**Supplemental Material**

Video Legend, Table III, Table IV

**Video Legend**

1. Toileting
2. Donning t-shirt
3. LBD
4. Eating universal cuff
5. Eating with a spoon – prostheses
6. Donning prostheses
7. Doffing prostheses
8. Applying toothpaste and brushing teeth
9. Brushing teeth with universal cuff
10. Pouring water from a cup
11. D1 flexion theraband – right
12. Scapular protraction retraction theraband – bilateral

Table III: Physical Therapy Interventions

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| **Category** | **Intervention** | **Outcome** |
| **Therapeutic Exercises** | Lower extremities | * 3-way hip strengthening in parallel bars: body weight progressed to 3-pound ankle weights
* Forward and lateral step-ups in parallel bars
* Squats at countertop
* Standing hip abduction- active ROM at countertop
* Supine exercises with manual resistance
	+ Clamshells, heel slides, hip flexion, hip abduction, bridges
* Leg press at percentage of patient’s body weight (10, 20, 25, and 30 degrees = 30%, 50%, 60%, and 70%, respectively)
* Dynamic side stepping, including over obstacles
* Sit to stands
* Nu-step machine, Model: T5XR, year 2013
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| Upper extremities | * With resistance band attached to forearm cuffs:
	+ D1 flexion (shoulder flexion and adduction) [Video-11]
	+ Bicep curls
	+ Triceps extension with shoulder extension
	+ Serratus punches: Unilateral and bilateral [Video-12]
	+ Shoulder flexion
	+ Shoulder abduction
	+ Shoulder horizontal abduction/adduction
	+ Rows
* With cable column attached to forearm cuffs:
	+ D2 extension (shoulder extension and adduction)
 |
| Core | * Trunk rotation with UE on fly machine
* Seated crunch with rotation
* Transverse abdominis activation in hook lying
	+ Progressed to include oblique activation
	+ Progressed to include trunk rotation
	+ Progressed to modified sit-up (active assisted ROM)
* Standing crunches with forearm cuffs attached to cable column
 |
| **Neuromuscular****Re-Education** | Balance training | * Slow hold perturbations in unsupported sitting
* Standing reaching task, incorporated squats
* Multidirectional walking without device
* Toe taps with UE support
	+ Progressed to without UE support
* Static stand on foam
	+ Progressively narrowed base of support
* Multidirectional stepping target practice
	+ Progressed to increase speed
 |
| **Therapeutic Activities** | Managing UE prostheses | * Initiated don/doff schedule with grid posted on wall
	+ Week 1: 2 hours on/off
	+ Week 2: 4 hours on/off
	+ Week 3: 6 hours on/off
	+ Week 4: 8 hours on/off [did not progress to this level]
* Written/pictorial guide for donning/doffing prostheses put on wall for nursing
* Utensils placed in universal cuff for feeding
* Practiced prosthesis hook with feeding
	+ Built up handles of utensils
* Reaching for rings with prosthesis
* Practiced pants up/down with prosthesis
* Practiced toileting with prosthesis (unsuccessful)
* Custom forearm toileting aide trialed with toileting (unsuccessful)
* Practiced don/doffing prostheses
	+ Prostheses had a designated hook on wall
	+ Also attempted in supine on bed
* Combing hair with hook prosthesis
	+ Able to comb 2/3 of head, but unable to reach posterior/inferior part of scalp
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Table IV: Occupational Therapy Interventions

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| --- | --- | --- |
| **Category** | **Intervention** | **Outcome** |
| **Washing face** | Bath mitt on left residual limb for washing face. | Good improvement.Initially able to wash left side of face independently, ModA\* for right side of face. This progressed to set-up assist of washcloth and she washed entire face with residual limb(s).Recommend use of soap pump.  |
| **Oral hygiene** | Practiced brushing teeth with 2 methods [Video-8]: 1. Toothbrush in universal cuff – used tongue or residual limbs to flip brush head to access all sides of teeth [Video-9].
2. Extra-long toothbrush handle held between knees with double sided toothbrush head.

Toothpaste management practiced with 2 methods:1. Use teeth to grasp cap while residual limbs stabilize tube and she unscrews cap, then residual limb squeezes tube while pressing against table top – unable due to poor dentition and very few teeth left.
2. Use of pump toothpaste container – recommended.
 | Good improvement.Initially, dependent – MaxA†: able to partially brush left side of teeth with toothbrush in universal cuff, but needs assist for thoroughness on left and to brush right side. Extra-long toothbrush handle between knees was very energy taxing and continued to require assist – she prefers universal cuff method. Practiced placing toothbrush into universal cuff and progressed to independent. Trialed using prosthesis, but length of prosthetic arm with toothbrush is extremely long and pt overshoots and has decreased control compared to universal cuff. |
| **Bathing** | Set-up assist for long-handed sponge to right residual limb with Coban® and bath mitt on left residual limb. Instructed patient to cross legs in “figure-4” to reach LE and feet. Therapy bent handle of long-handled sponge to improve access to buttocks and perineal area and recommends she sit on bath sponge for thorough cleaning of perineal area as balance and access in standing squat is difficult for patient. Additionally, for hard to dry areas post-shower, recommended placing towel on seat of rollator to assist in drying perineal area, towel on bed and patient transfer to supine to dry her back and use extra time to finish air drying in supine prior to dressing.  | Excellent improvement. Initially dependent. Progressed to MinA‡ overall with assist required under chest, for back, and thoroughness of perineal area. Other therapists beyond primary occupational therapist bathed patient dependently which limited the patient’s practice, indicating the importance of consistency with providers.For home use, could consider a wall-mounted loofah on the backrest of a transfer tub bench and a full body dryer as adaptive equipment.  |
| **Toilet transfers** | Practiced with and without rollator.Practiced with and without bedside commode over toilet. Easier for her to transfer on/off with use of bedside commode, but reduced access to peri-area using bedside commode due to hip abduction blocked and abdominal pannus.  | Good improvement with addition of rollator. Initially MinA without device. Progressed to Independent with use of rollator. Ultimately, no bedside commode used.  |
| **Toileting** | Numerous techniques practiced: Clothing Management:1. Practiced donning/doffing pants with UE prostheses – initially lack of prosthetic wrist joint (static wrist) limits access to pants, but also cable system limits grasp and release when prosthesis is reaching for side/back of pants.
	1. Once wrist joint installed, practiced locking/unlocking wrist joint to increase flexion angle to improved positioning – significant effort and time required.
2. Trialed residual limbs hooking inside of pockets to pull pants up – unable to get back of pants over bottom.
3. Trialed residual limbs hooking inside of stretch pants to pull pants up – unable to get back of pants over bottom.
4. Therapy sewed a pair of loops on lateral and posterior aspects of scrub pants – continued MinA to get pants over bottom with residual limbs and extra time.

Hygiene Management: 1. Practiced using copious toilet paper with prosthesis.
2. Trialed custom designed toileting aid made from splinting material for her to use with urgency or at night when prostheses are not in place – MaxA and unable to reduce burden of care.
 | Limited improvement. Initially dependent. Progressed to ModA for pants up with extra time, and independent for pants down with extra time, but extra time not always available due to urgency. MaxA for hygiene, whether using prostheses or custom toileting aide. Unable to use residual limbs. Recommended wearing dress with no underwear and purchasing a bidet with cleaning and drying options.Also, the patient would have benefited from dressing hooks installed slightly below the waist level – one hook facing up and one hook facing down – for pulling pants up and over the bottom and for pulling pants down over the bottom, respectively.  |
| **Eating** | Initially provided patient with long straws, condiment holder to keep meat and cheese sandwich together, cup with lid, and plate guard. Modified fork and spoon by elongating and thickening handles for use in universal cuff and with prosthesis(es).With prosthesis:1. Practiced doffing paper from straws with prosthesis (difficult due to fine motor task)
2. Practiced locking/unlocking wrist joint by forcefully pushing button on hard surface/table top.
3. Practiced grasp and release with prostheses – length of harness straps modified by prosthetist for optimal length and reduced effort by patient.
4. Practiced opening/closing various containers with prostheses, pouring water from one container to another, passing items from one prosthesis to another, and lifting and carrying items while sitting to standing
5. Simulated meal prep activity in kitchen with use of rollator and prostheses, including obtaining items from refrigerator and use of microwave.
6. Practiced use of utensils with prostheses (set-up for knife in left prosthesis) – able to cut foot and feed self with supervision and extra time.
 | Good Improvement. Initially dependent. Achieved independence with donning universal cuff (using mouth/teeth as an additional appendage), placing utensils in cuff, and using the utensils for feeding. Set-up assist required for straws in cups and cutting with utensils.Patient with difficulty removing paper from straws – recommended use of metal/reusable straws. If using prostheses to eat:1. Prosthetic forearm should be supinated 15 degrees for bringing fork/spoon to mouth.
2. To drink from a cup, prosthetic forearm should be pronated 15 degrees and patient grasps rim of cup at 12 o’clock position with hook and drinks from the cup with mouth at 6 o’clock position.
3. Prosthesis in 15 degrees of supination provides the best position for keeping a plate level while carrying it.

Therapy recommends use of simple microwave meals at home.  |
| **Dressing** | Upper Body:Initially dependent. Educated patient on excessive trunk movement and loose-fitting t-shirt required to shake pull shirt down over trunk in stand and progressed to supervision and extra time.Initially dependent progressing to MinA-ModA donning sports bra for pulling down in front and placing band under breasts.Initially dependent progressing to Independent doffing t-shirt.Lower Body:Practiced donning socks with bilateral prostheses (set-up assist to place socks in prostheses)Attempted donning pants in sitting, supine, and side lying with prostheses – continued to be MaxA – dependent. Trialed figure-4 position and residual limbs to lace legs into pant holes, then pulling up with residual limbs in a variety of ways: with loops sewn onto pants, using limbs in pockets to pull up, or using limbs on inside of pants to pull up. MinA-ModA with these residual limb methods.  | Good improvement with donning/doffing shirts. Initially dependent for UBD but progressed to supervision for t-shirt and MinA-ModA for sports bra. Limited improvement with LBD and donning/doffing bra. Initially dependent but improved to ModA for pants up and Independent for pants down with extra time. Able to don pants with MinA if loops are sewn on sides and back of pants. Recommended to patient wearing dresses without underwear to avoid LBD and for toileting. If insisting on wearing pants, recommend looser pants with elastic waist for ease of donning (not leggings) and dressing hooks installed on walls at home.Recommended wearing camisole instead of bra or no bra. Recommend slide on shoes without laces. |
| **Therapeutic exercises** | **Bilateral UE strengthening*** Active ROM and isometric exercises of all shoulder motions and scapular protraction/retraction. Progressed shoulder active ROM to wrist weights of one pound.
* Shoulder circles.
* Shoulder diagonals.
* Forearm pronation and supination.
* Progressed from in sitting to in standing.

**Core Strengthening*** Isometric transversus abdominis holds. Progressed to include LE marching, marching with opposite shoulder flexion with 2-pound weight, shoulder flexion with adduction, circles with 2-pound weight, and with flutter kicks. Progressed from supine to sitting.
* Seated march
* Modified crunches in sitting. Progressed to semi-supine on wedge.
 | Good improvement with UE motor control for prosthesis use; limited improvement for strength gains – likely underdosed resistance. Patient improved in her functional strength, as well as motor control with scapular retractions for prosthesis opening/closing. Core strength moderately improved, core weakness limited standing balance and flexibility for LBD and toileting. |
| **Patient and family education/ Prosthetic Education** | Co-treatment with prosthetist for UE prostheses use and modifications including: 1. Changing terminal device from cosmetic hand with grasping function to hook
2. Shortening harness cables to improve ease of patient grasping and releasing terminal device
3. Addition of a mobile wrist joint (initially static) with instructions and practice to lock/unlock wrist and then flex/extend or pronate/supinate
4. Socket system changed from pin-lock to slide on.

Educated on donning/doffing techniques of prosthesis (instructions with pictures posted on patient’s wall): 1. Prosthesis hung on blunt hook on wall while patient backs up to prosthesis and able to don first prosthesis independently, but ModA to don second prosthesis and shrug shoulders to place harness straps in correct position. Independent to back up to hook, shrug shoulders, and doff.
2. Prosthesis laid out on bed and patient able to don left prosthesis, but req modA to swing prosthesis around back and don right prosthesis, as well as adjust harness straps.

Educated on wearing schedule (2 hours on, 2 hours off, progressed by 2 additional hours on/off weekly) – wearing schedule posted on wall. Peer mentor utilized to assist with education and demonstration for donning prostheses and prostheses use with function. | Excellent improvement with patient education. Limited improvement with staff/family education.Patient independent with directing caregiver in donning prosthesis. ModA to don prosthesis when suspended from blunt hook on wall or flat on bed, but independent when doffing. Would have benefited from an UE dressing tree mounted on a wall at home for increased independence. Wearing schedule not adhered to – must make this a point of emphasis with patient and nursing staff. Family training initiated late in patient’s stay due to visitor restrictions with Covid-19 pandemic. Family member unable to provide level of assist needed for home discharge with toileting, bathing, and LBD.  |
| **Prostheses management** | Practiced the following:* Opening doors with prosthesis
* Taking off paper with straws.
* Brushing teeth with prosthesis.
* Eating with a fork and cutting food items with fork and knife with prosthesis.
* Toileting: pants management and hygiene with prosthesis
* Significant practice with opening and closing prosthesis and prolonged grasp.
* Grasping cups
* Pouring water, placing items on high shelf, passing items between prostheses, and picking up items from floor [Video-10].
* Carrying items (plates, plastic containers, boxes)
* Cooking activity with microwave
* Locking and unlocking wrist joint of prosthesis – practiced pressing release button against various firm surfaces: wheelchair armrest, table top (bed too soft), rollator seat
* Writing by grasping pen.
* Donning and doffing prosthesis
 | Good improvement. * Opening doors: easiest to use lateral aspect of terminal device combined with supination on lever-style door knobs. Difficulty grasping knob style doors due to excessive supination/arm external rotation required to open with this handle.
* Difficulty taking paper off straw – recommend use of reusable straws.
* Wrist joint at 15 degrees of supination provided the most stability when carrying plates for this patient.
* Patient initially grasped items very tightly, often breaking foam cups, but improved in her motor control and proper force when grasping items.
* Hand writing improved legibility with practice.
 |
| **Home modifications** |  Recommended the following to the patient:* Wearing no bra but possibly a camisole
* Wearing a dress without underwear and using a bidet with cleaning and drying functions for toileting
* Long-handed bath sponge with bent handle for showering; loofah board mounted on back of transfer-tub bench
* Using transfer-tub bench and removing glass doors in shower
* Eating primarily microwavable meals, placing dishes at easy to reach levels on counter, use of rollator seat for transport and using unbreakable dishes
* If insisting on wearing pants, needs dressing hooks installed near gluteal fold level on a wall at home.
* Easy to open containers (ie – flip top) for all items: storage, food, drinks.
* Pump toothpaste and soap
* Universal cuffs on each UE – openings of cuffs modified to make narrower for improved fit of stylus and eating utensils
* Use of Dycem® or Velcro® on tabletop to stabilize frequently used items (ie – cell phone, remote control)
* Recommend book stand to stabilize items when reading.
 | Excellent improvement when all techniques are used - All of these provided significant benefit for the patient and ability to perform ADLs§. Although patient did not achieve independence with all ADLs, these modifications provided a significant reduction in burden of care.  |

\*Moderate assistance; †Maximum assistance; ‡Minimal assistance; §Activities of daily living