Techniques and methods for monitoring the evolution of upper limb fine motor skills: literature review

Técnicas y métodos para el seguimiento de la evolución de la habilidad motriz fina de miembro superior: revisión de la literatura

Técnicas e métodos para o acompanhamento da evolução da capacidade motora fina de membro superior: revisão da literatura

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Abstract

Introduction: This review article is the product of research on the methods, techniques and devices used in the measurement of fine motor skills of upper limbs and its respective evolution, developed at Universidad del Cauca in 2018.

Problem: Objective measurement of the evolution of upper limb motor skills in the rehabilitation processes.

Objective: To identify the conventional techniques and electronic devices used in the measurement of the evolution of upper limb motor ability.

Methodology: Four scientific databases were reviewed in addition to the Google Scholar search engine. The keywords used for the search were: "fine motor skills", "hand measurement", "hand rehabilitation"and "hand function", among others.

Results: Approximately 3840 articles related to the subject were found. When applying the exclusion criteria, the article number to be revised was reduced to 63, which were analyzed in the present review.

Conclusions: The tools applied by health professionals are convenient due to their rapid execution and easy access, however they can be subject to human error since they depend on the experience of the user. Electronic systems present objective measurements, however, their complexity and cost are high.

Originality: This work presents information on the therapeutic techniques and technological devices used, in certain pathologies, for the evaluation of upper limb motor ability.

Limitations: Not all articles analyzed have a detailed description of the people in which the studies were conducted.

Keywords: Dexterity, Motor Ability, Fine Motor Skills, Measurement Of Motor Ability, Hand Functionality.

Resumen

*Introducción***:** El artículo es producto de una investigación sobre los métodos, técnicas y dispositivos utilizados en la medición de la habilidad motriz fina de miembro superior y su respectiva evolución, desarrollada en la Universidad del Cauca en el año 2018.

Problema: Medición objetiva la evolución de la habilidad motriz de miembro superior en los procesos de rehabilitación.

Objetivo: Identificar las técnicas convencionales y dispositivos electrónicos utilizados en la medición de la evolución de la habilidad motriz de miembro superior.

Metodología: Se revisaron cuatro bases de datos científicas además del motor de búsqueda Google Académico. Para la búsqueda se utilizaron las palabras clave: "fine motor skills", "hand measurement", "hand rehabilitation", "hand function", entre otras.

Resultados: Se encontraron aproximadamente 3840 artículos relacionados con la temática. Al aplicar los criterios de exclusión el número de artículo a revisar se redujo a 63, los cuales fueron analizados en la presente revisión.

Conclusiones: Las herramientas aplicadas por profesionales de la salud son convenientes debido a su rápida ejecución y fácil acceso, sin embargo pueden estar sujetas al error humano puesto que dependen de la experiencia de quien las utiliza. Los sistemas electrónicos, presentan mediciones objetivas, no obstante, su complejidad y costo es elevado.

Originalidad: Este trabajo presenta información sobre las técnicas terapéuticas y dispositivos tecnológicos, utilizados en ciertas patologías, para la evaluación de la habilidad motriz de miembro superior.

Limitaciones: No todos los artículos analizados cuentan con una descripción detallada de las personas en las que los estudios fueron realizados.

Palabras clave: destreza, habilidad motriz, motricidad fina, medición de habilidad motriz, funcionalidad de mano.

Resumo

Introdução: o artigo é produto de uma pesquisa sobre os métodos, técnicas e dispositivos utilizados na medição da capacidade motora fina de membro superior e sua respectiva evolução, desenvolvida na Universidad del Cauca, em 2018.

Problema: medição objetiva da evolução da capacidade motora fina de membro superior nos processos de reabilitação.

Objetivo: identificar as técnicas convencionais e dispositivos eletrônicos utilizados na medição da evolução da capacidade motora de membro superior.

Metodologia: foram revisadas quatro bases de dados científicos, além do mecanismo de busca Google Acadêmico. Para a pesquisa, utilizou-se as palavras-chaves "fine motor skills", "hand measurement", "hand rehabilitation", "hand function", entre outras.

Resultados: aproximadamente 3840 artigos relacionados com a temática foram encontrados. Ao aplicar os critérios de exclusão, o número de artigos a serem revisados diminuiu para 63, os quais foram analisados na presente revisão.

Conclusões: as ferramentas aplicadas por profissional da saúde são convenientes devido à sua rápida execução e fácil acesso, no entanto, podem estar sujeitas a erro humano uma vez que dependem da experiência de quem as utiliza. Os sistemas eletrônicos apresentam medições objetivas, apesar de sua complexidade e custo elevado.

Originalidade: este trabalho apresenta informação sobre as técnicas terapêuticas e dispositivos tecnológicos, utilizados em certas patologias, para a avaliação da capacidade motora de membro superior.

Limitações: nem todos os artigos analisados contam com uma descrição detalhada das pessoas nas quais os estudos foram realizados.

Palavras-chave: destreza, capacidade motora, motricidade fina, medição de capacidade motora, funcionalidade de mão.

1. INTRODUCTION

Over the next 4 decades it is expected that the population over 60 years old will increase by 50 %, from 274 million in 2011 to 418 million in 2050 [1], leading to age-related diseases representing the greatest cause of disability in industrialized countries. In most countries, cerebrovascular diseases (CVD) or strokes are the second or third leading cause of death and one of the main factors of disability in adults [2]. Additionally, a high percentage of those who survive a CVD develop sequels that affect their quality of life [3]: In Europe, for example, 235/100,000 inhabitants/year suffer from a CVD [4]; in China, a figure between 76.1 and 150/100,000 inhabitants/year is reported; in Latin

America between 35 and 183/100,000 inhabitants/year; in the case of Colombia, 88.9/100,000 inhabitants/year and in the United States, 700,000 new cases are reported annually [5]. To this figure, the prevalence (relationship between incidence and mortality due to CVD) can be added, being 13.37/100,000 for the European region, for Latin America Between 1.74 and 6.51/100,000, and in the United States it was estimated that 4,800,000 people had survived a CVD in 2001 [5]. Table 1 summarizes the prevalence of CVD in different regions of Colombia (data obtained from [5]).

Table 1. Prevalence of CVD in regions of Colombia.

Region	Prevalence	Year
Girón	16/1000	1984
Jamundí	12/1000	1984
Hato	8.2/1.000	1985
Sabaneta	5.59/1000	1992
Juan de Acosta	1.42/1000	1992
Piedecuesta	5.7/1000	2002
Aracatoca	4.7/1.000	2001
Región Suroccidental	6.8/1000	1996
Región Suroriental	17,2/1000	1996

Source: own work

Another important cause of disability is burns which, in addition to causing 300,000 deaths per year, also cause millions of people to consequently suffer sequels and disability [6]. Additionally, another circumstance that affects motor functionality is related to partial amputations in the hand, where 1.9 out of every 100,000 people/year between the ages of 25 and 65 [7] are the most likely to suffer psychological consequences and functional loss, such as a decrease in grip and force grip, problems with writing, turning a key, opening a vase or other activities of daily living (ADL) [8] as well as loss of life satisfaction [9].

Faced with all the aforementioned circumstances and in order to reduce their effects, it is necessary to carry out a rehabilitation process according to the needs and, at best, as early as possible. Some studies suggest that the use of human-machine interfaces and virtual reality help physical and functional recovery, however, and taking into account the variety of pathologies and the specific situations that each one represents, it is necessary to measure the incidence of the processes of rehabilitation used to individualize the training and enhance the obtained results.

Taking into account the review mentioned in Section 2 of this article, the methodological aspects used are related. In Section 3, the results and the answers to the proposed questions are presented, and finally in Section 4, the discussion is carried out and the conclusions defined.

2. MATERIALS AND METHODS

The study was conducted between February and April 2018, yielding 3840 articles related to search words: "fine motor skills", "hand measurement", "hand rehabilitation" and "hand function", in databases such as: Science Direct, PubMed, Regional Portal of the VHL and IEEE Explorer. The articles were filtered taking into account a series of inclusion criteria, beginning with those that answered the next questions: (i) What methods or techniques are used to measure motor ability? (ii) What methods or techniques are used to track the fine / gross motor evolution according to each pathology? and (iii) What technological tools are available to perform motor skill measurements? Subsequently, those who were older than 5 years of age and those who did not mention in a timely manner the method used to monitor the motor evolution of the participants of the experiment, were excluded, leaving at the end 63 articles that were analyzed for this review.

3. RESULTS

In this section we present the results found in the literature and the answers to the proposed questions.

3.1. Methods or techniques to measure motor skill and in what pathologies they have been reported

The measurement of motor ability can be classified into two broad categories, although in all cases the measurements and assessments are made manually. The literature shows that attempts have been made to reduce the subjectivity of the evaluation as much as possible. There are methods that can be based on (i) the measurement of a physical variable and (ii) a series of questionnaires.

3.1.1. MEASUREMENT OF A PHYSICAL VARIABLE

The *Functional Dexterity Test* measures hand dexterity. This test consists of 16 cylindrical objects arranged on a board with 4 rows of 4 holes each. The task is to turn the cylinders while the execution time is counted. It was tested in pediatric patients [10] [11].

The *Square test* consists of a sheet of paper in which you have four squares. The person is instructed to use his right hand to fill the squares with as many points as he can for 10 seconds, as a practice test. Afterwards he is asked to start in the first row and fill it from left to right. He is given a time of 30 seconds to complete the second row. Next, the sheet is rotated 180° and the remaining squares are filled from right to left using the left hand. The test was performed to measure dexterity in patients with multiple sclerosis [12].

The *Jebsen Taylor Hand Test* was originally designed for quadriplegic patients however studies have been presented where this test has been carried out in children [10], patients with burns [13] [14] [15], rheumatoid arthritis [16], osteoarthritis [16], Tunnel Carpal Syndrome [16], Distal Radial Fracture [16], Parkinson's [17], and Cerebral Palsy [18]. This technique seeks to measure hand dexterity of 7 different timed procedures for both hands: writing a letter, flipping a letter, lifting small objects, stacking chips, moving light objects, moving heavy objects, grabbing food and bringing it to the mouth.

The Nine Hole Peg Test consists of a board with 9 cylindrical holes. In the holes, small metal or wooden cylinders must be inserted, using the dominant hand and then the non-dominant one. The time taken for the person to introduce and withdraw the 9 cylinders from the board is measuered. The test measures hand dexterity and has been used to test children [10] and healthy adults [19] [20], patients with Burns [13], and autosomal recessive spastic ataxia of Charlevoix-Saguenay (ARSACS) [21].

The *Box and Block Test* is a tool that focuses on superior member skill. This consists of a wooden box divided into two compartments and 150 blocks. It consists of asking the user to move, one by one, the largest number of blocks from one compartment to another, in 60 seconds. The box should be oriented longitudinally and placed on the user's midline, with the compartment with the blocks facing the hand that is being tested. The test must start with the affected upper limb, and a 15-second trial period is allowed at the start of the test with each hand. It is not necessary to collect the blocks that fall from the work area. It has been used in studies with children [10] and people who have suffered a stroke [22].

The *Grooved Pegboard Test* is a technique that consists of a board with 25 randomly oriented holes and 25 cylinders that have the shape of a key on one of its sides.

The cylinders must be rotated to match the holes and be inserted. This technique uses factors such as: the time it takes to fill the first line of holes, the total time, the number of cylinders that fell, and the number of cylinders placed to evaluate the user. This test has been used to measure dexterity in children [10] [19] and healthy adults [19].

The *Purdue Pegboard Test* is a technique that seeks to measure the dexterity of both hands. It consists of a board with two rows in parallel, each with 25 holes. The cylinders are positioned in two containers located at the top of the board. The person must place, in a time period of 30 seconds, as many cylinders as he can using his dominant hand, then the non-dominant and finally using both hands (they must be inserted in the row corresponding to each hand) from the top to the bottom. Finally, the user must build "sets", which consist of a pin, a washer, a collar and another washer. The subject must complete as many sets as possible within a time lapse of 1 minute. Studies have been conducted on children [10] and healthy adults [23], patients with schizophrenia [24], osteoarthritis [25] and chronic fatigue syndrome [26].

The *Sollerman Hand Function Test* is a standardized test based on 7 typical grapples (Clamp with hand, lateral clamp, three-digit clamp, five-finger clamp, fly diagonal grip, fly transverse grip and fly spherical grip). It includes 20 unilateral and bilateral activities of daily life, each rated by the time it takes the person to do it (60 seconds maximum), the quality of movement and the pattern of grip used. Each unilateral task is performed with the hand most affected and with a certain grip pattern. Hand-held functionality has been measured using this test in people who have suffered a stroke [14] and in people affected by burns [14].

The *Minnesota Manual Dexterity Test* (MMDT) is a technique that consists of 60 cylindrical discs painted red on one side and black on the other. These must be inserted into the holes of a black board following a pattern of holes whilst being timed. This technique includes 2 subtests: one of location that uses only the dominant hand, and another of rotation that makes use of both hands. This technique has been tested on healthy adults [27].

The *WorkAbility Rate of Manipulation Test* (WRMT) is an adaptation of the MMDT that uses the same cylindrical discs, but with changes in the design of the board and the subtests. The board is white to improve contrast for people who have vision problems and is a bit smaller. The technique has been used on healthy adults [27].

Standardized Finger-To-Nose Test (SFNT) is a variant of the traditional Finger-Nose Test. Using the index finger, the subject must touch alternately and as fast as he can, in 20 seconds, the end of his nose and a horizontal objective 45 cm away. The number of times the target is touched is taken as a measure. In case of not touching it, the subject must move his finger until reaching it. This test focuses on the measurement of upper limb coordination. In [21] this test was developed with patients with ARSACS.

Suitcase Packing Activity is an activity that consists of complying with a packing list with specific instructions that must be executed step by step. This seeks to measure, in a precise and objective way, bimanual and unilateral hand-held functionality. This uses practical activities of daily life, such as folding clothes to highlight strengths and weaknesses of the hand. The activities are evaluated according to the time it takes for the user to perform them. This activity was tested on healthy adults [28].

3.1.2. QUESTIONNAIRES

The *Michigan Hand Questionniare* is an instrument to measure hand functionality from 37 items distributed in six sub-scales: Global operation, Activities of daily life, Pain, Work, Aesthetics and Patient satisfaction. It has been tested with patients who have suffered from a stroke [29], rheumatoid arthritis [30] [31], arthroplasty of the metacarpophalangeal joint [30], carpal tunnel syndrome [30] and burns [13]. It is noteworthy that in multiple studies it is used as a comparison tool.

The *Test D'évaluation Des Membres Supérieurs Des Personnes Âgées* (TEMPA) is a test which evaluates the speed of execution, the autonomy of the person and an analysis of 5 bilateral activities: Open a jar and take a spoon full of coffee, open a padlock, take and open a bottle of pills, write a letter and put a stamp on it, put a scarf around the neck, shuffle and deal cards. It includes 4 unilateral tasks: take and move a jar, lift a jar and fill a glass with water, manipulate coins, take and move small objects. It has been used to measure hand functionality in patients who have suffered from burns [13] [14].

The questionnaire *Disabilities of the Arm, Shoulder and Hand* (DASH and QuickDASH), responsible for determining musculoskeletal disorders of the upper limb, has been used in studies involving patients with burns [14], carpal tunnel syndrome [30], wrist or hand injuries [30], disorders on the wrist and shoulder [31], and distal radius fracture [31]. It is composed of 30/11 items rated on a 5-point scale, from "without difficulty" to "unable".

Boston Carpal Tunnel Syndrome Questionnaire (BCTQ) is a diagnostic tool for carpal tunnel syndrome and hand functionality [30] [31]. It is divided into 2 components: On the one hand, 11 items related to a scale of severity of the symptom, rated from "normal" to "very serious". On the other, 8 items related to a scale of functionality, rated from "without difficulty" to "unable to perform the activity due to hand and wrist symptoms".

The *Patient-Rated Wrist (Hand) Evaluation* seeks to measure hand and wrist functionality through a 15-item questionnaire that assesses the pain associated with the wrist and the disability generated in the execution of functional activities. The items contain 6 specific tasks and 4 questions in which the capacity of the patient in the execution of activities of daily life is determined. It is measured on a scale of 0 to 100, where 0 represents "No pain or disability." The items not evaluated are replaced by the average value of the subscale (pain, specific tasks, daily activities). This test has been evaluated in users with problems / injuries / disorders of wrist or hand [30], with osteoarthritis [30] and in people suffering from carpal tunnel syndrome [31].

The *Functional Index for Hand Osteoarthritis/Dreiser* is a questionnaire that includes 10 items to measure hand functionality in people with osteoarthritis in the hand. The items are rated on a scale of 0 to 3, these being "possible without difficulty" to "impossible" respectively [31].

Another test, usually performed on patients with osteoarthritis, is the Australian Canadian Osteoarthritis Hand Index, which is a technique that comprises 15 items to measure by a scale, pain, rigidity and hand functionality [31]. It is measured with the Likert scale from 0 ("None") to 4 ("extreme").

The *Manual Ability Measure-36* is a functionality evaluation tool comprised of 2 sections of 36 items. The first section contains clinical and demographic information, the second section involves the qualification of the 36 items on a scale of 1 to 4, being "Not feasible" and "Completed easily" respectively. It has been used in studies of patients who have suffered distal radius fracture [31].

The *Fugl-Meyer Assessment of the Upper Extremity* (FMA-UE) is a test that contains 33 items for paretic upper limbs. The 33 items are divided into 4 sections: Shoulder-arm, wrist, hand and upper limb coordination. Each item is evaluated using a 3-point scale, with a maximum score of 66 points. The maximum value indicates the maximum recovery of motor skills [32].

The *Action Research Arm Test* (ARAT) is a scale to evaluate the capacity of the hand and the arm. It consists of 19 functional items divided into 4 subtests: Grab, pinch, tighten and gross motor. It has been implemented in patients who have suffered a stroke [32].

The *Movement Disorder Society Unified Parkinson's Disease Rating Scale* is a test that seeks to measure the functionality of hand in patients with Parkinson's. This measures rigidity, finger touches, hand movement, pronation-supination movements, hand postural tremor, kinetic tremor, and the amplitude of tremor at rest [17].

The *Bruininks-Oseretsky Test of Motor Proficiency* is a technique that measures hand dexterity. It consists of multiple activities: Putting coins in a box, putting coins with both hands in two boxes, separating a deck of cards according to their color, holding pips (make handles), moving wooden cylinders (pegs), drawing vertical lines, making points in a circle, making points on a blank sheet. Each activity is evaluated and rated on a scale of points or from descriptive categories such as "Above average" or "Below average". It has been a study tool in the evaluation of motor skills in healthy children [19] and with amblyopia [33].

In *Adult-Assisting Hand Assessment Stroke Scale*, the participant must perform 1 of the 2 selected tasks: Prepare a sandwich (cut bread, cheese and vegetables, spread, open and close containers and plastic bags); and the task of the gift (unpack a package, open a letter, open a container to take out a piece of candy, pack a gift, cutting paper, packaging a gift, putting tape, tie ties, handle a case, handle a pen, fold paper and place it in an envelope). This scale has been studied in people who have suffered a stroke [34].

Chedoke Arm and Hand Activity Inventory (CAHAI) is a test to evaluate hand functionality. Composed of 13 items rated on a scale of 1-7, where 1 represents "The affected member performs less than 25% of the activity" and 7 represents "The affected member completes all the required components". Among the activities is: Open a coffee jug, call 911, draw a line with a ruler, serve a glass of water, drain a cloth, fasten five buttons, dry your back with a towel, put toothpaste in a Brush, cut some dough of medium resistance, pull up a zipper, clean a pair of glasses, put a container on a table, carry a bag up the stairs. In [35] this test was used in people with brain injury.

There are activities that have not been defined through a particular name, for example there is a program based on the standard and structured activity of making paintings with paper balls using the thumb and the index finger. It has been tested as a tool for measuring dexterity in patients with osteoarthritis [25].

3.2. Technological tools to measure motor skill

There are multiple methods to perform physiological measurements, among them: physical sensors, vision-based sensors, wearable devices or in some cases there are activities defined in virtual environments [36], where performance represents a relation of the activity with respect to motor ability. Some applications found in the literature are mentioned in the following sub-sections.

3.2.1. ARTIFICIAL VISION – OPTICAL SYSTEMS

Devices based on artificial vision are those that work based on cameras. These cameras can be used to follow optical markers and capture the movement made by the user. In these types of systems it is necessary to have visual, auditory or vibration feedback in order to generate stimuli for the user [37]. In some cases, this technology is combined with virtual or augmented reality systems to improve the feeling of immersion and maintain the user's interest during the sessions.

It is also possible to follow a laser pointer in order to determine the motor ability of the user based on the percentage of time in which it points and maintains a certain trajectory [38].

On the other hand, the use of technologies such as 3D printing, allow for the development of compact optical sensors, light and adjustable to the fingers, combined with algorithms to determine the corresponding position of each finger joint [39]. In all these types of developments, environmental conditions and the tools with which the person interacts play an important role; for example, it may be necessary to use gloves or have the person carry objects of consistent color (contrasting with the background) to obtain good results [40].

It is important to establish the degree of precision of vision-based devices. In cases such as Leap Motion, which is a device specifically developed to perform joint monitoring of hands, it has been compared to a goniometer concluding that it is a reliable device with high precision [41]. However, as explained in [42], with a single LeapMotion sensor, measurement errors occur due to occlusion effects, that is, when the palm of the hand is approximately perpendicular to the plane of the sensor; this is the reason why in [42], a system based on two sensors of this type, oriented orthogonally, was proposed. The advantages of this device are evident because in multiple investigations it is used in order to measure the ability of users to grasp in different tasks [43] [44] [45].

Other devices such as Microsoft's Kinect, work as a tool for interaction with virtual reality. In some studies, the score obtained or time taken, act as an index of performance and is related to motor skills. For example, in the serious game Good View Hunting [46] the participant is asked to remove the dirty regions of the screen or to clean a water stain, fog, children's drawings or car dust using the affected limb. The score is measured through the speed of execution. In Hong Kong Chef [46], that consists of two sections, whose common objective is to prepare food (take and leave ingredients, mix them, cut them and cook them). Again, the score is measured through the speed of execution. Many examples can still be mentioned, such as those presented in [47] [48] [49].

To perform motor skill measurements, the tasks of the conventional tests mentioned in Table 1 have also been virtualized. The Digital Box and Block Test is a Kinect-based system for recording and quantifying data during the execution of the Box and Block Test. An algorithm of artificial vision takes account of the blocks; however, the system is sometimes unable to account for all blocks due to lighting problems [50].

3.2.2. WEARABLE DEVICES

There are sensing devices that are considered invasive because the user must put them on / wear them, usually instrumented gloves [51] [52] with electric bending sensors or small inertial units for example. In the first case, it is reported that its use allows for the measurement of hand posture (Active Range Of Movement AROM and Functional Range Of Motion FROM) [53]. In the second case, with inertial sensors, it facilitates the measurement (of acceleration and orientation) in the 3 axes of each finger joint [54]. It is important to highlight that there are also sensors such as goniometers, dynamometers [55], potentiometers [56] and in some cases the electromyographic signals are measured to estimate the user's movement [57], [58].

3.2.3. TABLETS, HAPTICS AND SENSITIVE DEVICES

Another group of developments is oriented to the use of haptic interfaces or devices where the user has tactile feedback in the activities he performs through virtual reality [59], [60]. Although some of these are considered assistive devices, the device is monitoring the movements of the person by means of sensors [61].

The use of some technological tools such as Tablets or iPods bring technology to the rehabilitation and measurement of motor skills in the case of children, where they can perform cognitive rehabilitation exercises and motor skills; the activities developed allow establishing a relationship between the performance in the activity and the motor ability of the user [62]. There are also reports of the use of hybrid systems, where the use of Tablets or iPods has been complemented by peripherals, where the combination of motion sensors with Bluetooth communication allows capturing movement data and grip strength as the user draws a certain pattern or template on the Tablet [63]. The system compares the performance of the user with that of the template, and based on this, the execution score is determined.

Figure 1 shows that most of the studies found used sensors or devices that base their measurement on optical mechanisms. The reason for this is the precision with which they measure multiple articulations through image processing algorithms, however, these devices are implemented in conjunction with virtual reality systems, generally *serious games*, to motivate the user in the execution of movements.

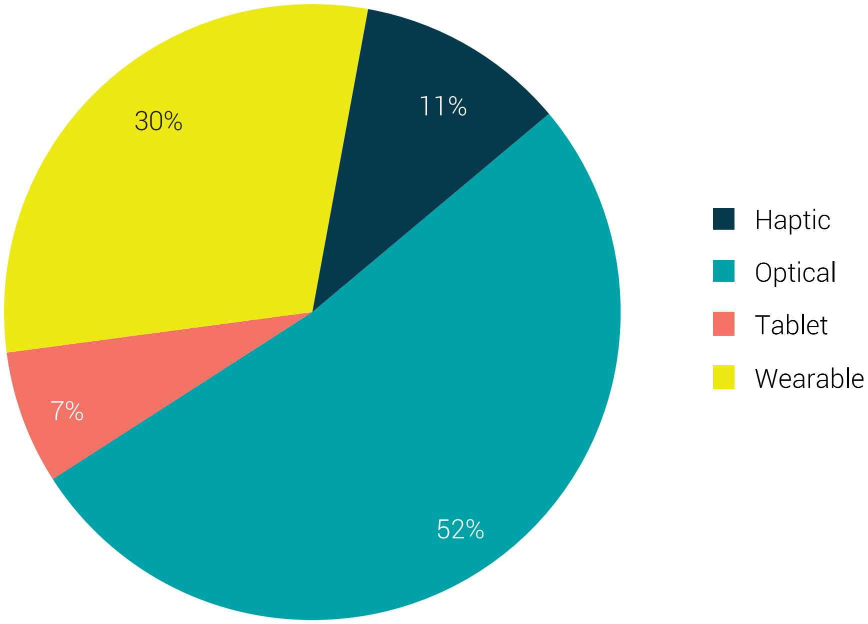

Figure 1. Number of technological developments classified by type.
Source: own work

Figure 2 shows that the measuring instruments are tested in equal proportions in healthy and unhealthy populations. In each case, the percentage of publications is 37 %. On the other hand, 26 % of publications do not report if the rehabilitation tool was tested on people.

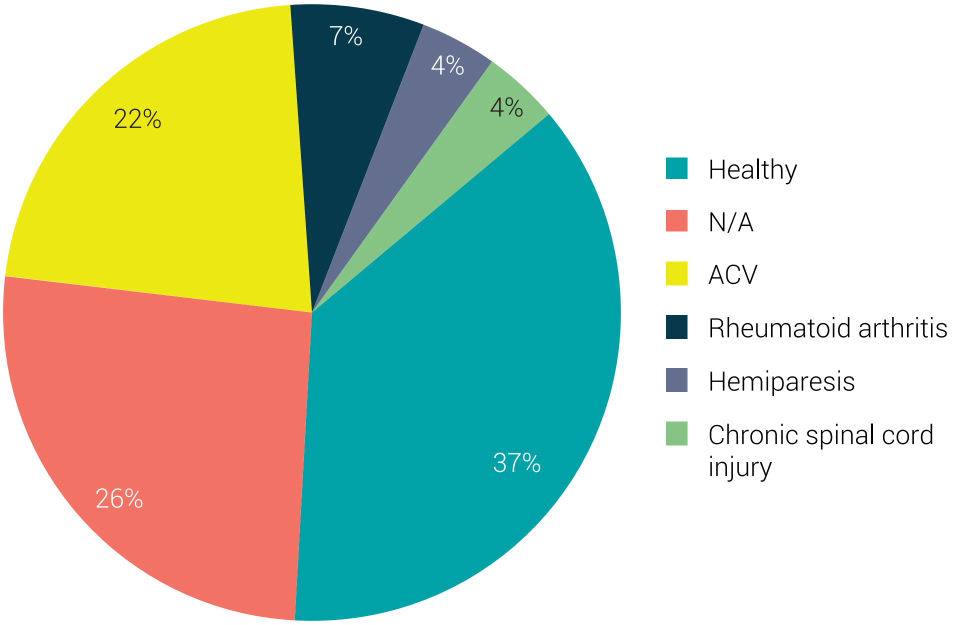

Figure 2. Percentage of pathology reported according to the developments found.
Source: own work

4. DISCUSSION AND CONCLUSIONS

In the present work, an analysis of the conventional techniques and the technologies used in the measurement of upper limb motor skills was carried out. To this end, a bibliographic search was carried out in different databases to answer three questions focused on the way in which the skill of the superior member is measured, the technological tools used and the pathologies in which it is sought to measure it.

In the obtained studies, no techniques or instruments for fine motor rehabilitation are mentioned when the patient has suffered mutilation or loss of movement in one of the fingers of the hand.

Although there are multiple methods to measure motor skills from questionnaires, these tools are subject to multiple human errors and depend on the experience of the person applying them. Electronic and computer sciences have been applied in the objectification of the measurement of upper limb motor skills, since conventional measurement techniques present subjective characteristics determined by the experience and measurement of the evaluator in charge, as well as the opinion of the user who performs the test.

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Conventional measurement techniques have clinimetric properties that allow for the measurement of their efficiency in the evaluation of the member in question and the consistency of the exercises that are performed, however, it is not usual for these parameters to be taken into account in the development of the devices and in the activities that are sought to be done with them.

Regarding the devices used, it is clear that there is no single or obvious solution to measure motor ability; there are a plurality of methods, with advantages and disadvantages, that seek to complement each other in order to make measurements objectively. For example, systems based on optical sensors present great precision, but have difficulty due to occlusion effects; or systems with inertial sensors, which are compact and portable, but have calibration processes and algorithms of medium difficulty.

Despite the costs that can be represented by a camera system for performing upper limb movement analysis, there are inexpensive commercial devices such as the Leap Motion and the Kinect that allow for reliable measurements of the joints of the hands.

Some studies present desertion on the part of the patients, possibly due to personal causes or the physical impediment they have when performing the activities. This reason may be the reason why most of the studies carried out were done on healthy users, instead of patients with some type of pathology.

The use of conventional techniques as indicative of measurement for the studies of technological instruments is frequent. This is because these techniques have been validated after multiple studies for different pathologies, showing that even with subjectivity, the evaluation can be accurate.

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