignment of expectations and the potential functionality of the prosthesis should be discussed upfront, prior to prosthesis provision. Some limitations in functionality may be an acceptable compromise for a user if it allows them to achieve some specific objectives.

Product Overview

Mechanical Partial Hand Product Overview

There are four products within the mechanical partial hand prosthesis family; three body driven devices and one passive ratcheting finger. They are designed to restore grip stability and encourage bilateral hand use.

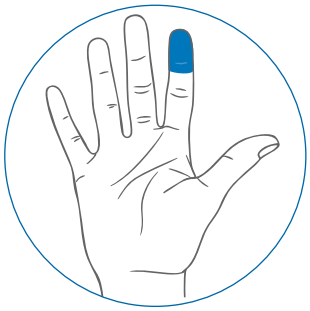
Robust, designed to cope with life's challenges, extensively tested to support a device lifecycle of at least 3 years.

Body driven devices

- Intended for absence distal to the metacarpophalangeal (MCP) joint.
- Each device is designed for the individual user's presentation to optimise functionality based on specific daily activities and goals.
- Available in 8 colours, 5 textures and 8 fastener colour options. Offering the user the ability to personalise their prosthesis.
- They are driven by the intact joint, the motion of the residual digit directly relates to motion of the prosthetic digit.
- By restoring digit length and movement, the user can achieve multiple grasps such as power, tripod and lateral.
- The residual digit must be long enough to suspend the ring of the device and have sufficient range of motion and strength to power the movement.
- The active motion assist the user in daily tasks such as; personal care, food preparation, office work, and hobbies, such as gym and sport.

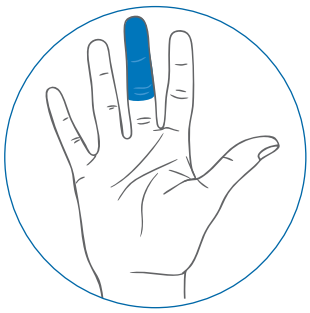
PIPDriver

For users with an intact PIP joint, and absence through the distal or middle phalanx.



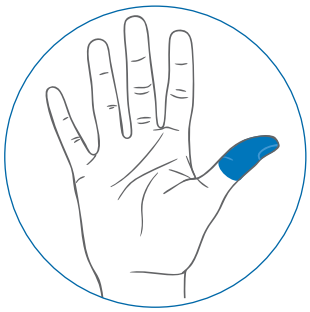
MCPDriver

For users with an intact MCP joint, and absence through the proximal phalanx.



ThumbDriver

For users with absence of the thumb distal to the MCP joint with an intact functional CMC joint.



Passive Ratcheting Finger: GripLock Finger

- Intended for absence proximal to the metacarpophalangeal (MCP) joint.
- They are passive, ratcheting fingers built onto a socket around the residuum hand.
- Available in 8 colours.
- There is no active motion of the prosthetic digit, as it is intended for users with no residual digit to generate the motion.
- The fingers are manually positioned using the sound hand or by pushing against an object.
- It is recommended that the user has an intact, functional thumb to oppose against the passive finger digits.
- Provides grip stability and encourages bilateral hand use.

GripLock Finger

For users with absence proximal to finger MCP joint with a functional thumb

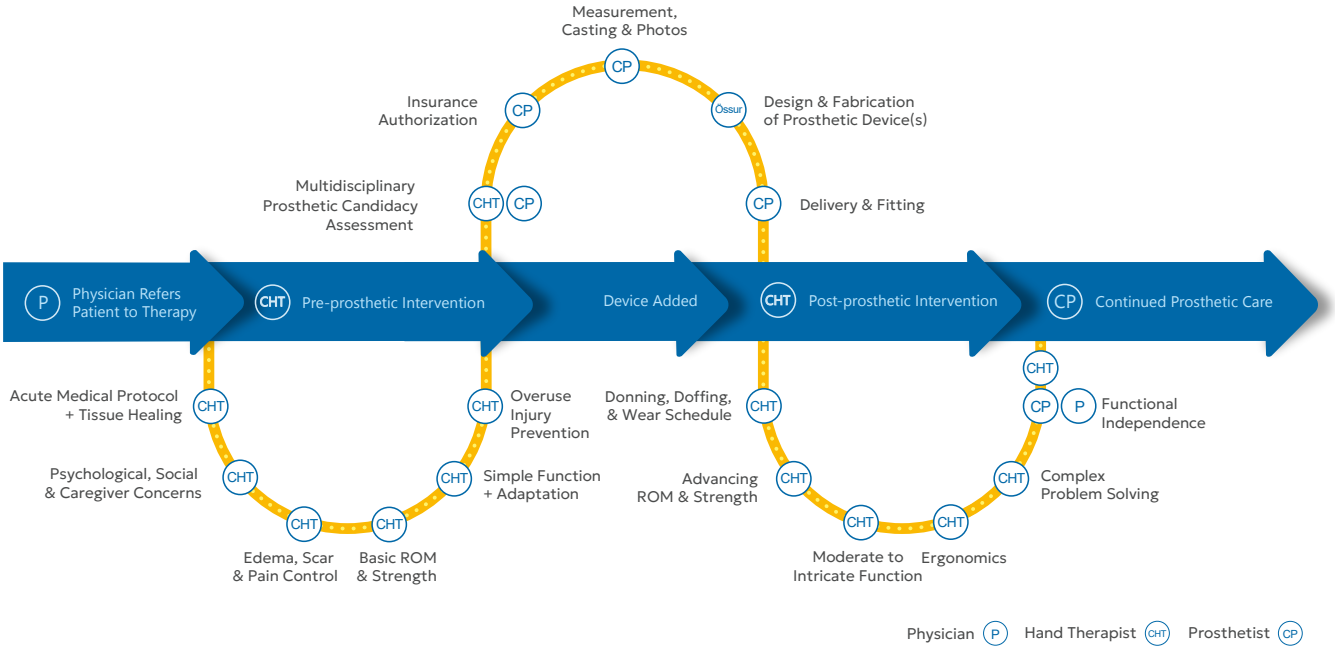
Rehabilitation Process

Pre-Prosthetic Phase

The informed therapist's map to positive outcomes

The rehabilitation process can be broken down into pre- and post-prosthetic phases.

This chart from The New Map[12] shows an example of how the fitting flow may look. However, every individual patient will have unique needs and journey of care.



Pre-Prosthetic Rehabilitation

The pre-prosthetic therapeutic journey can start from as early as three days post amputation through to functional independence.[12]

For non-amputees, or those with an established amputation, the journey may be a little different, but many of the principles still apply. They may be coming to prosthetics for the first time due to advances in technology now giving them options.

Pre-prosthetic therapy guidelines include managing acute medical protocol in light of physical needs, addressing psycho-social concerns, functional adaptation, overuse syndrome prevention and multi-disciplinary prosthetic candidacy assessment.

Initial Interview

The recovery journey begins with a thorough interview with the patient, complete with a focus on injury history, occupational background, current abilities, caregiver concerns and future goals, to determine the most effective plan of care.[12]

It is important to understand how the user is currently completing tasks.

What strategies or compensations have they adopted?

What are they not doing that they would like to?

This could be structured as a past, present, future conversation to encourage open discussion, enabling expectations to be realistically set and to form the basis of goal setting.

Therapy intervention can be affected by environment, lifestyle, community support and roles, and these elements must be included in the initial interview.[11]

Evaluation Interview

- Injury history, occupational background, hobbies and interests
- Functional skills, patient needs, current abilities, concerns, future goals etc
- Different kind of assessment tools can be used

Therapeutic Interventions

The specific therapeutic interventions may be provided directly by the therapist or by signposting the user to another clinical professional. The therapist oversees the holistic view.

Ensuring recovery through wound healing, pain and oedema management. Strength and range of motion are a key focus. Improving the pre-prosthetic condition will be beneficial for longer term prosthetic use.

- Educating on preventative strategies for overuse and addressing concerns before tissue dysfunction occurs.
- Introduce strengthening exercises using resistance putty or bands.
- Thumb touch exercises can improve range of motion of the fingers and thumb rotation, to aid overall dexterity and flexibility of the hand.
- Psychological awareness, understanding that many patients mourn their loss or struggle to come to terms with their altered self image and role.

The therapist tailors a specific program exploring adaptations, aids and techniques to increase the daily living skills of the patient based on their evaluation interview.

Therapeutic Intervention

- Promote wound healing
- Control pain / hypersensivity
- Control residuum shaping/ shrinkage
- Increase strength
- Maximise range of motion
- Prevent overuse
- Acceptance of loss
- Explore adaptation
- Explore functional aids
- Increase daily living skills

Rehabilitation Process

Post-Prosthetic Phase

Post-Prosthetic Rehabilitation

The post-prosthetic training phase commences once the user takes delivery of their prosthesis.

Body driven Mechanical Partial Hand Prostheses offer intuitive response to the user, giving immediate predictable motion, providing grip stability and encouraging bilateral hand use. However, training in the post-prosthetic phase is still beneficial for the user to achieve optimal functional outcomes.

Training provides support and encouragement when trying new activities, alongside re-education on what is possible.

The rehabilitation pathway should be personalised for the individual user.

Understand functional challenges

- It is important to understand what the user is struggling with, in their day-to-day life without a prosthesis, to understand where it will help most.

Understand prosthesis functional benefit

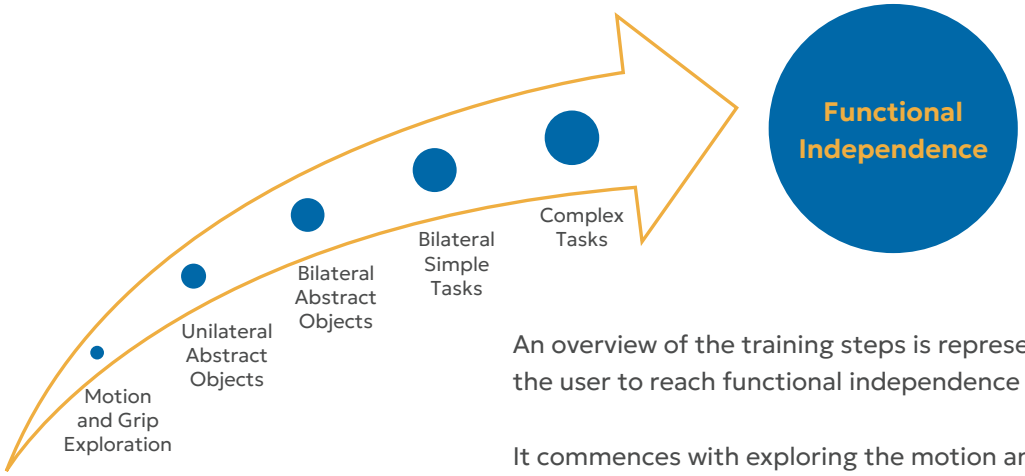
- Set realistic expectations and remember the prosthesis is a tool to improve function but does not replace all the functions of the hand.

Goal setting

- Goal setting can be introduced within the post-prosthetic stage.
- Focus on specific tasks which are important to the user.

Clinical presentation is important for successful device fitting but goals are imperative for successful user outcomes.

Journey to Functional Independence



An overview of the training steps is represented here. The aim is for the user to reach functional independence with their prosthesis.

It commences with exploring the motion and grips, before progressing to abstract object single handed, then bilateral exercises. Before moving on to bilateral tasks of moderate difficulty and then to more intricate and greater complexity tasks.

Motion and Grip Exploration

Explore range of motion and responsiveness

- The first step is for the user to explore the range of motion and grip patterns of the prosthesis without touching any objects.

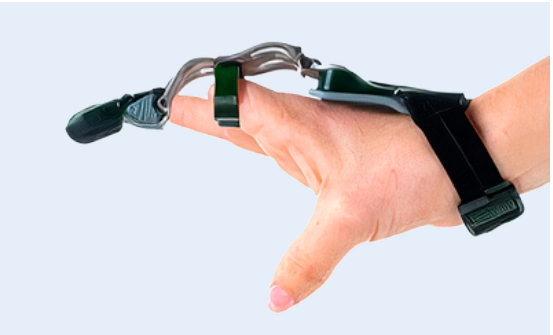
Proprioceptive awareness

- Flexing and extending their prosthesis and any intact digits helps them become familiar with the motion, responsiveness, and build proprioceptive awareness.
- Co-ordination of motion between the prosthesis and intact digits or multiple prostheses may require additional practice.

Explore grip patterns

- The user should explore potential grips including opposition, span of opening, flexion range, precision pinch, tripod, and lateral key grip. Depending on the user's physical presentation, not all grips may be possible. However, it is beneficial at this stage to understand what is possible before engaging with objects or complex tasks.

The user may have developed compensations which require unlearning. Therefore, it is important for the user to become familiar with their new movement and strength when wearing the prosthesis.



Unilateral Abstract

Grasp and release

- Once the user is happy with the motion of their prosthesis, abstract objects can be introduced for practicing simple grasp and release.

Object stability

- Starting with relatively large objects like a cone, water bottle, or stress ball, the user should ensure the object is stable within their hand. Considering object position and contact area with the hand and prosthesis.

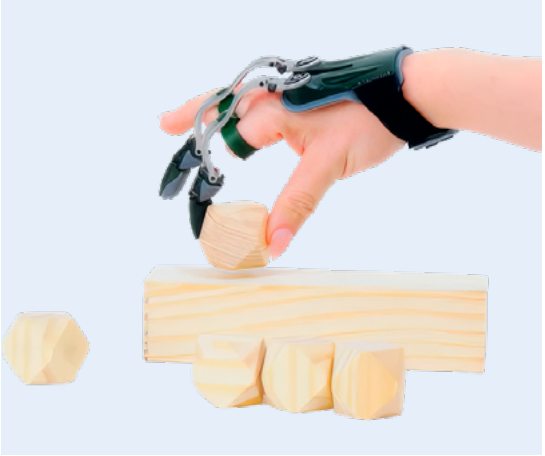
Grip strength: strong vs. delicate

- The user should consider the best grip to hold the object and the amount of strength required based on the weight of the object, exploring different positions within the hand to best hold differing object shapes.

Hint: Using a mirror can be useful at this stage for the user to observe their posture and positioning as they begin interacting with objects.

Decrease size and weight of objects

- As confidence and ability develop, the object size can be decreased or the weight increased.
- Initially, the user should work directly in front of them.



Function across planes of motions

- Complexity can be increased by expanding the planes of motion, moving the object further away, or placing it higher or lower.
- This will be good preparation for completing activities of daily living such as brushing hair behind the head, reaching up to a high shelf, or leaning down to tie shoelaces.

In hand manipulation

- In-hand manipulation can be explored by moving objects around within the hand, such as a pen, toy block, or set of keys.
- Complexity can be increased by expanding the planes of motion, moving the object further away, or higher or lower.

The aim of this phase is to develop control of motion, understand correct positioning of objects within the hand, and apply the appropriate grip strength.

Bilateral Abstract

Bilateral abstract training introduces the contralateral side while still working on abstract objects rather than task completion.

The function of both sides should be considered individually and together, with awareness of hand dominance, strength, range of motion, and prosthetic use.

Passing objects between hands

- Start by passing objects, such as a ball, from one hand to another.

Co-ordinate motion and timing

- Allow the user time to familiarise themselves with coordinating the motion and grasp and release.

Awareness of posture

- Pay particular attention to the user's posture and highlight any compensatory body positions or motions.

These initial steps may seem basic, but they are important to build solid foundations for the user's future prosthetic use.

Bilateral Simple to Complex Tasks

Use both hands together to complete simple tasks

By now the user should be comfortable with the basic functions, motions and grips of their prosthesis. The next step is to explore their bilateral function in simple tasks. Such as opening a drinks bottle or packet.

Increase task complexity

- Task complexity can be gradually increased at a pace to match the user's ability and confidence.
- The user should be encouraged to think about the steps involved in a task and how they could best approach it.
- Consider which hand is dominant, grip position, angle or approach or the necessity for any modifications to the task, equipment or environment.

Break down steps

- Use problem solving skills to approach tasks as the complexity increases.
- Exploring the best way for an individual to complete a task by breaking down the steps and finding the best solution for them.

The complex task phase is where users utilise their skills developed in the earlier phases in conjunction with their problem-solving skills. Examples of complex activities are those which have more involved steps or require greater coordination, such as meal preparation or home care.

Rehabilitation Process

Example Daily Activities

Example Activities of Daily Living

Here are some examples of common activities of daily living tasks which therapy training and goal setting can be structured around. These example of tasks are applicable to the majority of individuals, but there may be areas of specific focus or need based on the specific user.

Eating

Is one of the most essential daily tasks
Important points to consider and practice:

- Maintain a steady grip while moving the hand from plate to mouth.
- Cutting food with control and opening packets and drink bottles.

Dressing

Getting dressed is a daily routine that requires coordination, dexterity, and patience.

- Consider differing challenges of upper and lower body dressing.
- Special attention should be given to handling buttons, zippers, and shoelaces.

Hygiene

Personal hygiene plays a vital role in well-being and self-confidence. Focus on everyday tasks such as washing, toileting, and grooming.

- Practice combing hair, applying make-up, using a razor, squeezing toothpaste from tube, brushing teeth.

Meal Preparation

Meal preparation needs can vary greatly, from a simple snack to a family meal. Therefore, it is important to understand the user's needs and relevance to them when planning a training exercise.

- Practice grocery shopping, carrying bags, handling money.
- Explore how to use kitchen equipment safely and effectively.
- Opening packets, holding and stirring pots and bowls.
- Chopping and peeling vegetables.
- Prepare hot drinks.

Home Maintenance

Maintaining a clean and functional home is an important part of daily living.

- Washing dishes, cleaning surfaces, dusting and vacuuming.
- Explore basic home repairs to support practical problem-solving.

Mobility

Users should engage in practical training for everyday movement which is relevant to their situation.

- Consider how the user rides a bicycle, drives a car or navigates public transport
- If relevant, focus on the safe and effective use of mobility aids such as walking sticks, crutches or wheelchairs.
- Support to build confidence in range of environments.

Vocational Training

Support in the user's workplace to incorporate their new prosthesis may be required. Or alternatively exploration of the potential opportunity to return to work

- Occupation-based training (i.e. job visit)
- Simulation of work activities.

Leisure Activities

It is important to not only explore practical functional activities, but also leisure activities that are often the source of joy and satisfaction in a person's life.

- Based on user's specific interests and engaging hobbies.
- Explore the needs of the activity and develop suggestions and techniques on how the prosthesis can assist.

All of the therapeutic exercises should be tailored to the individual user, their needs and goals. They should be designed to be challenging while reinforcing confidence and independence in real life scenarios.

By exploring skills and personal interests, users build routines that support them on their pathways to functional independence with their prosthesis.

Post-Prosthetic: Care

In addition to functional tasks, training on how to manage and care for their prosthesis should be covered.

Don / Doffing

- Guidance on how to don/ doff the device is important to develop complete independence.
- Advice on best position to adopt, whether to don before or after dressing etc.
- For multiple devices or bilateral users; the best order to approach them in.

Wear schedule

The user should be educated on developing a wear schedule which fits in with their daily life. Each user has their own unique presentation so the schedule should be adjusted to best meet their requirements.

- A typical wear schedule may initially be 30 minutes 3 times per day.
- Slowly increasing use if no negative symptoms, skin irritation etc.
- With any signs of skin breakdown or irritation, the user should contact their clinical team.

Prosthesis Maintenance

The user should be made aware of the relevant device adjustments they can make whether that be to the positioning of the straps or on some devices the angle of the tip.

Device adjustments

- Positioning of the device or strap.
- Tip angle on ThumbDriver etc.

Cleaning

- A cleaning schedule should be discussed with the user to ensure they know how to care for their prosthesis and keep it fresh.

Device limitations

- Awareness of safe activities and environment of use.
- Avoiding forced full flexion or extension of device.
- Refer to instructions for use.

Post-Prosthetic: Follow Up

Follow up of the user should reflect lifelong care. The user's range of motion and strength should be re-evaluated to highlight any changes which may impact their abilities. It would be expected that through use of the prosthesis their function would increase.

Progress should be acknowledged, utilising outcome measures as appropriate. Reinforcing positive progress can aid the user to reflect on their journey.

Any negatives or challenges should be addressed and support provided to work on the difficult areas.

As the user gains more experience their needs and goals may change as they develop a new perspective of what is possible with a prosthesis. The therapist should be aware of these changing functional needs and ready to adapt the training program and goal setting with the user.

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