

# MacHAND Performance Assessment (MPA) 2.0

## Instructions and Scoring Manual

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MPA 2.0 Revised wording of instructions, scoring and images by Zoë Edger-Lacoursière and Bernadette Nedelec, McGill University, 2024

## MachHAND 2.0 Performance Assessment Instructions and Scoring Manual

The MachHAND Performance Assessment (MPA) is an adaptation of the original Ahuja Functional Hand Assessment developed by Mohini Ahuja, an occupational therapist at Chedoke McMaster Hospitals in Hamilton, Ontario. The original test kit of the Ahuja was adapted by replacing some of the equipment with common items to allow for easier reproduction and accessibility. The manual was also reworded to improve standardization, support reliability, and allow for ease of use (MPA 2.0).

Each MPA item represents a functional task involving one or more specific grasp or pinch patterns of the hand. This target motion is specifically noted alongside the description of each item. Instructions and a scoring key are also provided for every item.

This assessment has been created for individuals **aged 16 years old and up** who present with any type of hand injury, condition or impairment.

### **Items for Assessment Kit**

*The following items are needed to assemble the assessment battery. Some items have the option to be 3D printed to increase standardization (Indicated with this icon). If you do not have access to a 3D printer, we encourage you to contact local libraries and/or universities that could print them for you.*



-Stopwatch

-Standard doorknob **with key** (conical, not spherical); ours was mounted into a miniature frame and used on the tabletop (refer to photo next to item #1 in the manual). A door can also be used for this task.

-6oz. head tack hammer (170g head); 16oz. head claw hammer (450g head) (both with wooden handles). (Note, the 6oz tack hammer weighs about 225g with the wooden handle and the 16oz claw hammer weighs about 640g with the wooden handle). If the weight of the head needs to be adjusted to have these weights, we recommend using lead tape to do so.

-Large peanut butter jar (Kraft™ 1kg size); lid is tightened by the therapist until snug and a mark is made across the lid and jar as the indicator line for standardization. If this is not available in your country, these are the dimensions and weight of the jar: 9cm diameter, 16cm height, 1060g weight. Due to the high prevalence of peanut allergies, we also suggest emptying the contents of the jar and replacing it with another solution or keeping the contents sealed within the jar.

-Full soft drink can (355mL), weight of 380g.



-3D printed or Styrofoam™ disks 15mm thick; diameters = A =4.5cm, B=7cm, C=9.5cm, D=12cm, E=15cm. The 3D printed STL files for the disks can be found here: <https://www.thingiverse.com/thing:6131146>

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-Corelle™ dinner plate. If this is not available in your country, these are the dimensions and weight of the plate: 26cm diameter, 340g.

-6 inch square of Dycem or Ultimat (non-slip surface).



-3D printed or Styrofoam™ slates 15mm thick (width); 4.5cm height, length = A = 11.5cm, B = 13cm, C = 14.5cm, D=16cm. The 3D printed STL files for the slates can be found here: <https://www.thingiverse.com/thing:6131151>



-1 Canadian penny & 1 aluminum washer similar in size to penny; 1 standard metal paper clip & 1 safety pin similar in size to paper clip; 1 1/8" square nut & 1 1/4" hex nut; 1 1" long wood screw. All of these items can also be 3D printed. The 3D printed STL files for all these items can be found here: <https://www.thingiverse.com/thing:6131134>

-PaperMate™ classic ballpoint pen and writing test paper.

-2 prong indoor extension cord type A for North, Central, South America, Thailand, China and Japan. For other countries, use an extension cord with the most commonly used type of outlet where a lateral pinch can be used.

-Straight pin with glass or plastic head & small square of cotton broadcloth fabric approx. 2"x2" or 5cmx5cm.



-10 Canadian dimes or 10 3D printed dimes. The 3D printed STL files for the 10 dimes can be found here: <https://www.thingiverse.com/thing:6131137>



-5 buttons sewn onto fabric like a shirt, spaced 5 cm apart; button sizes 23mm (2), 18mm (2), and 14mm (2); Mounted onto a wooden frame 30cm x 30cm that can easily be pivoted to reflect the orientation of the opening to match the traditional presentation for men and women (refer to photo next to the item in the manual; commonly men buttons are on the right side and women buttons on the left side). The buttons can also be 3D printed. The 3D printed STL files for the buttons can be found here: <https://www.thingiverse.com/thing:6131140>



-Nut and bolt on a wooden block or 3D printed: Two 1/4 inch coarse thread hex nuts and a 2 inch bolt (1/4 diameter) set into a block of wood 6cm x15cm (minimum of 2.5cm thick); bolt is sunk into block from bottom so will sit flat on a table; leaving 1 1/4 inch of the coarse-threaded bolt exposed. First nut is threaded tightly down to wood surface; second nut is finger tightened down to level of first nut (see picture in item description). The 3D printed STL files for the nut and bolt on a block can be found here: <https://www.thingiverse.com/thing:6131122>

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-Standard 9-hole peg board with 6 pegs, or 3D printed 6-hole peg board. The 3D printed STL files for the 6-hole peg board and pegs can be found here: <https://www.thingiverse.com/thing:6121957>

-Two 2L plastic jugs (ours were from Rubbermaid™) with volume markers on side (markings at 1/2L and 1L on one jug and markings at 1L and 2L in the other jug).

-3 qt. stainless steel saucepan (Betty Crocker™). If this is not available in your country, a stainless-steel saucepan weighing 830g without the lid that can contain a minimum of 1L of water can be used.

-Corelle™ cereal bowl (532ml). If this is not available in your country, these are the dimensions and weight of the bowl: 16cm diameter, 5cm height, 190g.

-1/2 c. dried navy beans.

-1 soup spoon (15ml, 70g).

-680mL can of spaghetti sauce. These are the dimensions and weight of the can: 8.5cm diameter, 14cm height, 805g.

-1.36L can of tomato juice. These are the dimensions and weight of the can: 11cm diameter, 17.5cm height, 1555g.

-900mL soup broth box. These are the dimensions and weight of the box: 6cm width, 18.5cm height, 9cm length, 940g.

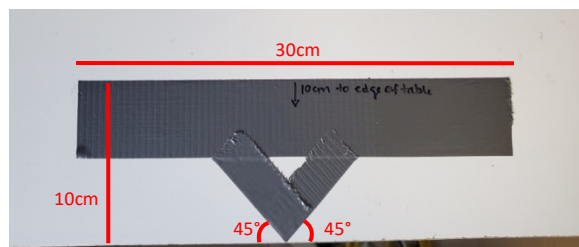
-1.8kg box of dishwasher detergent. These are the dimensions and weight of the box: 5cm width, 23cm height, 18.5 cm length, 1655g.

-Wooden or melamine “open box” to create a shelf 16 inches (40cm) above the table (ours was 16” height x 24” length x 12” width outside measurements) made of recycled melamine shelving and aluminum brackets. Add tape on the side panels to indicate a height of 10cm (4”) and 15cm (6”) (see picture in item description #17)

-1” thick, soft material (to reduce noise and vibration, such as bubble wrap) to hammer.

-Visual analogue scale (VAS) to assess pain. (An attached VAS scale is provided in **appendix 1** if you wish to print a copy.)

-30cm masking tape or other type of tape to stick on the testing table parallel to the edge of the table at 10cm (4”) distance from the edge. 2 other pieces of tape should be placed on the table to indicate a 45° from the edge of the table (on the right and left). See picture:



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**General Scoring Guidelines**

- 5 Performs function within normal limits**  
Subject is able to perform task without difficulty, stiffness, pain; VAS = 0, weakness or incoordination
- 4 Performs function with minimal difficulty**  
Subject is able to perform task but with some difficulty due to awkwardness, weakness, incoordination or mild pain; VAS = >0-3\*. Subject may experience sensitivity but no stiffness.
- 3 Performs function with moderate difficulty**  
Subject is able to perform task but with moderate difficulty due to some stiffness of digit(s) or joint(s), weakness, incoordination, or moderate pain; VAS = >3-6\*.
- 2 Performs function with great difficulty**  
Subject is able to perform task but with great difficulty due to marked stiffness of digit(s) or joint(s), weakness, incoordination, severe pain; VAS >6\*.
- 1 Performs function partially**  
Subject is able to initiate but not complete the task due to severe stiffness or weakness. The movement being assessed must be present.
- 0 Performs no part of function**  
Subject is not able to initiate the task nor is the movement assessed demonstrated.

\*If the subject being tested reports pain for one of the tasks, the pain must be measured using the VAS.

**Interpretation:** The assessment is scored out of 100, with higher scores representing higher levels of hand function.

**IMPORTANT CONSIDERATIONS:**

1) If both hands are affected, **the tested hand should be determined prior to the assessment (see scoring sheet)**. If the evaluator wishes to test both hands, the assessment must be repeated a 2<sup>nd</sup> time with the other hand after the initial hand has completed the entire assessment.

2) **Amputations:** For items requiring the use of all finger(s)(tips) – score with all available digits for amputees. In the presence of one or many finger amputations, for items requiring the use of specific prehension patterns or the use of specific fingers, if the subject can perform the function within normal limits (score of 5) with the residual fingers, the final score given should not be influenced by the fingers or type of prehension used to complete the task.

3) **Adaptive equipment:** For individuals using adaptive equipment (ex: universal cuff), **a list of the adaptive equipment used for each test item must be determined prior to the assessment (see scoring sheet)**. The use of an adaptive equipment does not affect the score. The subject must not require assistance to use the assistive device (Ex: must put the universal cuff on and off by themselves). If the subject requires assistance to use the assistive equipment, the administrator should consider this aspect when scoring the task (Ex: score of 5 with universal cuff = score of 4 if the subject needed help to put on the universal cuff, but could take it off. If the subject also needed help to take it off, the score would become 3 if they are still able to do the task within normal limits).

4) **Bimanual tasks:** The assessor may stabilize items when this is explicitly indicated in the task's instructions, which does not affect the score.

5) **Prosthetic training:** In the clinical setting, this evaluation can be done to evaluate prosthetic training progression. However, not all tasks will be able to be completed with all prosthetics.

**Introduce the assessment by saying:**

***“This test is designed to look at all of the different ways we use our hands to grasp and pinch for everyday activities. You will be asked to do 20 different tasks; and you will be given specific instructions for each task. Let me know if anything causes you pain, and it is ok to tell me if you need to stop at any time.”***

***\*At the beginning of each task, the text written in quotation marks must be read out loud to the subject being tested. The task can also be demonstrated by the evaluator.***

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1. **Door:** [power grasp, reach, wrist flexion, supination] – The subject is asked to open (by pushing) and close (by pulling) a miniature door by grasping the doorknob, making sure that all fingers are flexed around the doorknob, the thumb is abducted, opposed and flexed. The door is angled at 45 degrees to the hand being assessed (use the tape markings on the table). The door apparatus is placed with one edge against the edge of the table and should be stabilized by the subject or tester to ensure it does not move.

***“Open and close the door using all of your fingers to grip the handle.”***

Grade 5: Subject completes the task, demonstrating appropriate grasp as described above; VAS = 0.

Grade 4: Subject is able to complete the task but has some difficulty due to awkwardness, weakness, incoordination or mild pain; VAS = >0-3.

Grade 3: Subject completes task but has moderate amount of difficulty due to some stiffness, weakness, incoordination or moderate pain, VAS = >3-6.

Grade 2: Subject completes task with great difficulty due to marked stiffness, weakness incoordination or severe pain; VAS >6.

Grade 1: Subject is able to initiate task but unable to complete task.

Grade 0: Subject is unable to assume appropriate grasp and initiate task.



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2. **Key:** [*pad pinch, lateral pinch, precision*] – The subject picks up a key off the table-top, inserts it into the lock on the miniature door (which is placed parallel to the edge of the table and locked), and turns the key to unlock. The subject then turns the key in the other direction to lock the door and removes the key from the lock.

***“Pick up the key without sliding it off the edge of the table and insert it into the lock. Now turn the key to unlock the door.”***

***“ Now turn the key to lock the door and remove the key from the lock.”***

Grade 5: The task is completed normally using a lateral pinch to turn the key; VAS = 0.

Grade 4: The task is completed with minimal difficulty or discomfort; VAS = >0-3.

Grade 3: The task is performed with moderate difficulty **OR** the subject has to slide the key off the table **OR** uses alternate methods to pick up the key or pinch the key (if all fingers are present); VAS = >3-6.

Grade 2: The task is performed with great difficulty; VAS >6.

Grade 1: The subject is able to pick up the key and insert it into lock but can only turn it partially or cannot turn it.

Grade 0: The subject is unable to pick up key **OR** assume a lateral pinch.





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3. **Hammer:** [*power grasp and functional elbow flexion/extension*] – The subject is asked to pick up each of two hammers (a) 6oz tack hammer, and (b) 16oz claw hammer and hit a 1” thick, soft material (to reduce noise and vibration, such as bubble wrap or a pillow) five times, positioned 10cm (4”) from the edge of the table. All fingers are to be flexed around the bottom of the handle in a power grasp with thumb abducted and flexed on the handle. Subject picks the hammer up from the surface of the table and performs the task standing up parallel to the table in a comfortable position so that their upper arm remains adducted (close to the body, see below image). If the subject performs the tasks sitting because they are not able to stand up, they are not penalised for this.

***“You will need to stand up to do this task. Pick up the smaller hammer (3a), and use it to hammer the board 5 times.”***

***“This time I would like you to do the same thing with the bigger hammer (3b). Pick it up and hammer the board 5 times.”***

Grade 5: Subject completes the task with both hammers, demonstrating appropriate grasp as described above, with no discomfort anywhere in the arm or hand; VAS = 0.

Grade 4: Subject is able to complete the task but has some difficulty due to mild pain; VAS = >0-3, weakness or incoordination.

Grade 3: Subject is able to complete task with 3a and 3b with moderate difficulty due to some stiffness of digit(s) or joint(s), weakness, incoordination, or moderate pain; VAS = >3-6.

Grade 2: Subject is able to perform task but with great difficulty due to marked stiffness of digit(s) or joint(s), weakness, incoordination, severe pain; VAS >6 **OR** grasp is moderately restricted along with some stiffness of the shoulder, elbow and/or wrist.

Grade 1: Subject is able to pick up both hammers but cannot hit 5 times **OR** subject is able to complete the task only with hammer 3a.

Grade 0: Subject is unable to assume appropriate grasp and initiate task.



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4. **Pouring:** [power grasp, pronation/supination, coordination, endurance] – Standing, the subject pours: 1a) 1/2L from a jug containing 1L of water into a large saucepan, 1b) then pours the water back into the jug from the saucepan; then 2a) process is repeated using a second jug, pouring 1L from a jug containing 2L of water into saucepan and 2b) back again. If the subject performs the tasks sitting because they are not able to stand up, they are not penalised for this.

***“You will need to stand up to do this task. Pour half of the water from jug number one into the saucepan.”***

***“Ok, now pour the water from the pan back into the jug, using the same hand.”***

***“Now we are going to do the same thing, this time with more water. Pour half of the water from jug number 2 into the pan.”***

***“Now pour the water from the pan back into the jug using the same hand.”***

Grade 5: All steps of each task are completed with normal power grasp and no restriction anywhere in the extremity; VAS = 0.

Grade 4: Both components of the tasks are performed with minimal difficulty or discomfort; VAS = >0-3.

Grade 3: The subject is able to complete both components of the tasks with moderate difficulty; VAS = >3-6.

Grade 2: The subject is able to complete only task 1a & 1b with no difficulty, but is unable to complete with the heavier jug **OR** is able to complete both tasks with great difficulty; VAS >6.

Grade 1: Subject is able to complete only steps 1a & 1b with difficulty **OR** is able to pour from both jugs without difficulty (1a & 2a), but is unable to manipulate the saucepan (1b & 2b)

Grade 0: Subject is unable to complete any step.



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5. **Jar:** [*spherical grasp with elbow flexion*] – The subject opens and unscrews a tightly screwed peanut butter jar lid, removing it completely; the jar is held by the contralateral hand using a cylindrical grasp. After removal, the subject re-applies the lid and refastens to the indicator line. If the subject cannot open the tightly screwed lid, they are asked to re-try the task once the assessor loosens the lid slightly.

\*\*Note: Jar can be stabilized by assessor, focus is on the hand removing the lid.

**“Using your (hand not being tested), hold onto the jar of peanut butter, then use your (hand being tested) to open the lid. Try to use all your fingers and remove the lid completely.”**

**“Ok, now put the lid back on the jar until it is tight.”**

Grade 5: All digits are used without any difficulty or pain and the subject is able to loosen the lid, unscrew it and screw it back on tightly without difficulty or discomfort; VAS = 0.

Grade 4: Task is completed with slight discomfort; VAS = >0-3 or minimal difficulty.

Grade 3: Subject is able to perform task but has moderate difficulty due to some stiffness of digit(s) or joint(s), weakness, incoordination, or moderate pain; VAS = >3-6 **OR** Subject is able to unscrew and screw on the lid but does not use all of the available digits **OR** Subject is only able to unscrew lid **after therapist has loosened it slightly**. Once loosened, the subject is able to unscrew the lid and put it back on using all of the available digits without any difficulty.

Grade 2: Subject is able to perform task but with great difficulty due to marked stiffness of digit(s) or joint(s), weakness, incoordination, severe pain; VAS >6 **OR The lid is loosened** by the therapist and the subject is able to unscrew and replace the lid with some difficulty or pain; VAS = >0-3, using all available digits.

Grade 1: Subject is able to unscrew and replace the **loosened lid** with moderate difficulty, pain; VAS = >3-6 or clumsiness.

Grade 0: Subject is unable to initiate task or assume grasp position when the **lid is loosened**.



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6. **Plug:** [*lateral pinch*] – The subject pulls out and fully replaces a plug in the socket of an extension cord, using a lateral pinch.

\*\*Note: Assessor can stabilize the socket side, focus is on the hand holding the plug side.

***“Please hold the socket in your (hand not being tested) hand, and then use your thumb and the side of your index (demonstrate) to pull out the plug and push it all the way back in.”***

Grade 5: The subject holds the socket in the non-tested hand and is able to pull out and replace the plug without difficulty or discomfort, using the thumb, and side of index; VAS = 0.

Grade 4: Same as above, but done with some discomfort, pain; VAS = >0-3 or minimal difficulty.

Grade 3: The task is performed with moderate difficulty or pain; VAS= >3-6.

Grade 2: The subject is able to perform the task with great difficulty or pain; VAS >6; **may slowly ease or wiggle the plug out of the socket** and/or may only replace it partially.

Grade 1: The subject attempts to pull out the plug using the appropriate pinch (if all digits are present) but cannot complete the task due to severe stiffness or weakness.

Grade 0: The subject is unable to initiate the task or assume a lateral pinch (if no thumb/index amputation).



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7. **Pin:** [*fine pad pinch*] – The subject picks up a glass-head straight pin (at its centre) from the table using thumb and index and threads it through a piece of cotton cloth. If the subject has a thumb and/or index amputation, the task should be graded regardless of the grasp pattern used.

***“Using your thumb and index finger, pick up the pin without using the head and without sliding it off the edge of the table and thread it into the cloth. You can hold the fabric in your other hand.”***

Grade 5: Subject picks up the pin from the table on first attempt using index finger and thumb and places it through the cloth without discomfort; VAS = 0.

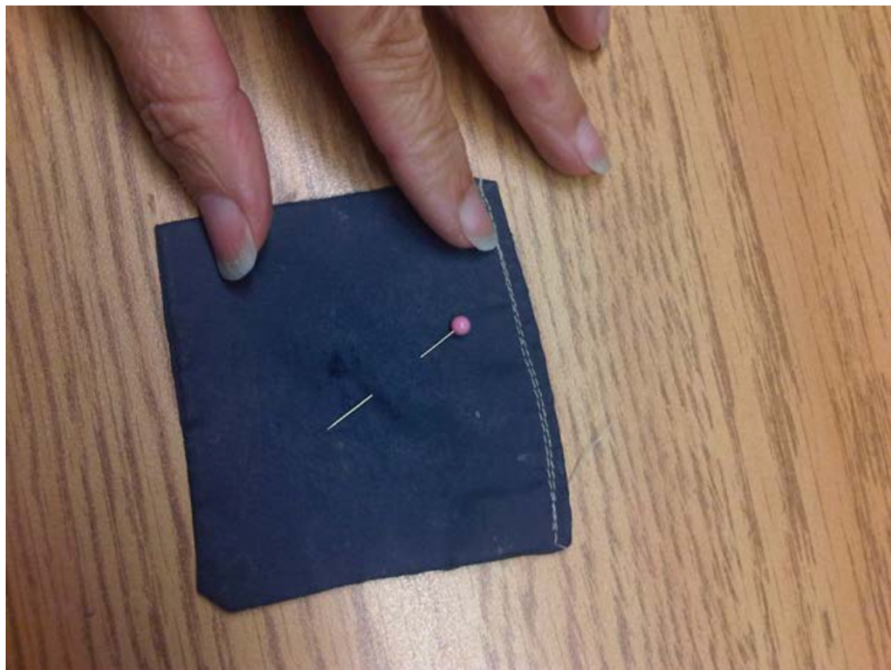
Grade 4: Subject picks up pin after 2 or 3 attempts without awkwardness or compensatory movements (ex: rolling off table), and threads it into cloth; VAS = >0-3.

Grade 3: Subject is unable to pick up pin at its centre but can successfully complete task using head of pin instead (subject must attempt centre point first) using thumb and index fingers if available ; VAS = >3-6.

Grade 2: The subject is able to do as described in grade 3 but with difficulty; VAS >6.

Grade 1: The subject is able to pick up the pin by its head but is unable to thread it into the cloth.

Grade 0: The subject is unable to pick up the pin using a fine pad pinch.



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8. **Dimes:** [*pad pinch with dexterity and in-hand manipulation*] – The subject picks up 10 dimes from the surface of the table, collecting all the coins in the same hand, until all 10 dimes are picked up and held in their palm. The dimes are placed so that they are not touching each other on the table.

***“Pick up all of the coins one at a time and hold them in your hand. Do not slide them off the edge of the table; you need to pick them up directly.”***

Grade 5: All dimes are picked up and held in the hand without difficulty; VAS = 0.

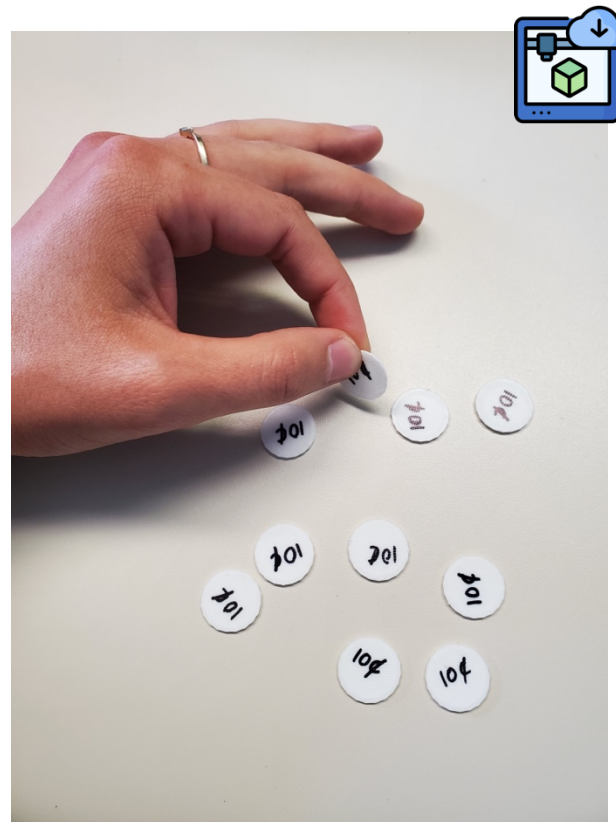
Grade 4: The subject is able to pick up all dimes as outlined above but does it slowly or with awkwardness; VAS = >0-3.

Grade 3: The task is completed with difficulty **OR** the subject is only able to pick up and hold 6 or more dimes; VAS = >3-6.

Grade 2: The subject is able to pick up and hold only 3-5 dimes; VAS >6.

Grade 1: The subject is able to pick up one or two dimes but may be unable to hold them in the hand.

Grade 0: The subject is unable to pick up dimes.



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9. **Buttons:** [*power pinch with dexterity*] – The subject unbuttons, then re-buttons 3 different sizes of buttons on a button board, held in front of their chest. The subject is asked if they usually wear shirts with right sided buttons or left sided. If they do not know, they are informed that woman’s shirts typically have buttons to the left and men on the right. The task is then conducted with the button orientation the subject most often uses. To change the orientation, simply turn the board 180° (see picture). If the subject reports wearing both types of shirts, the task can be done twice with both orientations and the best score is recorded.

\*\*Note: Assessor can stabilize the board, but not replace the untested hand.

**“Hold the board in front of you like a shirt. Now unbutton the top three buttons using your (test) hand and your untested hand to stabilize and then do them back up again.”**

Grade 5: The subject is able unbutton and refasten all three sizes of buttons without difficulty; VAS = 0.

Grade 4: Task is performed with minimal difficulty; VAS = >0-3.

Grade 3: Task is performed with moderate difficulty **OR** can only unbutton and button two sizes of button with no difficulty; VAS = >3-6.

Grade 2: The subject can unbutton all buttons but not refasten them **OR** the task is performed with great difficulty; VAS >6.

Grade 1: The subject is only able to unbutton partially **OR** can unbuttons 1 or 2 buttons.

Grade 0: The subject is unable to button or unbutton any buttons.



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10. **Nut and bolt:** [*timed dexterity, tripod pinch*] – The subject unscrews, removes and then refastens a nut onto a bolt fastened on a small wooden block as quickly as possible. Non-controlled spinning of the nut is not allowed; subject must use the thumb against the index and middle finger fingertips. Subject may stabilize the board with their non-tested hand. The task is timed with a stopwatch.

If the therapist is required to loosen the nut in order for the subject to complete the task, one grade is deducted from the required time. If the subject must spin to complete the task (ex: amputation), one grade is deducted from the required time.

***“Undo the nut as quickly as you can using your fingertips. You are not allowed to spin it without controlling it; you must turn the nut each time with your 3 fingers. When you get to the top, remove the nut completely, and then put it right back on and screw it down to the bottom of the bolt as quickly as you can. I will be timing you with a stopwatch. Do you understand? Ready, go.”***

	Dominant	Non-dominant	
Grade 5:	≤ 15 seconds	≤ 17 seconds	VAS = 0
Grade 4:	16–29	18-31	VAS = >0-3
Grade 3:	30–40	32-42	VAS = >3-6
Grade 2:	41–51	43-53	VAS >6
Grade 1:	≥ 52	≥ 54	
Grade 0:	Subject is unable to complete task.		





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11. **6-hole peg test:** [timed *dexterity and precision*] – The subject removes 6 pegs from a pegboard, puts the pegs in the bowl portion placed on the opposite side of the tested hand, and then replaces them as quickly as possible. The pegboard is stabilized with the other hand or by the evaluator if needed.

**“Take out the six pegs as quickly as you can, putting them in the bowl portion of the board as you go. When all the pegs are on in the bowl, you can put them right back in again. I will be timing you with a stopwatch. Do you understand? Ready, go.”**

Grade 5:	Dominant ≤ 14 seconds	Non-dominant ≤ 17 seconds	VAS = 0
Grade 4:	15–18	18-19	VAS = >0-3
Grade 3:	19–22	20-23	VAS = >3-6
Grade 2:	23–26	24-27	VAS >6
Grade 1:	≥ 27	≥ 28	
Grade 0:	Subject is unable to complete task.		



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12. **Timed writing/copying:** [*Tripod pinch, fine motor coordination, endurance*] – The subject copies 3 rows of 10 repeats of 5 different symbols, using a Papermate™ pen and task sheets. Task is completed with the tested hand even if it is not the dominant hand.

***“Working as quickly as you can, copy each of the symbols into the rows of boxes. This is a timed test, and I am not looking at neatness. Make sure you fill in every box in all three rows for each of the five symbols.”***

***“Ready, go.”*** (start stopwatch)

*(If hand being tested is non-dominant hand)* ***“I know this may feel awkward because this is not the hand that you usually write with, but the test expects that it takes longer and is scored accordingly.”***

***“Ready, go.”*** (start stopwatch)

**\*\*Note:** *If the subject does not naturally take a tripod pinch for this task, they are asked if they can demonstrate it after the task. If they can assume this position, they are not penalised for not using a tripod pinch for this task. If the position cannot be assumed due to amputations, they are not penalised.*

Grade 5: Subject is able to complete the task without difficulty or discomfort; VAS = 0, **OR** requires:

Dominant: < 3 minutes

Non-dominant: < 6 minutes

Grade 4: Subject is able to complete task with minimal difficulty, discomfort or incoordination due to minimal pain; VAS = >0-3, **OR** requires:

Dominant: 3-5 minutes

Non-dominant: 6-8 minutes

Grade 3: Subject is able to complete the task within the times specified for Grade 4 with moderate difficulty, discomfort, or incoordination due to pain; VAS = >3-6 or stiffness.

Grade 2: Tripod pinch is altered due to finger deformity, sensory changes or severe pain; VAS > 6 **OR** requires:

Dominant: 5-7 minutes

Non-dominant: 8-10 minutes

Grade 1: Subject has great difficulty picking up and positioning pen **OR** cannot complete the task due to severe fatigue, **OR** requires:

Dominant: >7 minutes

Non-dominant: >10 minutes

Grade 0: Subject is unable to pick up the pen and assume the appropriate grasp.

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13. **Simulated drinking:** [*cylindrical grasp, elbow flexion/extension, light pronation*] – A full soft drink can is lifted from the table to near the mouth and tilted to simulate drinking (see below image) and put back on the table. The can must be disinfected before and after each test.

***“Lift the can up to your mouth as if you were pretending to take a drink and then put it back on the table.”***

Grade 5: Subject is able to perform the task without difficulty; VAS = 0.

Grade 4: Subject is able to complete the task but has some difficulty due to mild pain; VAS = >0-3, weakness or incoordination.

Grade 3: Subject completes task but has moderate amount of difficulty due to moderate pain; VAS = >3-6, weakness, or decreased ROM **OR** Subject needs some assistance from the other hand to push the can into palm for initial grasping of object.

Grade 2: Subject completes task with great difficulty due to severe pain; VAS >6, weakness or decreased ROM **OR** requires significant assistance from the other hand to push object into the palm.

Grade 1: Subject is able to assume appropriate grasp around can, but unable to lift the can and complete task.

Grade 0: Subject is unable to assume appropriate grasp and initiate task.



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14. **Simulated eating: [lateral pinch, supination, elbow flexion / extension]** – Using a soup spoon, the subject picks up 10-15 dried navy beans from a cereal bowl containing 1/2 cup of beans and brings the spoon to the mouth. The beans are then replaced in the bowl.

***“This task looks at how you would use a spoon to eat with. Scoop up about 10 beans on the spoon, and bring it up near your face while sitting as straight as possible, as if you were pretending to take a bite. Ok, now you can put the beans back into the bowl.”***

Grade 5: The task is completed without difficulty as described above; VAS = 0.

Grade 4: The subject is able to complete the task but experiences some awkwardness of motion; VAS = >0-3.

Grade 3: The task is performed with moderate difficulty; VAS = >3-6.

Grade 2: The task is performed with great difficulty; VAS >6.

Grade 1: The subject is able to pick up the spoon but is unable to bring it to their mouth.

Grade 0: The subject is unable to pick up the spoon.



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15. **Pick-up and identify:** [*dexterity, sensation, and stereognosis*] – The subject is required to pick up and identify the following objects without seeing them, removing from a small cereal bowl without sliding the object up the side of the bowl: Canadian penny, washer, paper clip, safety pin, square nut, hex nut, screw. Subject is shown objects before starting the task, and the name of each object is verbally reviewed. The task is completed without the assistance of vision and each object is dropped on the table before picking up a new one. The subject may return to the items on the table if unsure without looking at them. \*\*\*If the person being tested has difficulties with language because of cognitive or linguistic concerns, a second set of objects can be used for the subject to identify by pointing

***“Take a look at the objects in this bowl. There is a Canadian penny (indicate by pointing), a washer, paper clip, safety pin, square nut, hex nut and screw. With your eyes closed, I would like you to pick them up one at a time and tell me what they are just by the feel of them. You need to pick them up without sliding them up the sides of the bowl, and I would like you drop them on the table when you are done. Do you understand? (if no, repeat instructions and demonstrate) You can hold the bowl on the table with your other hand. Ok, now close your eyes, and tell me what you are feeling as you pick up each item.”***

Grade 5: All objects are picked up without difficulty and identified correctly without hesitation; VAS = 0.

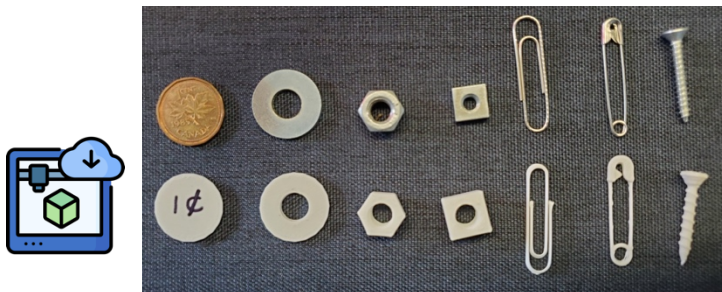
Grade 4: All objects are identified correctly but manipulation or picking up of the objects is done with minimal difficulty; VAS = >0-3.

Grade 3: One or 2 mistakes are made in identification of objects **OR** subject experiences moderate difficulty with manipulation or picking up of objects; VAS = >3-6.

Grade 2: 3 or 4 mistakes are made in identification **OR** subject experiences great difficulty picking up and manipulating objects; VAS >6.

Grade 1: More than 4 mistakes are made in identification of objects **OR** is able to pick up some objects but has great difficulty in manipulating or holding.

Grade 0: Subject is unable to pick up objects or manipulate them for identification.



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16. **Slates:** [*span*] – The subject picks up 4 rectangular slates on their long edge: 15mm (width); 4.5cm height, length= A = 11.5cm, B = 13cm, C = 14.5cm, D=16cm using the thumb and index for A, thumb and middle for B, thumb and ring for C, and thumb and small for D. Each slate is replaced on the table before proceeding to the next. **If the subject has amputation(s), allow them to pick up the slates using any combination of digits and grade based on the number of slates that were successfully picked up as described below.** Slates are placed in a row parallel to table edge about 10cm from edge.

***“Try to pick up each slate using the thumb and their associated finger (A=index, B=middle, C=ring, D=small) (demonstrate). Lift it up off the table, then set it back down and try the next one.”***

***If amputation:*** ***“Try to pick up each slate using any available digit (demonstrate). Lift it up off the table, then set it back down and try the next one.”***

Grade 5: All of the slates are picked up with each of the above combinations of fingers **without any difficulty**, pain; VAS = 0 or limitation.

Grade 4: The subject is able to pick up all of the slates with the above combinations with **minimal difficulty**; VAS = >0-3 **OR** the subject is able to pick up any 3 of the 4 slates with **no difficulty**.

Grade 3: The subject is able to pick up all combinations **with moderate difficulty**; VAS = >3-6 **OR** the subject is able to pick up any 2 of the 4 slates **with no difficulty**.

Grade 2: The subject is able to pick up all of the slates with the above combinations with **great difficulty**; VAS >6 **OR** the subject is able to pick up any one of the 4 slates **with no difficulty**.

Grade 1: Subject is only able to pick up any one of the 4 slates **with difficulty**.

Grade 0: Subject is unable to do anything that is described above.



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17. **Disks:** [*spherical grasp*] – 5 progressively sized disks (15mm thick; diameters = A = 4.5cm, B=7cm, C=9.5cm, D=12cm, E=15cm) are picked up from table-top to a height of at least 10cm (use marking on shelf from task #19 & #20, see below image) and replaced, using all existing digits. Disks are placed in a row parallel to table edge about 10cm from edge.

***“Pick up each disk using the tips of all of your fingers, lift it up to the 10cm line mark on the shelf and then set it back down again. Make sure that you are using all of your available fingers. Start with the smallest disk and work your way up to the largest one.”***

Grade 5: Subject is able to pick up all disks normally without restriction or discomfort and replace them on the table; VAS = 0.

Grade 4: All disks are picked up and placed back on the table without restriction but with minimal difficulty or discomfort; VAS = >0-3.

Grade 3: All 5 disks are picked up with minimal restriction of one digit **OR** with no restriction but moderate difficulty or pain; VAS = >3-6 **OR** the first 4 disks are picked up and replaced using all available digits.

Grade 2: Any 3 disks are picked up and placed back on the table using all available digits **OR** all disks are picked up with severe difficulty or pain, VAS > 6.

Grade 1: Any 2 disks are picked up and replaced using all available digits **OR** any 3 disks are picked up and replaced with using at least 2 digits.

Grade 0: Subject is unable to pick up any disk.



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18. **Plate:** [*lumbrical grasp, supination, endurance*] – The subject is asked to pick up a weighted plate (can from task 13 inside the bowl from task 14, see below image) directly from the table (ie. no sliding to edge of table), lifting to a height of 15cm (6”) (use marking on shelf from task #19 & #20, see below image). The edge of the plate should be positioned about 10cm from the table edge. The thumb should grasp the top of the plate, and the fingers support the surface beneath the plate. A piece of Dycem or Ultimat (non-slip surface) is on the plate and under the bowl to prevent shifting of the objects. The rater uses the stopwatch to time 5 seconds. If the subject cannot complete the task, they are asked to re-try the task with only the bowl on the plate. If the subject cannot complete this new task, they are asked to re-try the task with the empty plate.

***“Pick up the plate without sliding it off the edge of the table and hold it up to the 15cm line mark on the shelf for 5 seconds. You can then set it back down on the table.”***

Grade 5: Subject performs task without restriction or pain; VAS = 0.

Grade 4: Same as above except subject may have some minor difficulty **OR** discomfort; VAS = >0-3 **OR** may find it heavier than on the unaffected side.

Grade 3: The subject is able to lift plate with some difficulty **OR** the hand is shaky **OR** the grasp is restricted or awkward due to sensitivity **OR** unable to hold for the 5 seconds; VAS = >3-6.

Grade 2: The subject lifts successfully with only the bowl on the plate, VAS >6.

Grade 1: The subject is able to lift the plate with the bowl but not to the required height of 15cm/6” **OR** the subject is able to lift the empty plate without difficulty.

Grade 0: Subject is unable to assume the position **OR** lift empty plate.





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19. **Lifting cans onto shelf:** [*cylindrical grasp with functional reach, shoulder flexion/extension, endurance*] – The subject picks up a 680mL can of spaghetti sauce using a cylindrical grasp and places it onto a shelf 16” (40cm) above table height, then replaces it on table (one time). Task is repeated using a 1.36L can of tomato juice (5 repetitions). Shelf is positioned 10cm from edge of table.

\*\*Note: If needed, subject may use hand not being tested to support object (grade 1).

***“Lift the small can up onto the shelf, then set it back down again.”***

***“This time, pick the big can up and set it on the shelf, then bring it back down again.”***

***“Can you do this four more times?”***

Grade 5: The subject is able to lift the small can once, and the big can 5 times without difficulty; VAS = 0.

Grade 4: The subject has no difficulty with the small can, but has some difficulty while lifting the big can 5 times; VAS = >0-3.

Grade 3: The subject is able to complete with **no difficulty** using small can, but is unable to lift the big can 5 times **OR** the subject can complete the task with both cans with moderate difficulty; VAS = >3-6.

Grade 2: The subject can complete the task with the small can with **minimal difficulty**, but is unable to lift the big can 5 times; VAS >6.

Grade 1: The subject is able to pick up the big can but is unable to lift it onto the shelf **OR** the subject is able to complete both tasks using both hands to complete the tasks.

Grade 0: The subject is unable to complete the task using both hands.



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20. **Lifting boxes onto shelf:** [*lumbrical grasp with functional reach, shoulder flexion/extension, endurance*] – The subject picks up a 900mL box of soup broth and places it onto a shelf 16” (40cm) above table height, then replaces it to the table (one repetition). Task is repeated using a 1.8kg box of dishwasher soap (3 repetitions).

\*\*Note: If needed, subject may support object with hand not being tested (grade 1).

***“Lift the small box up onto the shelf, then set it back down again.”***

***“This time, pick the big box up and set it on the shelf, then bring it back down again.”***

***“Can you do this two more times?”***

Grade 5: The subject is able to lift the smaller box once, and the larger box 3 times without difficulty; VAS = 0.

Grade 4: The subject has no difficulty with the smaller box, but has some difficulty with the larger box; VAS = >0-3.

Grade 3: The subject is able to complete with no difficulty using the small box, but is unable to do task with big box **OR** the subject can complete the task with both boxes with moderate difficulty; VAS = >3-6.

Grade 2: The subject can complete the task with the small box with minimal difficulty, but not the big box VAS >6.

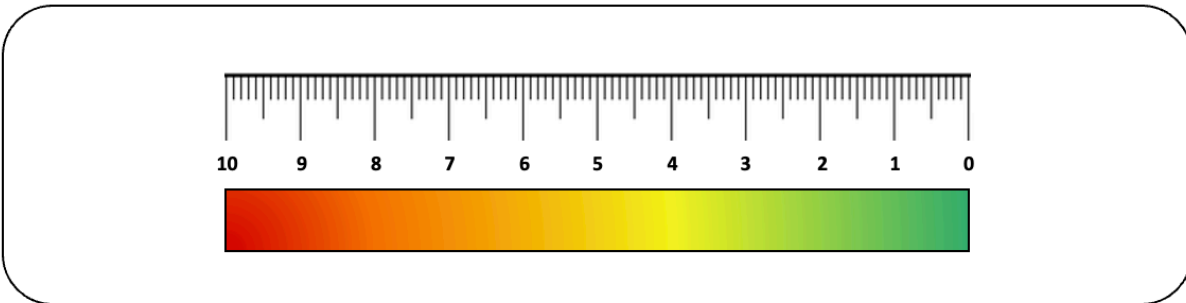
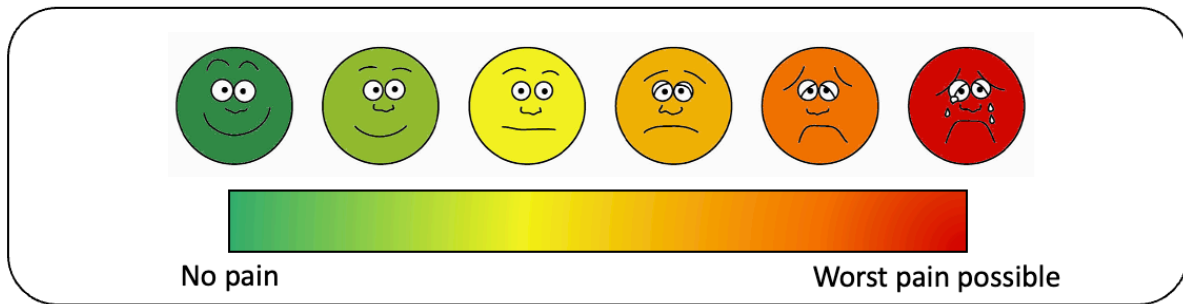
Grade 1: The subject is able to pick up the small box but is unable to lift it onto the shelf **OR** the subject is able to complete both tasks using both hands to complete the tasks.

Grade 0: The subject is unable to complete the task using both hands.



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**Appendix 1:** VAS scale to print and assemble.



**Instructions to assemble:**

To assemble, the ruler should be glued at the back of the front image (image with faces) so that the colors match on both sides (red face on front image match the red thermometer on the back image with the ruler). The subject should mark their pain with a movable Post-it™ flag on the front image (side with the faces), so that the assessor can determine the associated number score on the back of the scale.

Patient ID: \_\_\_\_\_

Rater: \_\_\_\_\_

Affected hand(s): L R

Date: \_\_\_\_\_

Tested hand: L R

Dominance: L R

**MachHAND TIMED WRITING TASK**


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Patient ID: \_\_\_\_\_

Affected hand(s): L R

Tested hand: L R

Rater: \_\_\_\_\_

Date: \_\_\_\_\_

Dominance: L R

**MacHAND SCORING FORM**

ITEM	TASK	FOCUS	ADAPTIVE EQUIPEMENT USED	GRADE	COMMENTS
1.	Door	Power grasp, reach, wrist flexion, supination			
2.	Key	Pad pinch, lateral pinch, precision			
3.	Hammer	Power grasp and functional elbow flexion/extension			
4.	Pouring	Power grasp, pronation/supination, coordination, endurance			
5.	Jar	Spherical grasp with elbow flexion			
6.	Plug	Lateral pinch			
7.	Pin	Fine pad pinch			
8.	Dimes	Pad pinch with dexterity and in-hand manipulation			
9.	Buttons	Power pinch with dexterity			
10.	Nut and bolt	Timed dexterity, tripod pinch			
11.	6-hole peg	Timed dexterity, precision			

Patient ID: \_\_\_\_\_

Affected hand(s): L R

Tested hand: L R

Rater: \_\_\_\_\_

Date: \_\_\_\_\_

Dominance: L R

12.	Timed writing	Tripod pinch, fine motor coordination, endurance			
13.	Simulated drinking	Cylindrical grasp, elbow flexion/extension, light pronation			
14.	Simulated eating	Lateral pinch, supination and elbow flexion/extension			
15.	Pick up and identify	Dexterity, sensation and stereognosis			
16.	Slates	Span			
17.	Disks	Spherical grasp			
18..	Plate	Lumbrical grasp, supination, endurance			
19.	Lifting cans	Cylindrical grasp with functional reach, shoulder flexion/extension, endurance			
20.	Lifting box	Lumbrical with functional reach, shoulder flexion/extension, endurance			
<b>TOTAL</b>				<b>/100</b>	