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The New Map:

The Collaborative Plan for Optimal Outcomes for Persons with Partial-Hand Amputations

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LEARNING OBJECTIVES

After completing this continuing education activity, participants will be able to:

- Identify how recent changes in prosthetic options have led to the need for a "New Map" in the care for people who have had finger and partial-hand amputations.
- Recognize the physical and psychological effects on a patient after traumatic partial-hand or finger amputation.
- Outline new strategies and techniques to integrate into therapy programs for people with partial-hand or finger loss.

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The New Map:
The Collaborative Plan for Optimal Outcomes for Persons with Partial-Hand Amputations

The human hand is a functional work of art. The hand can be vision in the dark and a voice when unable to speak. Based on the strength of a handshake, one's work ethic, trustworthiness and status are evaluated. A person's hands tell a story describing vocation, hobbies or even relationship status. Nearly every part of life involves the use of one's hands, making a traumatic partial-hand amputation a particularly devastating injury.

With the loss of one or more digits, many tasks require significant adaptation utilizing one-handed techniques or even changing hand dominance. This often results in the development of compensatory motions and overuse injuries. Compensatory motions with awkward body posture significantly increase the risk of overuse injuries within months after amputation. In fact, 50% of persons with upper extremity amputation experience overuse injuries,[1] estimated to develop within 2-5 years after injury.[2] Additionally, the compensating limb has a high rate of pain at the shoulder (45%), elbow (28%), wrist (28%) and hand (23%).[2] Increased reliance on the unaffected side and the compensatory patterns that develop can become debilitating. Not only is there a concern for overuse injury following a partial-hand amputation but also a concern regarding the patient's function, psychological well-being and quality of life.

Three main psychological stages follow persons who suffers traumatic amputation: panic — "fight, flight, freeze" — triggered by the actual event in the past; awareness they survived the event in the present; and realization they will live with an altered body for the rest of their life.[3] This process includes moving through the stages of grief as they mourn the loss of a body part, resulting in adjustments to self-image, roles, employment and activities.

Traumatic partial-hand amputations have a significant negative impact on quality of life and patients with this injury report a higher disability score on the disabilities of the arm, shoulder and hand (DASH) assessment than those with major unilateral upper limb amputation. This loss in function and independence may cause patients to suffer debilitating anxiety, depression and hopelessness.[2,4,5] Prosthesis options combined with skilled occupational or physical therapy can help patients get back to their meaningful activities.

Given advancements in engineering and technology, Naked Prosthetics (NP) has designed functional, robust prosthesis options for persons with partial-hand amputations. Adoption of, integration of and function with a prosthesis significantly increases with the addition of skilled therapy,[2,6] making the informed therapist a necessary partner with NP. This article introduces guidelines for the informed therapist including pre- and post-prosthetic intervention in collaboration with NP as an integral resource.

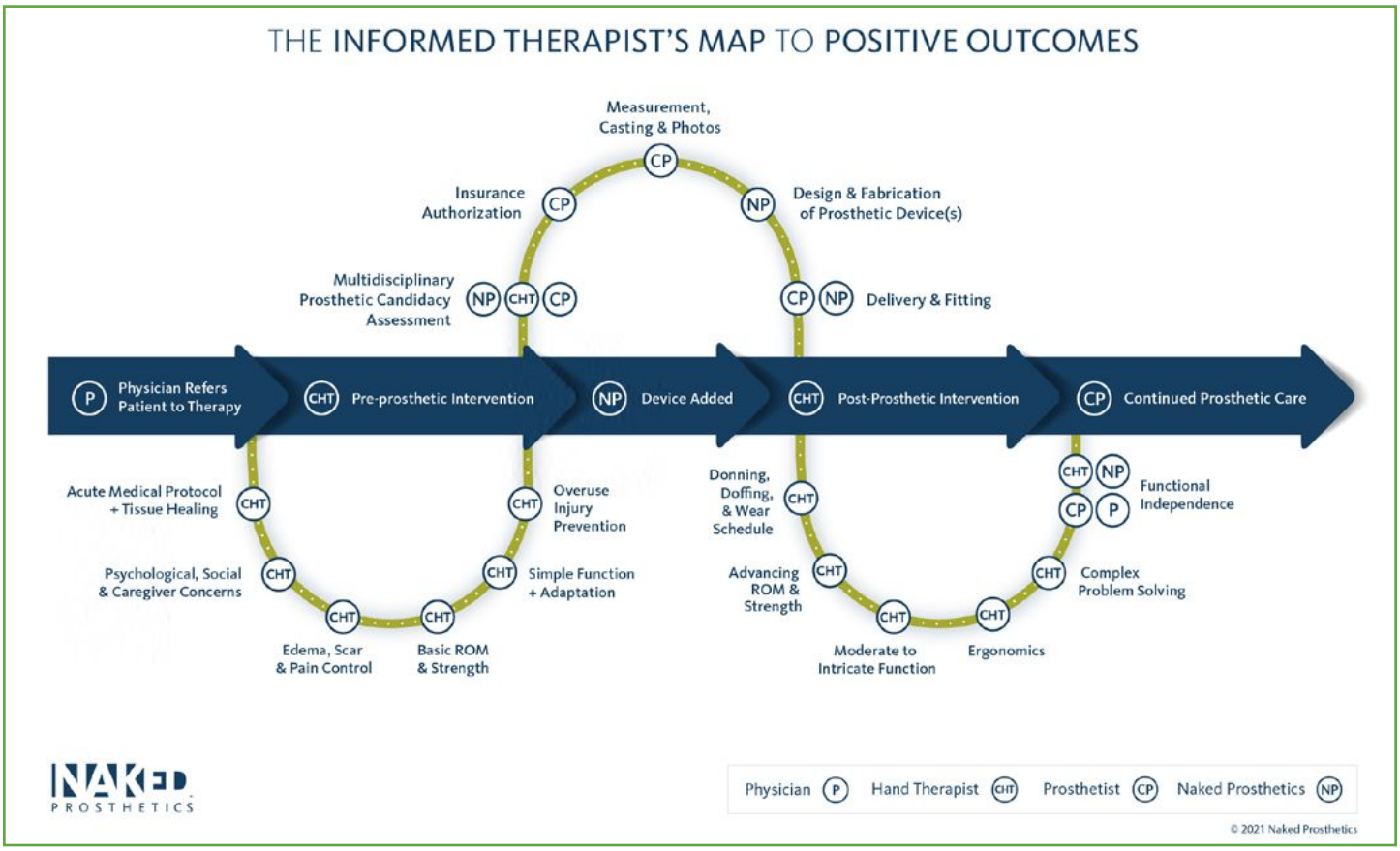
Let's Take a Road Trip!

Imagine we are taking a journey. We have a map, snacks, plenty of hand sanitizer and even a deck of cards for when we get bored. Despite our best efforts, we quickly become lost. Pulling over to the side of the road to investigate, we realize we are referencing a map published in 1954. Since its publication, direct routes have changed, exits have been altered and benchmarks have been redesigned, making our journey longer and more burdensome than we expected. By following the outdated plan, we stand to lose time, energy, confidence, trust, and patience. And we may not even get where we need to go.

We need a new map.

The Old Map

Reflecting on the old map, most people with partial-hand amputations were not referred



for prosthetic evaluation because of the inability of upper extremity prostheses to restore fine or gross motor function. The recovery journey was limited to surgical care and wound healing, while referral to outpatient hand therapy was not considered crucial.[6-8]

The old map illustrates an outdated approach lacking prosthetic and therapeutic interventions, resulting in non-optimal care. Considering current advancements in prosthesis design and multidisciplinary intervention, this antiquated strategy is obsolete.

The New Map: Pre- and Post-prosthetic Intervention

Multidisciplinary intervention, combining the expertise of surgeons, therapists and prosthetists, is the optimal system of care for persons with traumatic partial-hand amputation.[3,6,8,9] Thanks to organizations like NP, connecting the dots between these providers, multidisciplinary care is increasingly possible. This collaborative approach allows for initiating therapy as early as 3-5 days after amputation,[6] long before the person is evaluated by a prosthetist. Therapeutic intervention during this pre-prosthetic phase is driven by the needs of the patient's healing tissue and acute medical protocol in combination with psychosocial and functional considerations.

The informed therapist, most often a certified hand therapist (CHT), is the navigator of rehabilitation for partial-hand amputees. Patients trust that CHTs provide the best map to their success, particularly in the case of an added NP device.

Pre-prosthetic Therapy Guidelines

Using the new map for guidance, 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. Therapy intervention can be affected by environment, lifestyle, community support and roles, and these elements must be included in the initial interview.

The amount of change and new learning required for the patient to complete this journey from injury to independent function with a prosthesis can be an overwhelming surprise and cause of frustration, making it even more important for the informed therapist to offer encouragement and support throughout the process. The initial evaluation of cognitive flexibility may be as simple as discerning the patient's learning style and adapting to it. If there are significant concerns about memory or insight, more formal assessments such as the Allen Cognitive Level Screen may be appropriate to shape the plan of care.[10]

The psychosocial impacts of this injury can make navigating the process confusing and may include anxiety, post-traumatic stress disorder (PTSD) and depression. Fifty percent

of workers with hand injuries experience generalized anxiety 5 days after injury, which may be during the initial evaluation timeframe.[6,9] PTSD presents with repetitive memories, flashbacks and nightmares. Educating the patient on this possibility may help them manage fears of returning to the injury site as well as understanding how certain noises may cause emotional distress. Grief is a normal and universal reaction to loss and is anticipated. Depression may need to be screened and treated.[9]

CLINICAL TIP:

Design a home program to enhance participation by optimizing content for learning styles (kinesthetic, visual, read-write, auditory), such as a video-recorded home program instead of a simple handout of exercises.

It is possible for someone recovering from traumatic amputation to hold on to the irrational hope that the lost limb will grow back. Hiding an injured limb is a common avoidance behavior and may extend to neglecting appropriate care of the injured upper extremity.[8] The informed therapist remains vigilant in recognizing and addressing these ideation and hygiene concerns.

Patients with fears of reinjury and falling may present with a hesitancy to leave their home after dark,[8] possibly indicating the need for a balance assessment and intervention to promote confidence and safety. Finally, anxieties regarding societal and interpersonal interaction can be addressed by recommending a support group, involving family members in therapy and referral to other clinical team members.

CLINICAL TIP:

Use a standardized screening tool for depression, anxiety and PTSD, and if appropriate, refer the patient to a multidisciplinary team member specializing in these concerns. Also, consider recommending a **Finger and Partial Hand Amputee Peer + Support Group**.

A swollen or irregularly shaped residuum may not only present functional challenges, but also challenges for fitting a body-driven prosthetic device. Retrograde massage, elevation, active range of motion and compression can be included to achieve edema control. Careful thought given to wrapping techniques helps shape the residuum to reduce irregular pressure and increase surface area.[3,6,8,11]

CLINICAL TIP:

Wrap the distal aspect of a residuum with figure-eight, distal-to-proximal compression to facilitate uniform shaping of the healing digit.

Adherent scar formation is a common and frustrating obstacle after amputation. Tight scarring on the end of a residuum makes it more susceptible to breakdown or irritation if tissue shear occurs with the added prosthesis. When the fingertip and palmar-side skin are amputated the stratum lucidum layer of the epidermis is lost, resulting in skin complications.[12] The residuum may be covered by grafted or wrapped skin which lacks this unique protective layer of keratin, eleiden and thickened plasma membranes making it more prone to injury. Highly active people with partial-hand amputations often experience painful dryness and skin cracking and would benefit from education on skin care.

CLINICAL TIP:

Use many therapeutic options for scar treatment including scar mobilization, manual therapy, compounded scar creams or silicone liners.

Phantom sensation and phantom pain education are appropriate during early treatment. If phantom limb pain is a concern, mirror therapy has been shown to be an effective tool.[13-15] Because so many of these patients experience hypersensitivity after pain has resolved, navigating sensory needs and desensitization is a part of every plan.[3,16] The informed therapist tailors the program appropriately for cases with lost sensation, particularly for patients who are unaware of sensation changes.

CLINICAL TIP:

Educate about the consequences of sensation changes with safety concerns and include desensitization strategies if hypersensitivity is present. Sensory and desensitization strategies are available on the **NP website**.

Before the patient is fit for a custom prosthesis, improvements to range of motion and strength are important for function and independence. Because of the loss of structures with amputation, remaining anatomy guides the program. For example, if the amputation occurs at the PIP joint, the individual will likely have lost function of all extrinsic digit flexors (FDS and FDP) and the resulting motion of the MCP joint relies on the intrinsic hand muscles (lumbricals and interossei). The informed therapist designs an exercise program to successfully activate these intrinsic muscles, which promotes active range of motion and functional strength.

At this point in the journey, basic function in every avenue of life can be assessed. The informed therapist works with the patient to gain independence in practical goals like wound dressing changes or compression garment application. Additionally, picking up large-diameter items may become difficult and add strain to the affected hand. Even common tasks like holding a pencil can be challenging.

CLINICAL TIP:

Strengthen the hand with resistance putty, bands and daily functional use.

CLINICAL TIP:
Practice therapist-guided activities such as hand washing without breaking applicable precautions. Add grip material or a handle to the patient's cell phone to accomplish simple function and adaptation.

Evaluation of the health of adjacent digits, proximal joints, the compensating limb, cervical spine and body posture is important because these structures will have an increased demand for repetition, strength, and endurance. The presence of an overuse injury could exacerbate functional impairments. Educating on preventative strategies and addressing concerns before tissue dysfunction occurs helps prevent overuse injuries such as: rotator cuff tendonitis, subacromial bursitis, lateral and medial epicondylitis, carpal and cubital tunnel syndrome, DeQuervain's syndrome and trigger finger.[1,2,17,18]

Without skilled intervention, many persons with amputations experience these complications due to improvised compensation required from the rest of the body.

CLINICAL TIP:
Use a mirror during functional tasks to help the person observe their own posture and gain body awareness, allowing self-correction.

Another key part of pre-prosthetic therapy is early inclusion of a multidisciplinary prosthetic candidacy assessment. Applying well-fit, body-driven prosthetic devices can restore bilateral hand function for many tasks and significantly reduce compensatory motions.[6] Matching anatomy with goals is a requirement for excellent outcomes when adding a partial-hand prosthesis.

Anticipating this addition is often a powerful motivator for the patient to gain range of motion and strength, another reason to include a candidacy assessment early in this journey.

CLINICAL TIP:
Consult the **Naked Prosthetics Clinical Care team** for specific questions related to candidacy assessments.

As a DME manufacturer, NP does not bill the patient's insurance directly, but acts as a resource for the prosthetist during the authorization process, which is initiated after candidacy is confirmed. Depending on which device provides the most function, the following may be required from the ordering prosthetist: photos, videos, ring sizes, a positive cast and ROM measurements. Design and fabrication of body-driven prosthetic devices begins after insurance authorization and all needed measurements are received by NP. Once the device has been delivered to the prosthetist, NP is available to assist with a fitting appointment for the patient and prosthetist to ensure best fit. Together, the prosthetist and NP work with the patient to ensure best fit on delivery.

CLINICAL TIP:
Refer to **NP's FAQs for Therapy Practitioners** document for further information.

Post-prosthetic Therapy Guidelines

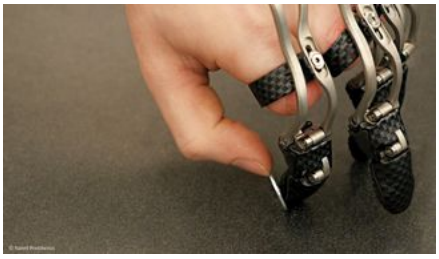
A milestone in the recovery journey is marked by the addition of a body-driven, functional NP device. As the navigator of this journey, the informed therapist maps the course for patients to functionally integrate a new device by understanding their needs, goals and abilities.

Precautions in therapy programs utilizing NP body-driven prostheses include high-impact activities (martial arts), forced full extension or flexion beyond the design of the device mechanism (push-ups) and entangling on exoskeleton design (fishing wire). Other limitations are guided by the device's material properties which cannot tolerate temperatures above 350°F. Exposing the device to temperatures beyond normal safety levels is not recommended because of its proximity to the wearer's natural anatomy.

NP device wearers typically achieve full-time use tolerance after 3 weeks. To prevent fatigue and skin breakdown, start a wear schedule of 30 minutes, 3 times

daily, and increase wear time if no negative symptoms occur. In addition to teaching a wear schedule, the informed therapist helps their patient learn how to don and doff the device independently.

CLINICAL TIP:
Record skin status pre- and post-activity with photo documentation.



NP body-driven prostheses offer intuitive response to the user, giving immediate predictability during motion. They have an output ratio of 1 to 1 for the **PIP**Driver™ and 2 to 3 for the **MCP**Driver™, allowing the patient to anticipate the force output almost immediately. This allows for natural control and safety with delicate activities and at the same time high functional strength. For example, a potato chip can be handled without crushing it because the user controls the device intuitively. This relationship between the person and the prosthesis means increased strength of the driving anatomy directly increases the force output of the prosthetic fingertip. In addition to advancing range of motion and strength, new motor learning occurs making it important for the informed therapist

CLINICAL TIP:
Continue evaluation of range of motion and strength and address imbalances or limitations.

to plan ample time to gain awareness and proprioception while using the device.

Continue the prosthetic training program with simple, single-handed exercises. Then progress to bilateral tasks of moderate difficulty and then to intricate, involved activities of daily living to progress prosthetic training and adoption.

While addressing functional needs, the informed therapist analyzes tool size, shape and angle of use, making adaptations to match the gripping capabilities of the prosthesis. Ergonomic principles are also applied to the patient's oft-used workstations.

CLINICAL TIP:
Build up handles on power tools, utensils or drumsticks to match the narrow "C" grip of NP devices. Develop a functional dexterity checklist based on the patient's valued activities (e.g., knotting a man's tie, managing a makeup bag, caregiving for infants or animals).

The final leg of the journey includes assisting the patient with the navigation of complex and challenging tasks. At this point, the patient is independent with basic and more intricate activities of daily living, and now it's time for complex problem solving of challenging goals (like playing an instrument or managing fishing gear).

The rehabilitation journey ends when pre- and post-prosthetic intervention has been completed and functional independence is achieved. The informed therapist has steered the course through this comprehensive guideline map, assuring the patient's best possible outcome.

CLINICAL TIP:
Administer timed practice sessions to problem-solve these complex and challenging activities with applicable equipment.

Conclusion

Advances in technology have necessitated a new therapy map for persons with traumatic hand amputations based on a multidisciplinary approach including a certified hand therapist, certified prosthetist and NP. Navigated by the informed hand therapist, this new map provides guidance through all the stages of prosthetic intervention for traumatic hand amputation cases. Pre-prosthetic therapy guidelines include managing acute medical protocol in light of physical needs, addressing psychosocial concerns, functional adaptation, overuse syndrome prevention and multidisciplinary prosthetic candidacy assessment. Receiving an NP body-driven prosthesis is a milestone in the journey that continues with multidisciplinary care. Post-prosthetic therapy guidelines include device use precautions, practical education on a wear schedule, adaptation of tools to fit available ROM of the prosthesis and complex problem-solving for functional independence. Going forward, the certified prosthetist continues care by assisting with fit optimization and lifetime maintenance of the NP device.

By collaborating with NP and a prosthetist, the informed therapist helps people with partial-hand amputations prevent overuse injuries, optimize function and realize a sense of wholeness with the addition of an appropriate NP device.

A manufacturer of high-quality prosthetic devices specifically for finger loss, NP offers free candidacy assessments as well as a world class Customer Care Team to answer questions and connect the informed therapist to physicians, prosthetists and other therapists. Designing and manufacturing products isn't all they do — NP gets people back to work, performing most ADLs, and back to doing the things they love.

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