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Research Article

Is it Possible to Assess more Grasps Configurations? A New Assessment Approach on Hand Strength

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Abstract

The grasp strength assessment is a global measure, and the current standardized assessment considers one configuration: the Hook Grasp corresponding to the second position of the dynamometer handle. The grasps configurations were recently classified in a new taxonomy sponsored by the European Commission and organized by the number of strength vectors, contact between the object and the hand, strength, and thumb position. The main objective of this work is to verify if it is possible to assess the grasp strength of the configurations, in this taxonomy, using the Biometrics E-Link® G200 Dynamometer. This experimental study analysed the grasp configurations compatible with the used of the dynamometer, in its five handle positions, maintaining the American Society of Hand Therapists assessment protocol. A caliper was used to measure the diameter of the dynamometer and the results cross with the characteristics of the grasps, regarding their diameter. There were identified eight grasps, which complied with it. Then were verified the possibility to apply these grasp configurations assessment in 60 participants without (N=30) and with neuromusculoskeletal hand pathology (N=30). Eight grasp configurations can be assessed with the Dynamometer G200. The strength behavior was identical to the described in the literature in participants with and without hand pathology. This would be useful for clinicians and therapists working in hand rehabilitation, assessing, and relating grasps with their use in daily tasks considering their configuration. This approach is focused on the patient and his grasping problems. Recommendations for this assessment are made.

Keywords: Grasp; Strength; Assessment; Grasp Taxonomy

Introduction

The hand is the most differentiated and sophisticated musculoskeletal part of the human being performing several meticulous movements and taks [1]. The clinicians and therapists feel the need to assess grasps in a more functionally and realistically way focus on their use in daily routines. Understanding the individual hand functioning can be helpful to clinicians and therapists during all the interventions process to define the treatments and have realistic outcome expectations [2]. However, witch individual has a unique way of functioning with his hand, during the recovery process being imperative to assess their capability to perform meaningful everyday activities, with both dominant and non-dominant hand [3].

Different methods have been proposed to assess special functions of the hand, one of those is the grasp, used in daily tasks. The hand has an important role in the occupation and health, giving us the ability to reach out, touch, and grasp objects, materials, instruments, people and built the world around us contributing to occupational performance giving sense and meaning to life [4]. On our daily activities, there are several tasks performed with different configurations of grasps and pinches. The grasps configurations are much more than just positions of the hand to grab objects, they have intention, symbolism, they have a cultural meaning and purpose [4]. Grasping has been the focus of different studies being one of the interests the hand shape and its contact with the object, which constrain how they can interact [5].

The factors that influence hand grasp strength can be classified as intrinsic and extrinsic. Intrinsic factors include changes in hydrogenic potential (pH), temperature, blood flow and accumulation of cellular metabolism products [6]. Regarding extrinsic factors, these are sex, age and hand dominance [7]. The hand grasp strength is lower in women than in men, and in both genders reaches its maximum value in the fourth decade of life, decreasing progressively as age advance [8]. Regarding dominance, it is known that when the

dominant or preferred hand is the right, it exerts about 10% more grasp strength than the non-dominant hand [9]. If the dominant hand is the left the hand grasp values, in both hands, should be considered equivalent [10]. The strength is the result of a muscular contraction, which can produce movement. In the tests to assess strength the most used is the isometric test, which assess the strength produced against an unmovable object, and the maximal strength test, which assess the value of maximal strength produced in one contraction [6].

The assessment of grasps strength is a global measure of the capacity to grab an object. The current standardized assessment of the grasp strength considers one configuration, the Medium Wrap as named in the new Grasp Taxonomy, or the Hook Grasp as usually known. This and the Fixed Hook are the only power grasp configurations, from the Grap Taxonomy, that exclude the use of the thumb to provide a counterforce to the other fingers and is not a common type of grasp used in many daily and work-related tasks [11,12]. For example, the most used grasps in the activity of food preparation, combining the preparation of a soup, a fish and a meat dish and a dessert, are the Index Finger Extension and the Writing Tripod with 19% and 14% of total duration during the activity [13]. Several everyday activities require the use of the hand as an all, involving the five strength vectors produced from the five fingers involved [14]. However, the significant contribution of the thumb, to the grasp strength is substantially disregarded while using the assessment configuration of the Medium Wrap/Hook-type power grasp [14]. The thumb, by his one, can provide approximately 50% of the total static grasp strength of all fingers in a whole hand grasping [11]. The contribution of the thumb in spherical grasp configurations reached at least 38% of total grasp strength depending on the weight and diameter of the cylindrical objects being grabbed [15]. The relation of an assessment and the difficulties in performing the activities of daily living, that use the assessed grasps configurations is also inexistent [16]. So, the use of only one grasp configuration to assess the strength and predict the functionality of the hand is very limited to allow the clinicians and therapists to make decisions on procedures, technics, treatments, assistive products, discharge or establish levels of disability.

The grasp configurations were recently organized in a new taxonomy sponsored by the European Commission [17]. They were grouped regarding their previous classifications in other taxonomies, their number of strength vectors (two to five), type of contact between the fingers/hand and the object (palm, lateral or pad), strength (power, intermediate and precision) and thumb position (adducted and abducted) [18]. In the Grasp Taxonomy, there are 22 grasp configurations made on objects with 3.5cm or more. This measure, 3.5cm, is the minimal diameter of the G200 Dynamometer when its handle is the first position. Of those 22 grasps configurations, 14 are considered Power grasps, one is Intermediate and seven are Precision grasps, according to the Grap Taxonomy [18].

All these grasp configurations are performed during daily activities regardless of whether they are related to leisure, work, or self-care activities. To do so is necessary that the functional integrity of the hand, which comprises adequate grasp strength, is normal, enabling the demands of the daily tasks in many occupational activities [19]. It is essential for these functions the movement of opposition between the thumb and the other fingers, the good mobility of the digital joints and effective strength of the flexor muscles. Any orthopedic, neurological or traumatological pathology, which affects the hand, tends to decrease the strength of the different grasps. The objective measurement of these strength is of paramount importance for the assessment of hand pathologies [16]. For paretic hands of stroke, hemiplegic cerebral palsy or brain injuries patients it would be a great profit to have a better understanding of the hand function during manipulation of objects in different tasks [20]. The assessment of the hand grasp strength can be one of the parameters used to verify and quantify the recovery level of functionality in hand rehabilitation [21]. It is recommended to use a dynamometer to assess the hand grasp strength. The dynamometer from the Biometrics E-link® is validated to do it [22] and is similar to the Jamar®, the most used and recommended dynamometer in the world [23].

An accurate assessment of hand function is essential to determinate the baseline that assists in establishing the diagnosis, guides the surgical or non-surgical treatment and provides support for objectively compare the results among researchers [16].

The power grasps presented in the Grasp Taxonomy that has 3.5cm of diameter, or more, between the thumb and the extremity of the index finger (the diameter of the grabbed object) are the Large Diameter, Medium Wrap, Small Diameter, Power Disk, Power Sphere, Index Finger Extension, Adducted Thumb, Ring, Sphere 3 Fingers, Extension Type and the Sphere 4 Fingers [18]. The Intermediate that complied with these measurements is the Stick, and regarding the Precision grasps those are the Inferior Pincer, Parallel Extension, Precision Sphere, Precision Disk and the Prismatic 4 Fingers [18].

This study aims to identify the grasps configurations from the Grasp Taxonomy compatible with the use of the Dynamometer G200, maintaining the assessment protocol of the American Society of Hand Therapists.

Materials and Methods

This experimental descriptive study analysed the grasp configurations compatible with the use of the Dynamometer G200, from the Biometrics E-Link® an instrument validated to assess the hand grasp strength [23]. In the first phase of this study, a calliper was used to measure the thickness of the dynamometer with the handle in the five possible positions. The results were cross with the characteristics of the grasps identified previously, regarding the diameter of the grasped object, according to the characteristics referred into the Grasp Taxonomy [18]. There were identified eight grasps configurations that complied with the diameter of the Dynamometer G200. These grasps configurations will be used in the second phase of the study to verify the possibility to be applied on the Dynamometer G200 to make the strength assessment of the participants. The selection of the participants was made by convenience, in the Military Hospital and a Hand Rehabilitation Clinic in Lisbon, Portugal. The inclusion criteria were to be Portuguese, with 20 to 65 years old, without and pathology or symptomatology, to integrate the control group, or diagnosed hand pathology such as muscle-skeletal lesions, to integrate the study group. For the study group, they also had to have two or three values, in the Classification of Functioning, Disability and Health for the body functions and activities specifically in the General tasks and requirements (d210 Accomplish a single task, d220 Performing multiple tasks and d230 Perform the daily routine), Self-Care (d510 Wash, d540 Dress up, d550 Eating and d560 Drinking) and Household chores (d630 Preparing meals and d640 Performing household chores). Pregnancy is an exclusion criterion, for all the participants since it is a transitory condition that can influence hand grasp strength [24]. Of the 60 participants, 30 had neuromusculoskeletal hand pathology and the other 30 had no hand pathologies neither pathological symptomatology.

The American Society of Hand Therapists assessment protocol was used: in a seated position on a back chair without arms, feet on the floor, knees, and hip at 90º, back in touch with the chair, harm along the trunk, elbow at 90º flection, forearm in a middle position and wrist between 0º and 30º [1,23].

Three measurements were performed for each hand to obtain an average of the hand grasp strength, and there was a rest period of thirty seconds between each measurement [1,23]. The sustained strength was also collected once, during a five second test, maintaining the same assessment protocol. This test also registers the peak force and the time to peak. All these procedures were explained to the participants, identified by an alphanumerical code, and their informed consent to participate was collected. Before starting the test, the participants were asked to remove all the objects from the hand and wrist, such as rings, bracelets, and watches.

Descriptive statistics were calculated, including totals (N), means, minimum, maximum and standard deviations. The data collected was analysed with the Statistical Package for the Social Sciences (version 27).

This study was approved by the Ethical Commission of the Faculty of Human Kinetics, University of Lisbon and all procedures followed are in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Results and Discussion

Regarding the first phase of this study, the values of the dynamometer diameter, with the handle in the five possible positions, were cross with those from the grasps configurations of the Grasp Taxonomy. There were identified eight grasps, that can be applied on the dynamometer, with the exact configurations presented on the Grasp Taxonomy being the dynamometer grabbed in the same position as the object is grabbed in the images of these grasp configurations (Figure 1).

From these, one is already validated and can be assessed with the dynamometer handle in the second position, and it is the Medium Wrap. The others were the Index Finger Extension, the Parallel Extension, the Small Diameter, and the Adducted Thumb in the first position of the handle of the dynamometer. In the second handle position, besides the Medium Wrap, already referred, there is the Inferior Pincer. In the third handle position the Ring configuration and in the fifth position the Large Diameter.

In the second phase of this study, the participants were asked to perform these eight grasps configurations, using the Biometrics E-Link® G200 Dynamometer, and applying maximum strength on it, maintaining the American Society of Hand Therapy protocol assessment position.

The 30 healthy subjects had an average of 36.7 years (21-61). There were 53,3% (N = 16) female, 46,7% (N = 14) male and 90% (N = 27) right-handed dominant. Regarding the 30 injured subjects, they had an average of 42.5 years (24-63), 40% (N = 12) were female and 60% (N = 18) were male. All of them had right-handed dominance (N = 30).

Table 1 shows that the medium strength of the right-handed men and women without pathologies is superior on the right hand

Grasp Configurations	Example	Handle position	Medium Hand Strength Values (Kg)		Examples of grabbed objects
			Right	Left	
Large Diameter		V	26,62	24,30	Grab a glass, a phone, a pack of napkins, a large piece of fruit, a hairdryer, a ball, a 1.5l, 1l or 0.75 l bottle, a jar, a packet of cereal, a can, cylindrical large vegetables, the stair rail, a pack of shower gel, a roll of toilet paper, the car side mirror, a packet of rice, the alarm clock, or a bowl.
Small Diameter		I	27,16	24,90	Grab a broom, a mop, the shower, the hairbrush, the handle of the shopping cart, a stroller, a bike, a door, a hammer, a knife or the toothbrush, a fan, a stapler, a rope, the oars from a canoe, the wooden spoon, the dough roll, a leaf saw, the steering wheel of the car, the dog's leash, a makeup brush, a candle, a walker, or a microphone.
Medium Wrap		II	36,37	33,14	Grab a carrot, the cable of the vacuum cleaner, the diesel fuel pistol, a tennis racket, the steering wheel of the car, the iron, the handle of a suitcase, a knife, a window, a door, a broom, a hammer, a frying pan, the dog's leash, a banana, a peeler, the rod from the public transports, a screwdriver, the shower, a remote control, the car speed handle, a gym alter, a liquid yogurt, a walker, a microphone or a wheelbarrow.
Adducted Thumb		I	24,56	22,62	Grab a phone, a rod in public transport, a remote control, a tray, the handle of a knife, a suitcase, a vacuum cleaner, a shopping basket, a hammer, a rain hat, a bike, a door, a window, the tennis racket, the baby's egg, the diesel fuel pistol, the dog's leash, a snooker cue, the paint roller, the handle of the frying pan, a landline, the steering wheel of the car, a banana, a book, a tablet, the controls of a console, a stapler or a microphone.
Inferior Pincer		II	6,92	6,25	Grab an egg, a can, a piece of fruit, a matchbox, a tobacco pack, a cup of coffee, a perfume bottle, a hair foam pack, the earrings, a candy, a cake, a ball, a school case, a book, the broom handle, the handles of a suitcase, a glasses box, a tube, a mobile pen, a small pack, the nail case, a wallet, a wafer, or a plug from an appliance.
Index Finger Extension		I	16,34	15,36	Grab a comb, a hairbrush, a knife, a cigar, a spray, a microphone, a hose, a frame eraser, a saw, a screwdriver, a remote control of the television, the dough-cutting utensil (e.g., patties), a perfume bottle, a saw, a peeler, the handle of a suitcase, a briefcase, or a backpack.
Ring		III	11,78	10,71	Grab a rolled-up towel, a deck of cards, a pack, a case of the glasses, a mug, a cup, a piece of fruit, a shoebox, a hole punch, a bulb, a jar, a cake, a can, a school case, a ball, a lady's purse, a bivalve to eat, a box, a stapler, a berlin ball, or a wooden roll.
Parallel Extension		I	8,89	8,19	Grab a book, a pack of tissues, a fan, a matchbox, a wallet, a notepad, a laptop charger, a tablet, a television remote control, a computer, a small package, an eye mascara, a comb, the nail polish, the back of a chair, a tray, the viola's arm, a bundle of sheets of paper.

Figure 1: Grasp configurations, that can be assessed with the dynamometer in the different handle positions, and their use in daily tasks [16,25].

in all the grasps configurations. The same happens with the peak force. Regarding strength, men have more strength than women and their peak force is higher in both hands. There is a significant difference (p > 0,05) between men and women medium strength, peak force, and time to peak.

Table 2 shows that the medium strength of the men with pathologies on the right hand is superior on the right hand. Regarding

Grasp	Gender	Side	Medium Strength (Kg)	Peak Force (Kg)	Time to Peak (s)
Large Diameter	Male	Right	37,3 ± 10,3	37,3 ± 9,4	1,13 ± 0,5
		Left	34,53 ± 8	34,48 ± 9,3	0,98 ± 0,4
	Female	Right	16,69 ± 2,6	16,38 ± 2,6	1,1 ± 0,6
		Left	14,81 ± 3,2	13,96 ± 2,9	0,99 ± 0,4
Small Diameter	Male	Right	36,6 ± 8,7	35,5 ± 8,9	1,13 ± 0,6
		Left	34,1 ± 5,3	31,35 ± 6,7	0,96 ± 0,3
	Female	Right	18,40 ± 2,8	17,38 ± 4,1	1,08 ± 0,4
		Left	16,38 ± 3,7	15,56 ± 3,2	0,96 ± 0,5
Medium Wrap	Male	Right	49,1 ± 10,6	47,2 ± 10,7	0,99 ± 0,3
		Left	45,44 ± 8,7	44,19 ± 10,2	0,92 ± 0,3
	Female	Right	24,57 ± 3,3	25,02 ± 4,1	1,01 ± 0,5
		Left	21,71 ± 3,1	22,76 ± 3,5	1 ± 0,5
Adducted Thumb	Male	Right	33,23 ± 8,6	32,1 ± 8,7	1,12 ± 0,8
		Left	30,92 ± 7,5	28,68 ± 7,8	1,13 ± 0,6
	Female	Right	16,51 ± 3,7	15,5 ± 3,5	0,89 ± 0,4
		Left	14,92 ± 3,4	13,9 ± 3	0,94 ± 0,4
Inferior Pincer	Male	Right	9,5 ± 3	8,98 ± 3	0,83 ± 0,5
		Left	8,34 ± 2,3	7,8 ± 2,4	0,81 ± 0,4
	Female	Right	4,54 ± 0,9	4,5 ± 0,9	0,85 ± 0,7
		Left	4,31 ± 0,7	4,31 ± 1	0,63 ± 0,3
Index Finger Extension	Male	Right	22,4 ± 7,8	21,56 ± 8	1,03 ± 0,5
		Left	21,62 ± 6,7	20,42 ± 6	1 ± 0,6
	Female	Right	10,70 ± 3,3	10,84 ± 2,9	1,17 ± 1
		Left	9,50 ± 3,3	9,9 ± 2,9	1,03 ± 0,5
Ring	Male	Right	16,11 ± 3,9	14,76 ± 4,2	0,68 ± 0,4
		Left	14,60 ± 3,8	13,77 ± 3,2	0,72 ± 0,4
	Female	Right	7,76 ± 1,3	7,86 ± 1,7	0,89 ± 0,4
		Left	7,11 ± 1	6,92 ± 1,4	0,68 ± 0,2
Parallel Extension	Male	Right	11,51 ± 2,7	11,48 ± 3,1	0,84 ± 0,4
		Left	10,5 ± 2,2	10,53 ± 1,9	1,7 ± 2,2
	Female	Right	6,45 ± 1,2	6,36 ± 1,4	0,86 ± 0,6
		Left	6,05 ± 1,1	6,29 ± 1,2	0,75 ± 0,5

Table 1: Medium Strength, Peak Force and Standard Deviation of right-handed participants without pathology.

women with pathologies in the right hand, they always have more strength in the left hand. Concerning the peak force, men with pathologies in the right hand, have a significant difference between the medium strength and the peak force. This did not happen with women. Regarding strength, men have more strength than women and their peak force is higher on both hands. There is a significant difference (p > 0,05) between men and women medium strength, peak force, and time to peak.

All the subjects perform the tests without difficulties. The Inferior Pincer was the grasp that has less strength and peak force,

Grasp	Gender	Side	Medium Strength (Kg)/SD	Peak Force (Kg)/SD	Time to Peak (s)/SD
Large Diameter	Male	Right	37,3 ± 10,3	21,29 ± 7	1,42 ± 0,8
		Left	34,53 ± 8	32,24 ± 5,8	1,26 ± 0,8
	Female	Right	8,85 ± 5,3	8,97 ± 5	0,62 ± 0,3
		Left	16,27 ± 4,2	16,77 ± 4,7	0,85 ± 0,3
Small Diameter	Male	Right	36,6 ± 8,7	17,92 ± 6	1,12 ± 0,9
		Left	34,1 ± 5,3	33,33 ± 4,8	1,13 ± 0,6
	Female	Right	10,52 ± 6,7	10,65 ± 6,7	0,53 ± 0,2
		Left	17,27 ± 4,8	17,7 ± 5,2	0,72 ± 0,3
Medium Wrap	Male	Right	49,1 ± 10,6	28,89 ± 9,7	1,39 ± 1,1
		Left	45,44 ± 8,7	46,83 ± 3,9	1,11 ± 0,5
	Female	Right	14,37 ± 8,8	14,65 ± 8,8	0,78 ± 0,3
		Left	23,58 ± 5,3	23,47 ± 5,8	0,83 ± 0,3
Adducted Thumb	Male	Right	33,23 ± 8,6	15,74 ± 4,5	1,36 ± 1,2
		Left	30,92 ± 7,5	29,99 ± 4,7	1,19 ± 0,7
	Female	Right	8,32 ± 6	8,57 ± 6	0,47 ± 0,3
		Left	15,93 ± 6,4	15,87 ± 6,7	0,45 ± 0,1
Inferior Pincer	Male	Right	9,5 ± 3	4,74 ± 1	0,72 ± 0,5
		Left	8,34 ± 2,3	7,51 ± 1,8	0,67 ± 0,4
	Female	Right	3,32 ± 1,1	3,6 ± 1	0,48 ± 0,3
		Left	5,05 ± 0,9	5,13 ± 0,8	1,07 ± 0,8
Index Finger Extension	Male	Right	22,4 ± 7,8	10,28 ± 7	0,83 ± 0,8
		Left	21,62 ± 6,7	19,87 ± 6	1,1 ± 1
	Female	Right	6,75 ± 4,1	6,91 ± 4,2	0,45 ± 2
		Left	10,92 ± 3,4	11,88 ± 4	0,75 ± 0,2
Ring	Male	Right	16,11 ± 3,9	8,59 ± 3,6	0,64 ± 0,4
		Left	14,60 ± 3,8	13,48 ± 3,8	1 ± 0,6
	Female	Right	4,7 ± 1,7	5,07 ± 2,4	0,45 ± 0,1
		Left	8,3 ± 2,3	8,77 ± 2,7	0,53 ± 0,2
Parallel Extension	Male	Right	11,51 ± 2,7	7,06 ± 1,7	0,74 ± 0,3
		Left	10,5 ± 2,2	11,42 ± 2	1,07 ± 0,7
	Female	Right	3,78 ± 1,5	4,02 ± 1,7	0,52 ± 0,4
		Left	6,73 ± 0,6	6,88 ± 0,7	0,1 ± 0,6

Table 2: Medium Strength, Peak Force and Standard Deviation of right-handed participants with pathology on the right hand.

both in women and men. This is also the grasp that only uses two strength vectors, with pad contact, being a precision grasp. The Medium Wrap is the grasp configuration through which the participants can apply more strength. This is also the grasp configuration that is validated to assess hand grasp strength, and recommended, by the American Society of Hand Therapists [1,23].

The results complied with the characteristics of the strength, described in the literature, being the men and the right hand stronger than the women and the left hand. There were found significant differences between the strength media, the peak force, and the time to peak of men and women either in the control group or the study group.

This study shows that is possible to access seven more grasps using the Dynamometer G200 of the Biometrics E-Link®, being this

similar to the Jamar®. The grasps that can be assessed are the Index Finger Extension, being the Dynamometer grabbed in a horizontal position, the Parallel Extension, the Small Diameter, the Adducted Thumb, the Ring, the Large Diameter, and the Inferior Pincer being, for this configuration, the dynamometer held lightly around the readout dial by the examiner [23], as it can become unstable for the position of the instrument. The position test used is the same recommended by the American Society of Hand Therapists except in the Index Finger Extension where the forearm is in pronation. The positions of the handle of the dynamometer are shown in Figure 1, as well as some tasks in which these grasps are used.

This will be important for practitioners to assess upper extremity impairments, strength changes, and work capacity or demands [20]. Strength measurements are quick, cheap and can detect pertinent clinical data to be used in the rehabilitation process [22]. These have acceptable reliability and validity, which is valuable for clinical reasoning in the determination of functional impairments and functional progress [26]. It is also important to establish the capability to return to previous employment for patients with injuries in the hand and with relevant hand tasks activities in their daily work. Grasp strength testing provides information on hand function and can be used as a predictor for treating hand injuries and related conditions, as well as identifying illness and disability risk factors [22].

The use of injured hand participants in this study allows us to verify the possibility to perform these grasps by people with reduced strength and constraints such as pain, range movement limitations or edema.

Future studies are needed to establish the normative data for these grasps configurations. Also, it would be interesting to reproduce this study with specific pathology groups using only one type of pathology. The limitation of this study is that the data cannot be used in all types of pathologies, such as amputations or rheumatological. There is also one grasp, the Finger Extension that cannot fulfil all the requirements of the assessment protocol of the American Society of Hand Therapists. This configuration must be done with the forearm in pronation. In this case it would be interesting to validate a new assessment position otherwise it can be used only to compare the results of the therapeutic interventions in a patient and not with other patients or studies.

Conclusion

Increasingly, it is necessary to relate the assessment and intervention, within the scope of hand therapy, with the person's performance in her daily life. Knowing how to easily assess more grasps configurations, and which grasps are used on tasks performed during activities of daily living, clinicians and therapists can have their decision-making process facilitated, regarding the treatment, the technics, the assistive products to be used or the discharge. This also allows having a more centred client approach by assessing the grasps identified by the patient to be difficult to perform. With this assessment approaches the intervention can be focus on the real difficulties of the patients in performing a specific grasp configuration, associated to tasks in several activities, and the results measured according to it. The result of this study shows that is possible to assess more grasps configurations. This will be useful, not for implementing as an assessment protocol to be implemented regularly, but to be used as necessary when a specific task or activity is identified to be difficult to perform.

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Conflict of Interest

The authors declares that there is no conflict of interest of any kind.

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